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A Vocationally Approved Peformance-Based Technical Drawing Curriculum

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A VOCATIONALLY APPROVED PERFORMANCE-BASED TECHNICAL DRAWING CURRICULUM

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ABSTRACT

The essential parts of a Vocationally Approved Performance-Based Technical Drawing Curriculum were developed and based on components of the Washington State Commission on Student Learning, the Carl D. Perkins Applied Technology Education Act of 1990, the State of Washington Districtwide Plan For Vocational Education, the Commission on Achieving Necessary Skills (SCANS report) and the recent change from Industrial Arts philosophies to Technology Education philosophies. The grades 9-12 curriculum included manual and computer aided Architectural and Mechanical Drafting skills which are used widely in the Drafting fields.

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CHAPTER 1

Background of the Project

Introduction

In 1990 the Carl Perkins Vocational and Applied Technology Act was revised. The act mandated each state to develop its own vocational plan. Plans were to include a change from an Industrial Arts instructional philosophy to a Technology Education instructional philosophy.

In 1992 the Washington State Commission on Student Learning was established by the Legislature. It is charged with developing statewide essential academic learning requirements, performance standards and student assessment systems including a Certificate of Mastery. The Commission is also charged with planning and implementing a professional development process, and taking other actions to develop a performance-based education system.

The Washington State Office of Public Instruction (OSPI) New Districtwide Vocational Plan implemented in 1992 requires vocational programs in the state to include, among other things, occupational identification, student characteristics, competency based academic and occupational objectives and core standards program assessment.

These actions in conjunction with Washington state and HB1209 legislation , have mandated a performance-based educational system. Performance-based education places a significantly greater emphasis on how well students are learning, and less emphasis on state-level laws and rules which dictate how instruction is to be provided. Decisions on how instruction is to be provided are now to be made by school districts, not by the state of Washington..

Vocational Education and Technical Drafting in the state of Washington have been impacted by actions in Industrial Arts philosophy which focused on project centered activities and taught practical vocational skills. This has been changed to a Technology Education philosophy which stresses the development of problem solving skills along with practical skills.

The related component parts of these elements and the design of vocational curriculum in the state of Washington are essential for successful educational reform in vocational education now and into the future. Because of the author's professional need for a modern approved curriculum which reflects these changes in state and federal education, this project was to develop a vocationally approved performance-based technical drawing curriculum.

This project describes, compares and analyzes two different types of education models: Performance-Based Education as used and defined by the Washington State Commission on Student Learning and mandated by House Bill 1209, and Competency-Based Education as used and required by Washington State Vocational Education. This project includes a model and an illustrated example / curriculum which reflect educational reform at the state and federal levels.

Purpose of the Project

The purpose of this project is to develop a vocationally approved, competency based and performance based grades nine through twelve technical drawing curriculum. This will include Architectural and Mechanical Drawing elements. It will follow Federal vocational guidelines and include competency-based objectives. This curriculum will cover both manual and Computer Aided Drafting skills used in today's industries. This curriculum will also reflect a Technology Education philosophy which emphasizes problem solving and process over project learning activities.

Statement of the Problem

Washington state laws governing education have changed and a Technology Education philosophy has replaced Industrial Arts methods. Current curriculums and teaching methods do not reflect those changes by and large. A curriculum design model, which reflects the new changes in state and federal educational reform and mandates is needed not only for myself, but for other vocational teachers for the successful development, approval and integration of future vocational curriculums in the state of Washington.

Significance of the Project

Educators are leery and confused over changes in federal and state legislation which affect them. Over the last five years K-12 educators in the state of Washington have been unsure over what is required of them in the name of educational reform. Much misinformation exists which adds to the confusion. This project, in part, is an attempt to sift through all of the information, legislation and committee actions to develop a curriculum model based on these changes. Hopefully this project will benefit others. The project utilizes state and federal vocational curriculum requirements and the new state educational reform requirements to develop an outcome-based / curriculum design model. House Bill 1209, the legislation which mandates performance-based education, does not require an outcome-based instructional model which is similar to competency based. However, I will include competency-based objectives because it is a requirement for vocational approval and it also follows a logical sequence to performance-based education.

Definition of Terms

Competence: The individual's demonstrated capacity to perform, i.e., the possession of knowledge, skills and personal characteristics needed to satisfy the special demands or requirements of a particular situation (Governor's Council on Educational Reform, 1992).

Competency-based Objectives: Specific, precisely stated student outcomes which have been recently verified as being essential for successful employment in a particular occupation in which the student is being trained. These competencies explain exactly what the student is to be able to do. They either can perform these competencies, or they can't. (Blank, 1982).

Performance-based Assessment: Ways of assessing student program achievement which require direct demonstration of the target knowledge and skill. Performance assessment includes direct writing samples, open-ended questions, demonstrations, experiments, and group projects (Governor's Council on Education Reform, 1992).

Performance-based Educational System: An educational system in which a significantly greater emphasis is placed on how well students are learning, and significantly less emphasis is placed on state-level laws and rules that dictate how instruction is to be provided. The performance based educational system does not require that schools use an outcome-based instruction model (Commission on Student Learning, 1994).

Performance Standards: The criteria used to determine whether a student has successfully learned the specific knowledge or skill being assessed. These standards will be set at internationally competitive levels (Commission on Student Learning, 1994).

Performance-based/Outcome-based Education: A system designed to meet specific objectives or standards of what students should know and be able to do, with flexibility to the process necessary to achieve those objectives/standards. Students proceed through a performance-based (outcome-based) system by demonstrating competency (Governor's Council on Student Learning, 1992).

Outcome-Based Objectives: A performance, or behavioral activity expected from a learner. A criterion by which the performance can be judged to be successful including givens, or conditions that are necessary for the performance to occur satisfactorily (McAshan, 1979).

Orthographic Projection: A system of showing an object in several views at right angles to each other by lines drawn perpendicular.

Limitations

This project is limited to developing a vocational related manual and computer aided Technical Drafting curriculum for grades nine through twelve at a secondary school in the state of Washington. While a complete curriculum will be developed only one unit, activities and lessons will be included in this project as an illustration.

CHAPTER 2

Review of the Literature

Government Mandates

Several essential components of this Vocationally Approved Performance-Based Technical Drawing Curriculum were developed and based on recently passed state and Federal requirements. This section of this literature review discusses these new requirements.

In 1992 The Washington Governor's Council on Education Reform and Funding outlined seven basic assumptions which can serve as the foundation of school improvement. Two of those assumptions directly affected vocational education. First, the education system should emphasize student performance and results rather than the administration of routine policies and procedures. Second, student assessment should be based on student performance and mastery. All students should be assessed on their achieving mastery of learning goals.

As a result of the work of the Governor's Council on Education Reform and Funding, HB1209 was passed by the state legislature in 1993. HB1209 mandated performance-based education and includes four goal areas in which school and teachers will be held accountable for student success. Those four goal areas are:

1. Read with comprehension, write and communicate effectively in a variety of ways and settings.
2. Know and apply the concepts and principles of mathematics, social, physical and life sciences, civics, history, geography, arts, health and fitness.
3. Think analytically, logically, creatively and integrate experience and knowledge to reason and solve problems.
4. Understand the importance of work and how performance, effort and decisions

affect career and educational opportunities.

Present vocational education curriculum was not performance-based driven with competency-based outcomes and it did not include some of the goals just mentioned. These changes now make it necessary to reform vocational education programs like Technical Drawing.

In 1992 the Washington State Commission on Student Learning was established by the Legislature. The Commission is made up of people appointed by the Governor and the State Board of Education. It was charged with developing statewide essential academic learning requirements, performance standards and student assessment systems including a Certificate of Mastery. The Commission was also charged with planning and implementing a professional development process, and taking other actions to develop a performance-based education system. The Commission on Student Learning was also given the task of developing new K-12 curriculum for the state in mathematics; social, physical and life sciences; civics, history, geography, arts, health and fitness.

In 1992 the Washington State Office of the Superintendent of Public Instruction's vocational department published the Districtwide Plan For Vocational Education Packet. This packet includes descriptions of new vocational education programs and classes posted for 1993-94. It also included a list of points to include when applying for vocational program approval, standards for educational programs in general and more specific standards for specific program areas.

At the Federal level, the 1990 Carl D. Perkins Vocational And Applied Technology Act describes the components necessary for new vocational program approval. This is in order for school districts to be eligible for Federal vocational funding. Students will need to demonstrate acquired occupational competencies upon successful completion of a course. Under basic standards for all vocational education programs, all program objectives are defined in terms of occupational competencies to be developed. In addition to these requirements, vocational programs seeking Federal funding through the 1990 Carl D. Perkins Vocational And Applied Technology Act must:

1. Identify the specific occupation or occupational field for which the program is intended by using the title and CIP code number, which is 210103 for Engineering related which goes with Technical Drawing programs.

2. Identify the need for additional trained personnel in this occupation, or occupational area through recommendations from advisory committees, local surveys, Employment Security and, or other reliable sources.

3. Describe the potential students for which the program is intended. Include any of these items as applicable: Grade, sex, age level or group, occupational desires, handicapped and, or disadvantaged.

4. Identify the specific employment objectives in terms of competencies to be developed in each of the major units of instruction with measurable student learning outcomes. Indicate the number of hours of instruction planned for each unit.

5. List both academic and occupational competencies that students will have acquired upon successful completion of this course.

6. List the sequence of courses offered for the occupational area and show how this course fits into that sequence. For example, which classes are necessary to complete training for Technical Drawing support areas.

7. Indicate the type of instruction to be utilized, i.e., lecture, demonstration, field, cooperative, etc.

8. Indicate what facilities, equipment and supplies are to be provided for this course.

9. Indicate how student leadership development will be incorporated as an integral part of the instructional program through the inclusion of student learning objectives established for this class. Indicate if an affiliated national vocational student organization will be utilized. Also indicate how handicapped students will be encouraged to participate

in leadership activities and in student organizations.

10. Describe plans for supervised occupational experience, extended learning activities, and, or on-the-job cooperative training.

11. Describe provisions for supervision, direction or coordination of planned related occupational experience and, or cooperative programs for students. Indicate assurance that the teacher load will be such that this essential phase of the vocational program may be performed satisfactorily.

12. Indicate the extent of outside recommendations furnished concerning the proposed program. Indicate the manner in which continuing advice and counsel will be sought from the advisory committee.

13. Indicate name(s), vocational certification status, vocational experience and the professional vocational certification number of instructors.

14. Where applicable, give plans for assistance in job placement. Describe plans for follow-up of students, surveying employer satisfaction and general program evaluation. (State of Washington Superintendent Of Public Instruction, 1992)

In 1991 the Secretary's Commission on Achieving Necessary Skills was directed to advise the United States Secretary of Education on the level of skills required to enter employment. The Commission was asked to define the skills needed for employment, propose acceptable levels of proficiency, suggest effective ways to assess proficiency; and develop a dissemination strategy for the nation's schools, businesses and homes. The Commission's recommendations are known as the SCANS report. The SCANS report identifies five competencies and a three-part foundation of skills and personal qualities that lie at the heart of job-performance. The report maintains these competencies and the foundation should be taught and understood in an integrated fashion that reflects the workplace contexts in which they are applied. The SCANS report believes after examining the findings of cognitive science, that the most effective way of learning skills is in context, placing learning objectives in a real world environment rather than first learning in an abstract environment.

In a broad sense, the competencies represent the attributes that today's high-performance employer seeks in tomorrow's employee. Work involves a complex interplay among the five competencies and the three elements of the foundation: 1. The basic skills 2. Higher order thinking skills. 3. The diligent application of personal qualities. The five competencies are: 1. (Resources) Identifies, organizes, plans, and allocates resources. 2. (Interpersonal) Works with others. 3. (Information) Acquires and uses information. 4. (Systems) Understands complex inter-relationships. 5. (Technologies) Works with a variety of technologies.

Defining minimum levels of proficiency requires judgments about the learning potential in yet-to-be designed schools. Also, it requires imagining what the workplace of the year 2000 should and could look like.

In summary, these are the government mandates which influence or are directly forcing a change in vocational education: HB1209 mandates performance-based education which include the four goal areas. The Commission on Student Learning is currently working on performance standards for K-12 curriculum and as these are developed, those changes which affect vocational education will need to be implemented. The 1990 Carl D. Perkins Vocational And Applied Technology Act mandates that students will need to demonstrate occupational competencies on completion of a course. The SCANS report identifies five general competencies which must be taught and understood in an integrated fashion.

<u>Technical Drawing Instructional Techniques</u>

Several essential components of this Vocationally Approved Performance-Based Technical Drawing Curriculum were developed and based from information related to sound general educational theories and practices in teaching techniques and strategies. Also included in this section is information related to more specific teaching techniques and strategies as they relate to Technical Drawing and Computer Aided Drafting (CAD). This section of this literature review represents information from those sources.

Ascher (1993) believes that Performance based assessment has a number of advantages: (1) It allows a range of expression. (2) It permits assessment of learning in a natural context while students make use of skills. (3) It assesses a large range of competencies. (4) It requires students to demonstrate mastery in an integrated way; and (5) It has ecological validity, because students perform as they will have to in life.

The following types of performance-based assessments are described by Ascher: (1) station activities, which require students to proceed through a series of discrete tasks, either individually or in teams, in a given amount of time; (2) domain projects, which require students to complete a set of exercises designed to explore an idea, concept, or practice central to a particular academic or artistic domain; (3) portfolios, which consist of several projects completed in a sequence to show progress with a subject; and (4) videotapes, which can show students performing or being interviewed.

Research supports the Governor's Council On Educational Reform's decision to use a Performance-Based Educational System rather than a behavioral one. According to Budke and Kerka (1988) it has been shown that human performance is easier to measure than human behavior and Ascher (1993) describes the variety of ways that human performance can be measured as listed previously.

According to Blank (1982) there are four characteristics which distinguish training programs that might be considered genuinely competency-based from those that are not. The characteristics are: *What* it is that trainees learn. *How* they learn each task. *When* they proceed from task to task and *If* students learned each task. The most fundamental difference is that Competency-based is a systematic approach to training while the more traditional is not. Each component of a CB training program is designed, monitored and adjusted according to the student's results.

Becker (1991) surveyed fifteen well respected and prominent drafting instructors on the content and teaching strategies for Computer Aided Drafting (CAD). From that survey he identified a number of recommendations.

- All drafting students should be taught CAD.
- The knowledge and techniques used in traditional drafting are very important and will be needed using CAD.
- CAD and traditional drafting should be taught consecutively rather than concurrently, with CAD being taught first.
- The student-to-computer ratio should be 2:1 (students: computers).
- "Open-lab" (extra time for students to use CAD outside of class) is very important for students learning CAD systems because of the time required.
- All students learning CAD should be familiar with the various types of input devices (mouse, keyboard, digitizing pad, etc.).
- Drafting students should learn to work on team projects.
- Students learning CAD should know the concepts of customizing a system through generation of libraries, macros, etc.
- Sketching should be taught using traditional drafting.
- Students should learn to sketch to proportion.
- Students should learn to sketch real objects, not just shapes.
- Students should learn traditional methods of measurement (Architecture, Mechanical, Metric, etc.) using scales.
- Students should learn unit manipulations and limits relationships using CAD.
- CAD should be used to stress modification, manipulation of dimensions.
- Orthographic projection should be taught using both traditional drafting and CAD.

- Visualization of objects should be stressed when teaching orthographic projection.
- The concepts of pictorial drawings (axonnmetric, oblique and perspective) should be taught using traditional lecture, demonstration, and sketching.
- There is no need to teach traditional methods of pictorial drawings because the computer can do a better job.
- The concept of revolutions should be taught using sketching only.
- Various types of sections should be taught.
- Gears and cams should be taught using CAD.
- Shop processes should be taught using traditional lecture, readings and discussions.
- Students should use traditional methods to learn the use of measuring tools.
- Architectural drafting should be taught using both traditional and CAD methods.
- Architectural, piping, structural and electrical drafting is best taught using CAD because each requires respective tasks.
- Logging in/out is taught when students first sit down at the CAD workstation.
- The disk operating system (DOS) is important for students to learn because it controls file operations, formatting, etc.
- Proper file operations are very important because if not properly performed they can destroy files and harm the system.
- Software operating commands can be learned only through experience using CAD.
- Digitizer types, techniques to use and care of equipment are important for students to learn.
- Plotting can be simple or complex (depending on the system), but all students should learn how to plot drawings.
- Care of CAD hardware and software should be taught to all drafting students.
- Microcomputers will become more commonplace for Design/Drafting.
- Geometric Dimensioning and Tolerancing are vital to drafting.

- Complex sheet metal layout (developments) should be taught using both traditional and CAD methods.

Becker (1991) drew the following conclusions from his survey.

- Experts from programs with extensive CAD facilities used more CAD in instruction. Those from programs with limited CAD facilities taught more traditional drafting.
- When teaching CAD, traditional lecture, demonstration, discussion and problem/practice were all effective if the instructor properly incorporated them.
- Identifiable differences in strategies for teaching traditional drafting and CAD were discovered. These differences related to the use of the computers and software versus using traditional drafting instruments.
- CAD should stress concepts and know-how rather than quality of motor skills. Traditional lettering, sketching, measuring and drafting media were valued as necessary in drafting curriculum. From a program planning perspective, these traditional techniques will benefit by indicating the type of equipment that must be present in the drafting curriculum and the methodology to use when developing the curriculum.

In teaching drafting, some students have trouble with visual conceptualization. That is, making sense out of, or applying a technical drawing to the actual finished object, or taking a real object and producing a technical drawing of it. Braukmann and Pedras (1993) call this construct ideation, which is the conceptualization of a mechanical design of a particular arrangement to solve a mechanical problem. Visualization skills are essential to this process. Both engineering instructors and industry representatives believe visualization to be the most important graphic skill for engineers, draftsman, manufacturers and assemblers.

Braukmann and Pedras (1993) took a look at developing visualization skills through exercises. They explain that current visualization teaching methods involve the use of rules, the theory of orthographic projection, the use of aids such as three dimensional foldouts and the effect of lateralization. In lateralization the left brain is associated with language, the right with spacial processing. Because of the abstract nature of visual conceptualization, none of these methods are considered effective.

Because of the problems in teaching visual conceptualization to drafting students, Braukmann and Pedras (1993) looked at the two and three dimensional abilities of CAD to solve the problem of teaching visual conceptualization. Because it was not known whether methods of teaching drafting based on extensive use of three-dimensional software would enhance visualization skills Braukmann and Pedras compared the effect of two types of teaching methods on spacial visualization skills of drafting students. Those two methods were orthographic projection using three-dimensional computer-generated models vs. traditional two-dimensional manual drafting views.

From this study, Braukmann and Pedras (1993) found that, by all appearances, three dimensional computer model exercises were no better than traditional exercises at improving spatial visualization skills.

Vocational Student Organizations, or VSOs, are another teaching strategy which is globally used in Vocational Education and Technology Education. Buchholz High School in Alachua County, Florida is one example of how VSOs can be applied in a drafting program. According to Coleman (1993) Buchholz students are attracted to his drafting program in part because of the involvement in VSOs. Coleman believes that successful VSO activity increases student interest and enrollment in vocational courses. Students who are involved with VSOs tend to be the ones who want to learn, and make to most of their education.

The opportunity to enter skills contests is one of the most attractive reasons for joining VSOs. Members of Coleman's drafting classes have won several hundred awards over the years including ribbons, scholarships, drafting equipment and software. They have won these awards from the Vocational Industrial Clubs of America (VICA), Technology

Student Association (TSA) and from the American Design and Drafting Association (ADDA).

Quality performance is most important in these competitions according to Coleman (1993). Set standards for architectural drawing quality are much higher than more generalized type competitions because drafting is the main part of the club. Standards for all competitions increasingly become higher year after year because students competing in these competitions set a standard. Students rise to a level of expectation which they set themselves. This rises with the increasing experience of club members in competitive events.

Usually between 10 - 15 students represent the drafting classes at Buchholz High School at VSO competitions. About a quarter of the members perform well enough to compete in regional, state and national competitions. Students experience success at some level and that all of them are encouraged to do their best. The national drafting contest sponsored by ADDA is limited to ten entries per instructor, so choosing the top ten is performed through a careful screening process over many months.

When Coleman became the drafting teacher at Buchholz nine years ago he had nineteen students, now he has one hundred and twenty-one. Students pay dues of $15.00 and also raise money through fund-raisers for transportation and other expenses to attend these events. Enthusiasm is also required and the success of the drafting program depends on how well Coleman teaches drafting and related skills. Skills such as thinking, problem-solving, attention to detail, following instructions, applied mathematics and design.

An average of 20 to 30 extra hours per week is required to be members of these organizations and participate in all of these competitions. However, membership and participation in just one of these clubs is beneficial by itself. Enthusiasm, hardwork, appropriate training, patience, curiosity, knowledge and teaching skills are required to be successful participants.

The changeover from Industrial Arts teaching strategies and philosophy to Technology Education strategies and philosophy have come about in the United States mostly because of businesses criticizing public schools for producing graduates who can not think, or solve problems. Christensen, Gonzales and Martin (1991) tell us that Technology Education first appeared in 1947 when William E. Warner proposed "A curriculum to reflect technology". However it was not until the technology education movement of the 1980s that the crusade became implanted. It became popular in secondary schools, but was not reflected in teacher education training programs.

Brigham Young University is one of the universities determined to change the philosophy on its teacher education program for Industrial Arts Majors to reflect Technology Education. Since the late 1980s four new courses related to technology developments were added in cluster areas of construction, communications, manufacturing and power.

The Communications course at Brigham Young encompasses segments of drafting, Computer Aided Drafting, graphic arts, photography and electronic communications. This became a model which is still followed in Washington State high schools. The course is based mainly on Learning Activity Packets written in a form which includes the best ideas from several agencies and groups. The students rotate through the learning activity packets and other activities to achieve as many competencies as possible. If a student has adequate competencies in some segments of the course, alternate assignments are given so each student makes effective and efficient use of class time. Approximately forty Technology Learning Activity Packets have been developed for the Communications cluster. Other activities and assignments in which students participate include the following:

- Developing LAPS
- Bulletin Board
- Time Line

- Poster Collage
- Communications Research
- Media Blitz
- Video Presentation
- Instructional Aid

Kolde (1991) suggests that vocational education should become an educational delivery system, not a content area. Using a variety of approaches, such as applied learning and experimentation, the system needs to encourage students to learn how to learn. New research, according to Kolde suggests that jobs of the future will require more skill and education not less. There is a shift toward finding better educated middle-level workers who have a strong capacity to comprehend. Integration of more traditional academic coursework into vocational classes is essential in the development of students to produce a more capable workforce.

An old idea that still exists today is that Industrial Arts, Vocational and Technology Education type classes are for those students who are not going onto college and for lower functioning students. Wood shop and Mechanics type classes were, and still are in many cases a dumping ground for lower academic students. In today's industries workers need to be well rounded academically both in language and in mathematics in order to be competitive and keep jobs. The successful accredited mechanics of today, for example, are students who graduated in the top third of their classes. Automotive dealership service training centers test applicants in language and mathematics and only accept the best. In many cases they only accept applicants, as mechanics, who have some college background.

According to Kolde (1991) a report by the Committee for Economic Development states: "Mastery of the old basics reading, writing and arithmetic may be sufficient for an entry level job, but because of the constantly changing nature of work, minimum skills are not sufficient preparation for career advancement. Schools must make a greater effort to develop higher level skills such as problem solving, reasoning and learning ability" (p.454).

Kolde (1991) believes that mastery of the old basics should not be the sole measure of the students' ability, but also the students' ability to apply that knowledge and skills. Successful vocational education programs in the U. S. have raised the required competencies in mathematics, science, communications and organizational skills. These competencies are not isolated in theory based academic programs, but are correlated and integrated with technical occupational skills.

An interesting innovation in dealing with the often tedious job of recording competencies in vocational education is the use of bar coding. Evans and Midles (1994) gave a seminar on the use of bar coding for keeping track on vocational students competencies. In that seminar they mentioned that as far as bar coding equipment goes, there is not much available for the Macintosh computer. Most of the bar coding equipment available is for IBM compatible computers. Several bar coding formats exist. Evans and Midles suggest that educators stick to the 3 of 9 format. This is because other educators are developing systems which need to be compatible with our own.

Typically the bar code readers plug into the computer. However a portable hand held bar code reading system and recorder is available. The portable system can be used throughout the day and later the information can be downloaded into the computer. This kind of system has the advantages of being portable and also frees up the computer for other uses. Some disadvantages of this type of system is that the handheld device needs to be programmed by the user to meet their specific needs. Programming knowledge is necessary to do this. However, software is available called Program Generator which aids in the programming process.

The small penlight type bar code readers are not a good idea to use because they wear out the bar codes from scratching over the print. It is better to purchase scanner type bar code readers. With these, they simply pass over the bar codes with an air gap between the scanners and the bar code so the print does not wear out. Also the scanners can pick up the bar code print from five, or more feet away.

TPS is a company which offers bar coding equipment for Macintosh computers. TPS offers a bar code font which Microsoft Word program uses so teachers can print bar codes directly onto competency work sheets and assignments. This system costs about $1400. Evans and Midles also suggest teachers purchase File Maker Pro, a data base software for Macintosh, to keep track of students' data. Another company called Diploma Technologies has a system called Skill Track. This is a turnkey solution for recording and tracking student competencies. This system includes a bar code hand held reader and is only available for IBM compatible computers. Evans and Midles were not familiar with this system and could not compare it to the TPS system which they use.

Evans and Midles mentioned that they will have most of the vocational competencies bar coded on floppy disks for most vocational areas and to ask district vocational directors to get these from Evans.

Evans and Midles, after trying many methods found that by making each student a name tag with the students' ID bar code printed onto it, he can scan the students ID bar code right off the name tag. Then scan off the level of competency. These are printed on the back of the students name tags. Then the student scans the competency in itself. Students keep their checked-off competency worksheets in a folder and turn these in. This is done at the end of every grade period. Competencies are numbered and bar codes simply represent those numbers. Evans and Midles recommend that teachers also include the competency name along with the number to reduce the time used in looking up numbers to find out what competency they refer to.

When the student completes the program successfully the teacher prints out a list of student competencies including the degree of proficiency. These go into the student's portfolio and is used when applying for jobs. If a student needs another competency list, the teacher can simply print out another one.

Mize and Rappaport (1994) are two professionals who have combined school and industry to give vocational students at George Westinghouse Vocational and Technical High School a practical learning experience. Rappaport is the principal at George Westinghouse High School and Mize is vice president at Ricoh Corporation.

In 1991 George Westinghouse High School initiated Total Quality Management methods. Compared to other similar inner school vocational programs, the TQM program at George Westinghouse has achieved different results: only 2.1% of the students dropout, 72% enter college, the rest find immediate jobs. Since implementing TQM students have increased awareness, more motivation, and better grades. TQM is a widely used management practice which made Japanese Industry the largest player of the world trade market. TQM philosophies include improving customer satisfaction, product and service qualities and management/staff relations. TQM also makes use of Quality Improvement Teams. This team identifies the most immediate problems and challenges and brainstorm for solutions. The objectives of George Westinghouse High School are meeting and exceeding customer goals, continuous improvement, sharing responsibilities, and reducing scrap. The TQM approach is to view students and parents as customers. They also defined the needs of their customers which included counseling, practical work skill learning, parental support and job/college placement.

Ricoh and George Westinghouse made an agreement to provide students with hands-on printed circuit board repair experience and Ricoh with added service support. This program uses TQM and offers students real-world problem solving experience and transferable workplace skills. Students repair faulty circuit boards for Ricoh copy machines and pays the school $12.00 per board. Ricoh also provides costly workstations for the school. Repaired boards are examined by company technicians. Those boards which do not meet inspection are returned to the school with critiques citing the problems and identifying the quality improvements needed.

George Westinghouse High School students get real-world hands-on experience, and Ricoh reduces service costs and helps students improve their education.

Summary

Vocational and technical education in the State of Washington is undergoing reform. From HB1209 to individual communities, everyone from teachers to parents and students is questioning education and demanding a better way. New curriculum is being rewritten in response to legislative and commission urgings. HB1209 mandates performance-based education which will be determined by individual schools. The Washington State Commission on Student Learning is writing new curriculums for schools. The Washington State Office of the Superintendent of Public Instruction's vocational department has a districtwide plan and guidelines for vocational education which reflect The 1990 Carl Perkins Applied Technology Act and the Secretary's Commission on Achieving Necessary Skills (SCANS). A brand new committee, the Legislative Evaluation and Accountability Program Committee (LEAP), is looking at how vocational funding is spent in this state. All of these efforts will result in dramatic changes in Technology Education in Washington's Public Schools.

CHAPTER 3

Procedures Used in the Study

The purpose of this project is to develop a vocationally approved, competency based and performance based technical drawing curriculum for grades nine through twelve. The research procedures used in this study include the following elements:

1. Multiple computer assisted ERIC and CIJE searches.
2. Library research at the Central Washington University, Illinois University and University of Southern California libraries.
3. Internet searches and contacts.
4. Journal articles, books, government documents, contacts with specialists, a conference workshop and government committee contacts were the sources used for research.

The computer assisted ERIC (Education Resources In Circulation) search was carried out through the Central Washington University, Illinois University and Southern California libraries through the Internet computer network. I received help from Central Washington University Computer Services in setting up my home computer. I used the reference area of the CWU library for CIJE and ERIC resources along with computer searches. I also accessed curriculums, journal articles and ERIC references from the Microfiche section at CWU. At the annual August Vocational Conference in Yakima I obtained information on bar coding vocational competencies. I phoned the Commission on Student Learning in Olympia, they mailed me a copy of HB1209, a synopsis of the work the Commission has done to date along with the recently developed state curriculum which the Commission has developed so far. I also phoned the LEAP Committee in Olympia, they mailed me a synopsis on the work they have done to date and a questionnaire on Vocational Education.

CHAPTER 4

Results of the Study

Introduction

This section is limited to developing a vocational related manual and computer aided Technical Drafting curriculum for grades nine through twelve at a secondary school in the state of Washington. While a complete curriculum will be developed, only one unit and its related lessons will be included in this project as an illustration.

The curriculum for this unit is presented in three parts: Part I: the curriculum objective which includes a major task area, a performance objective and a list of enabling objectives. The enabling objectives serve also as a list of competencies. Part II: a series of assignments which reflect the objectives in order. Part III. worksheets and supportive information sheets which follow along with the objectives and assignments in order.

This is a ten unit outline for the Beginning Technical Drawing Program Model:

Unit 1. Use and Care of Drafting Tools and Equipment.

Unit 2. Perform Basic Computer Skills

Unit 3. Apply Basic Drafting Skills

Unit 4. Prepare Basic Multi-View Drawings

Unit 5. Prepare Basic Computer Aided Drawings

Unit 6. Basic Architectural Drafting

Unit 7. Residential Floor Plan Design

Unit 8. Prepare Basic Manual Architectural Drawings

Unit 9. Prepare Basic Computer Aided Architectural Drawings

Unit 10. Prepare Architectural Models

The unit "Residential Floor Plan Design" incorporates the changes in Technology and Vocational Education, as outlined in chapter two. It also includes the components for vocational program approval. This new approach includes, but is not limited to these components:

1. Performance Based Objectives
2. Competency Based Objectives
3. Cooperative Learning
4. Problem Solving
5. Process over Project
6. Teacher as Facilitator
7. Student Centered
8. Discovery
9. Portfolios
10. Quality Control Management

Because of limitations in equipment in my particular classroom, I have my classes divided in two groups. Half of the class works on manual drafting while the other half works on computer aided drafting. Every two weeks the groups rotate. Because of this, and the teacher as facilitator component, the assignments included here are intended as independent learning activities.

One of the most difficult problems students have with Technical Drawing is with conceptualizing space. In addition to the other competencies and components included, this unit was designed to develop visualization and spacial skills.

Part I. Unit Model For Technical Drafting Program

Unit 7: Residential Floor Plan Design

Task 01.01: <u>Develop a Space List of Residential Fixtures</u>

PERFORMANCE OBJECTIVES: Given a list of basic household fixtures, appliances, furniture and spaces, seek out and measure each piece by length, width and height. Calculate the area of each.

ENABLING OBJECTIVES: (competencies)

1. Describe the process of calculating area.
2. Demonstrate the proper use of a tape measure.
3. Identify specific fixtures, appliances and furniture pieces by name.
4. Develop a conceptual understanding of an amount of space needed in the design of human dwellings.
5. Demonstrate the ability to convert inches to feet and feet to inches.
6. Demonstrate the ability to convert square feet to square inches and square inches to square feet.

Task 01.02: Compare Space Lists Within Design Teams

PERFORMANCE OBJECTIVES: Given the completed Space Lists, compare the lists with other design team members. Discuss differences and the possible reasons why differences may exist. Develop one corrected version of these lists for use in the floor plan design activity.

ENABLING OBJECTIVES:

1. Analyze multiple sets of collected data.
2. Develop one set of collected data.
3. Demonstrate the ability to come to a consensus, or compromise as a member of a design team.
4. Demonstrate the ability to communicate ideas effectively and respect others' ideas within a design team.

Task 01.03 Design a Rough Draft Residential Floor Plan to Meet The Needs of a Client

PERFORMANCE OBJECTIVES: Given the completed and revised Space Lists, criteria and limitations of a client, past standards and technical drawing knowledge, in teams of three design a rough draft floor plan which will meet these requirements.

ENABLING OBJECTIVES:

1. Analyze client needs and criteria. And incorporate them into this assignment.

2. Demonstrate the ability to come to a consensus, or compromise as a member of a design team.
3. Demonstrate the ability to communicate ideas effectively and respect others' ideas within a design team.
4. Demonstrate Quality Control Methods when dealing with client needs.
5. Analyze and apply the limitations of client, cost, space and standards to solve these limitation problems.
6. Discover multiple possible solutions to design problems through design team interaction.

Task 01.04 Design a Final Revised Floor Plan Which Meets The Needs of a Client

PERFORMANCE OBJECTIVES: Given the rough draft, and the Space Lists, criteria and limitations of a client, past standards and technical drawing knowledge, individually design a final floor plan manually and on CAD for approval by the client.

ENABLING OBJECTIVES:

1. Analyze client needs, and criteria. Then incorporate them into this assignment.
2. Demonstrate Quality Control Methods when dealing with client needs.
3. Analyze and apply the limitations of client, cost, space and standards to solve these limitation problems.
4. Demonstrate Quality Control Methods when dealing with client needs.
5. Describe the process of calculating area using Generic CAD.
6. Develop final designs plotted on CAD to be used for presentation to the client.
7. Demonstrate knowledge of drafting principles and standards in developing final drawings.

Task 01.05 Present Design to The Client For Revision, or Approval:

PERFORMANCE OBJECTIVE: Given the student's completed residential floor plan design on CAD, present this design verbally and visually to the client using prepared drawings which address the client's needs.

ENABLING OBJECTIVES:

1. Demonstrate ability to verbally defend floor plan design based on client needs, limitations, construction codes and standards.
2. Demonstrate effective verbal communication when presenting design to client.
3. Demonstrate ability to integrate old, or new client needs to design.
4. Demonstrate ability to apply Quality Control Management techniques.

Part II. Assignments

Task 01.01 Assignment:

Develop a Space List of residential fixtures. Given a tape measure and a list of basic household fixtures, appliances, furniture, and spaces, seek out and measure each piece by length, width and height. Calculate the area of each. Turn into instructor when complete.

Task 01.02 Assignment

Compare Space Lists within your design teams. Given the completed Space Lists, compare the lists with other design team members. Discuss differences and the possible reasons why differences may exist. Develop one corrected version of these lists for use in the floor plan design activity and for future floor plan development activities. Turn into instructor when complete. When you get this back, put it in your folder.

Task 01.03 Assignment

Design a rough draft residential floor plan to meet the needs of a client. Given the completed and revised Space Lists, criteria and limitations of a client, past standards and technical drawing knowledge, design a rough draft floor plan which will meet these requirements in design teams of three members. First, draw individual rough floor plan drafts to use as a basis in designing a team product. Next, using all the individual designers, brainstorm and analyze each design within your group for usable segments only. Do not disregard any designs, or portions of designs until all brainstorming discussions and activities are through. From this, develop one rough floor plan to use as a group design. Turn finalized rough draft floor plan into instructor when complete.

Task 01.04 Assignment

Design a final revised floor plan which meets the needs of a client. Given your rough draft, the design teams rough draft, the Space Lists, criteria and limitations of a client, past standards and technical drawing knowledge, design a final floor plan individually manually and on CAD for approval by the client. Plot out the CAD drawing on "C" size paper for use as a visual in presenting your design to the client. Turn into instructor when complete.

Task 01.05 Assignment

Present your design to the client (the class) for revision, or approval. Using your completed residential floor plan design on CAD, present this design verbally and visually to the client using prepared drawings which address the client's needs. Be prepared to defend your design to the class with reasoning as to why you designed it the way you did. When you have this accomplished put this in your folder.

Part III

Worksheets and Supportive Information Sheets

Tasks: 01.01, 01.02

SPACE LIST

Assignment:

Develop a Space List of residential fixtures. Given a tape measure and a list of basic household fixtures, appliances, furniture, and spaces, seek out and measure each piece by length, width (depth) and height. Calculate the area of each.

Davenport: Length__________" Width__________"

Easy Chair: Length__________" Width__________"

Coffee Table: Length__________" Width__________"

End Table: Length__________" Width__________"

Entertainment Center: Length__________" Width__________"

Wood Stove: Length__________" Width__________"

Kitchen Table: Length__________" Width__________"

Kitchen Hutch: Length__________" Width__________"

Kitchen Stool: Length__________" Width__________"

Kitchen Sink: double, or single? Length_________" Width_________"

Dish Washer: Length_________" Width_________" Height_________"

Combo. Range Oven : Length_________" Width_________" Height_________"

Oven: Length_________" Width_________" Height_________"

Range top: Length_________" Width_________"

Refrigerator: Length_________" Width_________" Height_________"

Upright Freezer: Length_________" Width_________" Height_________"

Chest Freezer: Length_________" Width_________" Height_________"

Kitchen Cabinet height from floor to countertop: Height_________"

Kitchen Cabinet countertop depth: Width_________"

Kitchen Cabinet upper height: Height_________"

Kitchen Cabinet lower height: Height_________"

Clothes Washer: Length_________" Width_________"

Clothes Dryer: Length_________" Width_________"

Utility (washtub) sink: double, or single? Length_________" Width_________"

Hot Water Tank: Width_________" Height_________"

Furnace: Length_________" Width_________" Height_________"

Single Bed: Length_________" Width_________"

Twin Bed: Length_________" Width_________"

Queen Bed: Length_________" Width_________"

Night Table: Length_________" Width_________"

Desk: Length_________" Width_________"

Chest of Drawers, single: Length_________" Width_________"

Chest of Drawers, double: Length_________" Width_________"

Book Case: Length_________" Width_________"

Hall width: Width_________"

Small Bedroom: Length_________" Width_________"

Medium Bedroom: Length_________" Width_________"

Large Master Bedroom: Length_________" Width_________"

Doorway: Length_________" Width_________" Height_________"

Living room: Length_________" Width_________"

Kitchen: Length_________" Width_________"

Dinning room: Length_________" Width_________"

Bathroom, full: Length_________" Width_________"

Bathroom, half: Length_________" Width_________"

Utility / Laundry room: Length_________" Width_________"

Family room: Length_________" Width_________"

Garage, single: Length_________" Width_________"

Garage, double: Length_________" Width_________"

Tasks: 01.03, 01.04, 01.05

DESIGN CRITERIA

CLIENT NEEDS AND LIMITATIONS

1. Funding limitations: The client has $85,000 available for this project.
2. New residential construction in this area costs about $60.00 per. sq. ft. total.
3. The client has a bad leg and cannot climb many stairs.
4. The town which oversees building restrictions where the lot is located on which this home will be built has restricted the height of new construction to 20 feet.
5. The client enjoys cooking for friends and has many dinner parties. The client insists that the kitchen be the central room, or hub of the house.
6. The client believes that family room, living room combination homes are a waste of space and insists that this home only have one, or the other of these rooms, not both.
7. The master bedroom must open onto a deck.
8. The kitchen to be open and "airy".
9. The client wants to be able to see and hear people in the living room/family room while he is cooking.
10. No noise from the washer, dryer, or dishwasher can disturb the client and his guests from meaningful conversation.
11. The client does not want to get wet when unlocking his front door.
12. The client is a bachelor with no children.
13. The client would like large rooms, but wants the home to have good re-sell value, in case he needs to sell it.
14. The client has a beater 1969 Ford pick-up and does not care if it is garaged.
15. The lot size is 80' X 120' with an 80' side parallel to an access road.
16. The client does not want traffic patterns to go through the middle of rooms.
17. The client also would like workspace for woodworking with a large outside door.

Part III

Example of Completed Worksheets and Supportive Information Sheets

Tasks: 01.01, 01.02

SPACE LIST

Assignment:

Develop a Space List of residential fixtures. Given a tape measure and a list of basic household fixtures, appliances, furniture, and spaces, seek out and measure each piece by length, width (depth) and height. Calculate the area of each.

Davenport: Length 6' " Width 36 "

Easy Chair: Length 24 " Width 36 "

Coffee Table: Length 3' " Width 18 "

End Table: Length 22 " Width 24 "

Entertainment Center: Length 49 " Width 15 "

Wood Stove: Length 24 " Width 24 "

Kitchen Table: Length 60 " Width 40 "

Kitchen Hutch: Length 3' " Width 15 "

Kitchen Stool: Length 14 " Width 14 "

Kitchen Sink: double, or single? Length 19 " Width 33 "

Dish Washer: Length 24 " Width 24 " Height 33 "

Combo. Range Oven : Length 30 " Width 27 " Height 36 "

Oven: Length n/a " Width ______ " Height ______ "

Range top: Length n/a " Width ______ "

Refrigerator: Length 28 " Width 27 " Height 61 "

Upright Freezer: Length 28 " Width 27 " Height 61 "

Chest Freezer: Length 4' " Width 27 " Height 35 "

Kitchen Cabinet height from floor to countertop: Height 36 "

Kitchen Cabinet countertop depth: Width 2' "

Kitchen Cabinet upper height: Height 21 "

Kitchen Cabinet lower height: Height 34 "

Clothes Washer: Length 29 " Width 26 "

Clothes Dryer: Length 29 " Width 26 "

Utility (washtub) sink: double, or single? Length n/a " Width ____ "

Hot Water Tank: Width 24 " Height 5' "

Furnace: Length 20 " Width 26 " Height 58 "

Single Bed: Length 3' " Width 79 "

Twin Bed: Length 4' " Width 79 "

Queen Bed: Length 5' " Width 81 "

Night Table: Length 16 " Width 12 "

Desk: Length 28 " Width 26 "

Chest of Drawers, single: Length 31 " Width 18 "

Chest of Drawers, double: Length 57 " Width 18 "

Book Case: Length 28 " Width 12 "

Hall width: Width 38 "

Small Bedroom: Length 8' " Width 9' "

Medium Bedroom: Length 10' " Width 10' "

Large Master Bedroom: Length 10' " Width 12' "

Doorway: Length 3' " Width 6 " Height 6'6" "

Living room: Length 14' " Width 16' "

Kitchen: Length 10' " Width 12' "

Dinning room: Length 9' " Width 12' "

Bathroom, full: Length 6' " Width 8' "

Bathroom, half: Length n/a " Width "

Utility / Laundry room: Length 8' " Width 7' "

Family room: Length 10' " Width 12' "

Garage, single: Length 12' " Width 14' "

Garage, double: Length 22' " Width 14' "

Tasks: 01.03, 01.04, 01.05

DESIGN CRITERIA, CLIENT NEEDS, AND LIMITATIONS

1. Funding limitations: The client has $85,000 available for this project.
   a. What costs are involved in home construction? Example, Land, Architect fees, etc.
   b. If the client changed their mind and looked for a lot the same size in a different neighborhood, could this effect their budget?
   c. Does the designer think the client is being realistic with a budget of $85,000?
2. New residential construction in this area costs a minimum of $60.00 per sq. ft. total.
   a. What types of problems might occur which would effect the price per sq. ft.?
3. The client has a bad leg and cannot climb many stairs.
   a. Could a multi-level home be designed anyway?
   b. Is there more than one solution to designing a multi-level home for this client?
   c. What might be two problems with designing a multi-level home for this client?
4. The town which oversees building restrictions where the lot upon which this home will be built has restricted the height of new construction to 20 feet.
   a. Could a multi-story home be built on this lot? How?
5. The client enjoys cooking for friends and has many dinner parties. The client insists that the kitchen be the central room, or hub of the house.
   a. How could living room and kitchen areas be incorporated together?
   b. Should and must the living room and kitchen areas be put together?
   c. In order to make the kitchen the central hub of this house does it need to be located in the center of the house?
6. The client believes that family room, living room combination homes are a waste of space and insists that this home only have one, or the other of these rooms, not both.
7. The master bedroom must open onto a deck.
   a. What are all the options for doing this?

b. Besides the standard options, are there any more? Can the designer think of an innovative idea?

8. The kitchen is to be open and "airy".

   a. The designer may want to make a list of options to achieve this before deciding. Any new ideas?

9. The client wants to be able to see and hear people in the living room/family room while he is cooking.

10. No noise from the washer, dryer, or dishwasher can disturb the client and his guests from meaningful conversation.

    a. What problems may exist if the dishwasher is located somewhere other than in the kitchen area?

11. The client does not want to get wet from wind and rain when unlocking his front door.

    a. Does the designer need more than just a roof to keep water out of the front doorway area?

12. The client is a bachelor with no children.

    a. Must the designer consider three, or fewer bedrooms?

13. The client would like large rooms, but wants the home to have good re-sell value, in case he needs to sell it.

    a. If the design of the house only appeals to single people will it be difficult to sell?

14. The client has a beater 1969 Ford pick-up and does not care if it is garaged.

    a. How could the truck be protected from the elements without a garage?

15. The lot size is 80' X 120' with an 80' long side which is parallel to an access road.

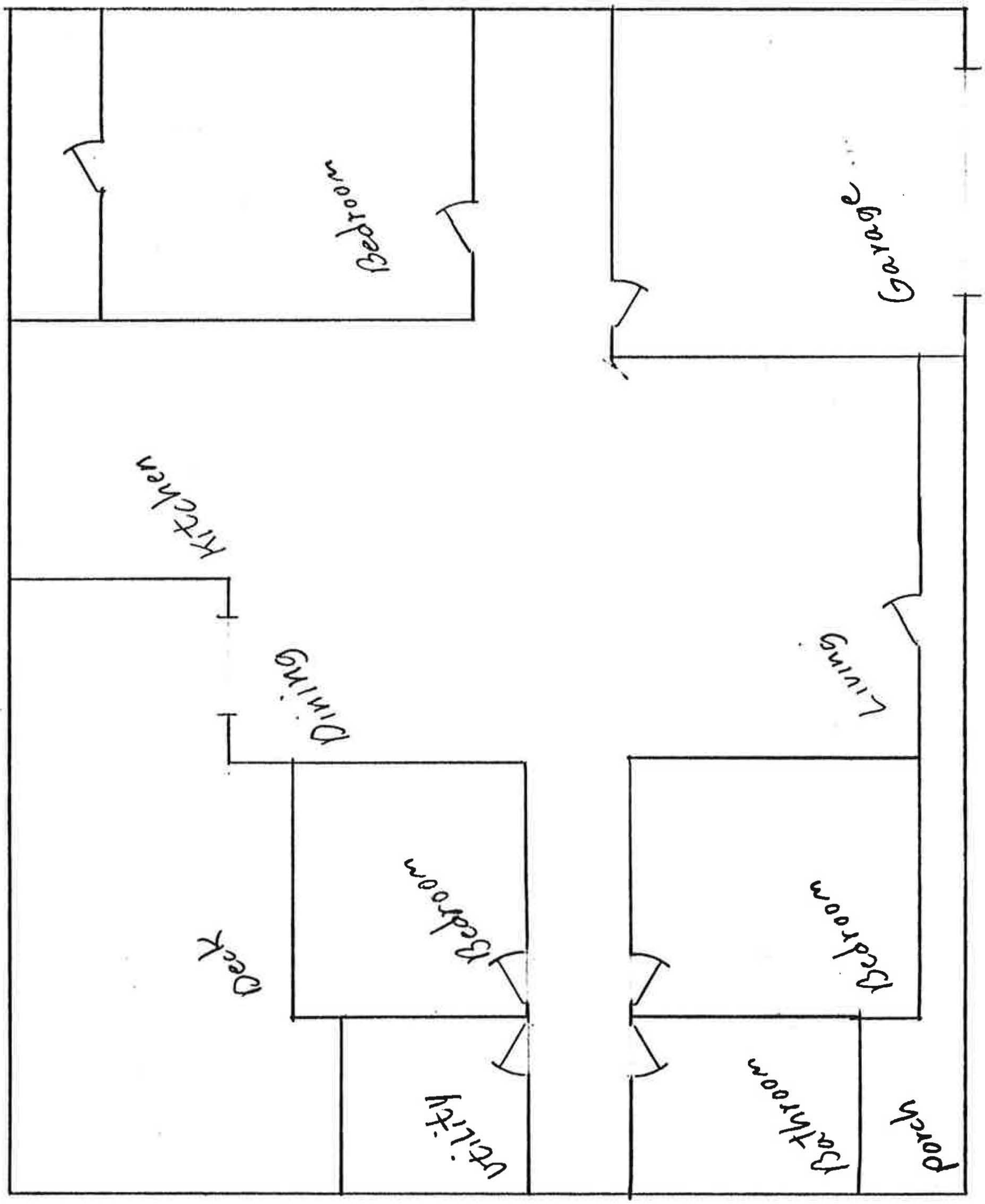
    a. How does this effect the design of the house, or does it?

16. The client does not want traffic patterns to go through the middle of rooms.

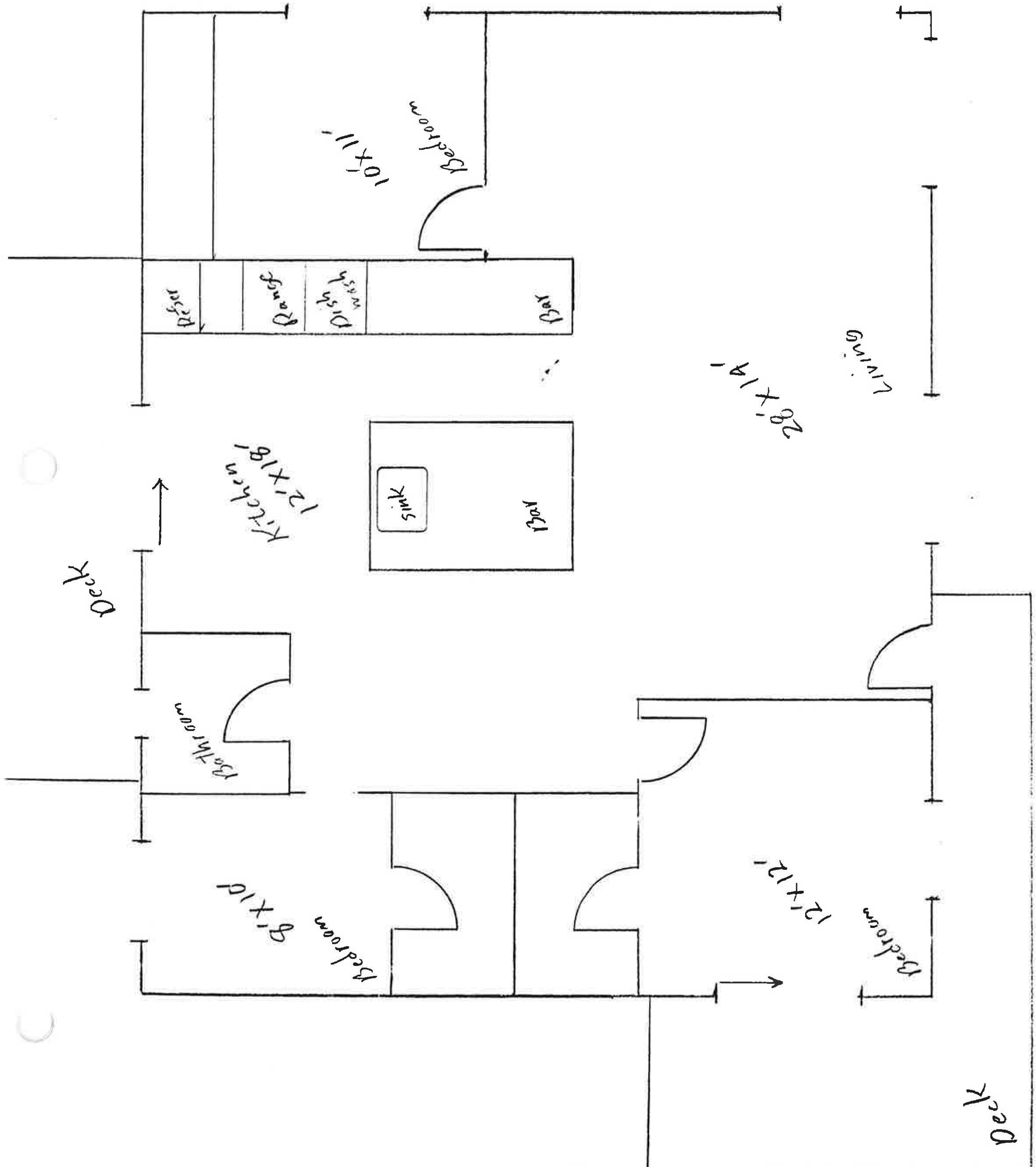
    a. Does this limitation limit the designer to a formal hallway?

17. The client also would like workspace for woodworking with a large outside door.

Task: 01.03


Bedroom
Garage
Kitchen
Dining
Living
Deck
Bedroom
Bedroom
Utility
Bathroom
Porch

Task: 01.03


Bedroom
10'x11'
Refer
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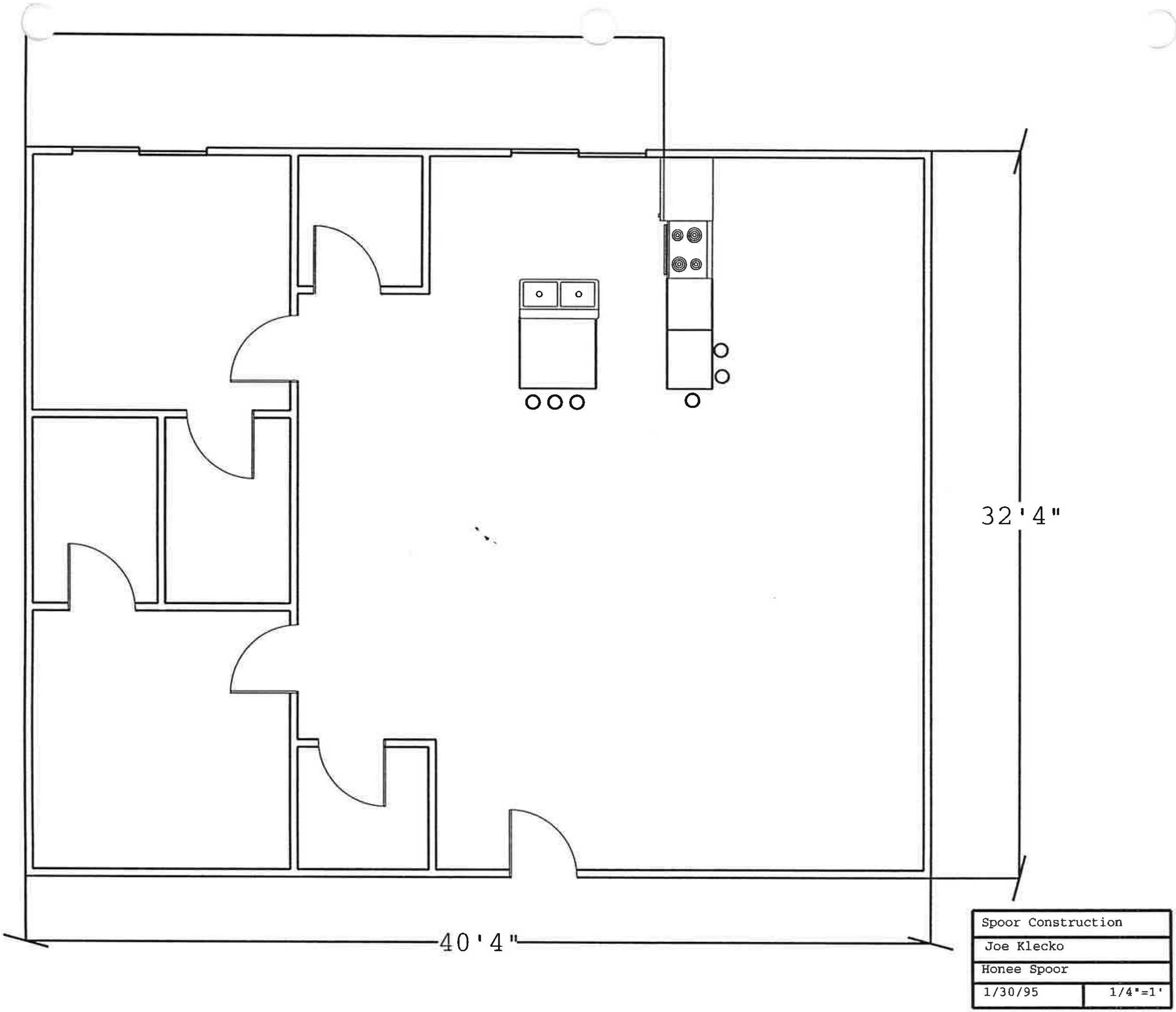
Dish wash
Bar
Living
28'x14'
Kitchen
12'x18'
sink
Bar
Deck
Bathroom
Bedroom
8'x10'
Bedroom
12'x12'
Deck


32'4"
40'4"
Spoor Construction
Joe Klecko
Honee Spoor
1/30/95
1/4"=1'

CHAPTER 5

Summary, Conclusions, and Recommendations

Summary

The revisions in education, Technology Education and Vocational Education in recent years have brought changes, changes in legislation, types of objectives used, philosophies and teaching methods. The related component parts of these changes are essential for successful education reform in vocational education and in some cases for vocational approval. This project is a study and culmination of work from government documents in legislation and committees, along with examples of approaches in methodology in teaching Technology Education and vocational education. This project also includes an example curriculum in Technical Drawing which includes this new approach.

Conclusions

As a result of this study, the following conclusions are made:

1. It is essential that a performance based educational approach and performance based objectives along with competency based objectives are used.
2. The best educational methodologies for teaching Technology Education and vocational education are as follows:
   a. Cooperative Learning
   b. Stress Problem Solving
   c. Stress Process over Project
   d. Teacher as Facilitator, not answer person, or lecturer
   e. Student Centered
   f. Discovery
   g. Portfolios
   h. Quality Control Management

Recommendations

As a result of the conclusions of this study, the following recommendation is made:

1. Vocational and Technology Educators should include as many of these components into their curriculum as the curriculum material will allow.

Personal Observations

1. Students who have little experience in working in cooperative learning groups have difficulty in seeing the value of working in teams.

2. Some students prefer to work alone and tell me they work better alone because they are more effective and can accomplish assignments much faster. Most of these students who would rather work alone are high achievers. I have them work in groups anyway and explain to them the importance of learning how to work with others as a team and that many jobs require it.

3. Most students would rather work in groups. In many cases, the quality of finished assignments from groups are more comprehensive than those done from individuals.

4. When I apply these components into units the preparation time is increased, however the time I spend with individual students is decreased.

5. Students would rather learn from peers, or each other, than a teacher.

6. Students are on task much more with the application of these components as compared to traditional methods.

7. Students enjoy learning from activities rather than reading about something from out of a book.

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