Can computer assisted instruction (CAI) effectively assist incarcerated juveniles in learning introductory woodworking skills?

Steven Charles Ambellan

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CAN COMPUTER ASSISTED INSTRUCTION (CAI) EFFECTIVELY ASSIST INCARCERATED JUVENILES IN LEARNING INTRODUCTORY WOODWORKING SKILLS?

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Interdisciplinary Studies:

Integrative Studies Option

by

Steven Charles Ambellan

March 2001
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Approved by:

Dr. Bob London, First Reader

Dr. Thom Gehring, Second Reader

3/20/01 Date
ABSTRACT

The author, a wood shop teacher, was concerned that he was not able to devote enough time to students that were attempting more advanced projects that require higher order thinking skills. In order to devote more time to students at this critical juncture, a tutorial was created utilizing Computer Assisted Instruction techniques to teach the incoming students introductory woodworking skills. The assumption was that if the students could learn techniques from the tutorial in the same amount of time as before, the project would be considered a success. The average time taken to progress through four levels of projects before the tutorial was compared to the average time taken after the tutorial was introduced.

The result was that there was a slight decrease in the time it took to complete the same amount of work using the tutorial with no difference in the quality of the product. The teacher was able to provide more attention to students with more advanced projects.
ACKNOWLEDGMENTS

There are many people responsible for the completion of this project. I would like to thank the following people that have provided me with support and assistance.

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Who not only had the vision that began this journey for all of us, but who also believed in me.

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Who have provided support for one another on this journey.

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CHAPTER ONE

INTRODUCTION

At Los Pinos High School, operated by Orange County Department of Education for juvenile felons, wood shop is one of the few hands-on vocational programs in the curriculum. The student population of Los Pinos is always in transition, with students entering and leaving the institution daily. The average stay for a student is about ninety days. Students are generally low performers and have a history of truancy and failure in the conventional school system. Among offenders, the prevalence of students classified as learning disabled is significantly higher than in the general student population (Kleilitz et al, 1986). The weighted average estimate of the prevalence of juvenile offenders with learning disabilities (LD) is 35.6% and, of offenders with mental retardation (MR), 12.6% as compared to a prevalence among all school children of 4.49% for those with LD and 1.86% MR (Nelson et al, 1987). Incarcerated students struggle with life issues such as drug addiction, paternity, and threats from rival gangs. Because most of the students at this institution are older, few choose to finish high school upon release.

The woodworking program at Los Pinos High School teaches students basic woodworking skills through six
levels of projects. Students may choose from several options in levels one, two and three. In the course of finishing these projects, the student becomes familiar with the tools in the shop and learns safety procedures. Upon completion of the first five required levels, the student is encouraged to design and build his own project. Student designed projects, must:

(a) be drawn to scale by the student;
(b) be made of materials available in the shop;
(c) include a cut list indicating the size of the parts;
(d) not exceed 14" in any one dimension.

Students who have not previously made anything in their life learn to create objects of utility and beauty. Typically, these young men are very proud of their creations.

Although few have prior woodworking experience, most students are eager to learn the craft. Upon successful completion of the required projects, they possess the requisite skills to assemble self-designed projects. However, most are uncomfortable with this freedom given them and many lack the math and reading skills, as well as the higher-order thinking skills necessary to design and complete projects. Yet, through these student designed
projects, students gain experience with higher levels of
cognition, an important objective in education. It is
therefore desirable that the teacher be available during
this phase of the students experience to facilitate the
student’s transition through the process.

In practice, the majority of the teacher’s time is
spent with new students demonstrating necessary but
elementary skills. Consequently, the teacher is not always
accessible to students struggling with their first self
designed project.

The hypothesis of this project is that if a
multimedia curriculum could assist students in completing
the first four levels of projects, the teacher would be
able to spend more time with students who are working on
more difficult student designed projects. This project
explores the following general question: "Can Computer
Assisted Instruction (CAI) effectively assist incarcerated
juveniles in learning introductory woodworking skills"?

To explore this question, the researcher developed a
Computer Assisted Instruction (CAI) tutorial covering the
first four levels of required introductory project, and
field tested the effectiveness with the students in the
wood shop classes. The three classes per day are each two
hour "Block Classes" consisting of ten students per class.
Students attend school and vocational training on alternate days, so that there are generally 60 students enrolled in woodshop at any given time. In evaluating the effectiveness of the project, the researcher asked three questions:

1. Were students using Computer Assisted Instruction able to complete their required projects in approximately the same amount of time as those using written plans?

2. Were students comfortable with Computer Assisted Instruction in the wood shop and could they learn other skills through educational technology?

3. Did the CAI tutorial enable the teacher to provide more assistance with student-designed projects, which develop higher level cognitive skills which facilitate incarcerated students' transition into mainstream society?

The results of the field testing supported the following conclusions:

1. Students using Computer Assisted Instruction were able to complete their required project in approximately the same amount of time as those
using written plans with no decline in quality of the finished product;

2. Students were comfortable with Computer Assisted Instruction in the wood shop, and they could learn other skills through multimedia instruction;

3. The CAI tutorial enabled the teacher to provide more assistance with student-designed projects, which develop higher level cognitive skills, facilitating incarcerated students' transition into mainstream society.

In chapter two, Review of The Related Literature, the researcher discusses research on CAI in general as well as its appropriateness for the subject population. In chapter three, the methodology and the design of the curriculum are discussed. In chapter four, the researcher presents the conclusions derived from the data and presents recommendations for further research.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

In this section, the author will review literature on the subjects of the definition of learning, categories of Computer Assisted Instruction with their corresponding strengths, and the opinions of CAI critics. Opinions supporting the integration of computer technology into a traditional industrial arts program will be presented as well as research which supports the appropriateness of vocational training in general and higher level cognitive skills training specifically for the subject population.

For the purposes of this project, instruction was defined in the sense used by Venezky and Oslin (1991) as planned learning experiences. Learning is an increase in accessible knowledge or ability. An increase in inaccessible knowledge might in some worlds appear as learning, but inaccessible means not accessible, untappable, and therefore not of practical value. Planned means deliberate, but not necessarily in a preprogrammed step-by-step fashion. Planned still leaves room for student control and random generation of problems, but within the constraints of specified learning goals and instructional modes. It is recognized that not all learning occurs through instruction as defined.
Computer Assisted Instruction

Dillon (1994), defines CAI as Computer Assisted Instruction, an acronym describing programs that use the computer as an instructional tool rather than as an automation machine. Sewell (1990), defined two broad categories of potential gain that can be derived from Computer Assisted Instruction. The first category of potential gain involves the ability of CAI to improve performance in specific curriculum areas. Sewell refers to this approach as the “product approach.” Applications in this context deal mainly with school curricula as it currently exists. The use of such programs is designed to make teaching easier, more effective, faster or more convenient. The bulk of CAI is oriented toward the product approach because, when correctly implemented, it promotes the following:

a. Ease of use for learners and teachers;

b. Use of drill exercises that can help develop basic skills through repeated practice;

c. Individualization: access to materials enables learners to proceed at their own rate.

For these reasons, according to the proponents of the method, CAI and related activities are generally
considered by students to be more motivating than traditional methods.

A second general category concerns the development of more broadly-based cognitive skills, including problem solving, thinking skills, analysis and synthesis. Although this approach may utilize specific skills, the emphasis is much more upon the development of cognitive skills across the curriculum (Sewell, 1990, p. 29). Improved cognitive skill benefits due to CAI are derived from a shift in the locus of interaction toward a more active learner role as well as by providing an opportunity to interact with a simulated representation of some aspect of the world (Sewell, 1999 p. 34). What this means is that the mere act of operating a computer makes students believe that they have a degree of control over the learning process, thus increasing their commitment to the success of the result.

In his research on virtual learning, Schank (1997), stated that learners will teach themselves better than the world's best trainer, or highest-paid motivational speaker. Additionally, Schank's research indicates that "Memorization without corresponding experience is worthless" (p. 47).

According to Schank (1999), an enormous amount of virtual learning time is wasted attempting to memorize
facts, procedures and slogans with no impact on behavior or learned skills. In order for the acquired knowledge to be valuable, it must immediately be put to use.

Critics of CAI are abundant and tend to fall into two general categories. The first category is composed of those who feel that computers take control of the curriculum away from the teacher. For the purposes of this paper, this will be called the lack of control argument. The second category of critics feel that while effective, computers take us one more step away from human contact. This will be labeled the dehumanizing argument.

Proponents of the lack of control argument argue that teachers should teach, and computers are just another diversion. Once students get into their computers, it is difficult to monitor their work and ensure that they're on task. Stoll (1999) states: "these teaching machines direct scholarship away from reading, away from writing, away from scholarship. They dull questioning minds with graphical games where quick answers take the place of understanding" (p. 13). A corollary to this argument is that if students can effectively learn from the computer, then teachers are unnecessary.

Dehumanizing argument: An example of this line of thinking is argued by Nicholas Negropointe, founder of
Massachusetts Institute of Technology’s Media Laboratory, who presented the “atoms versus bits discussion” (Reginer, 1996, p. 74). Atoms make up the physical world. Trees, birds, fish, rocks, hamburgers as well as the reader of this paper are composed of atoms. Bits and other electronic particles/waves are transmitted in the electronic world to create pictures, sounds, text, and video we see on televisions, hear on radio, and manipulate on our personal computers. Negroponte pointed out that, as we move from atoms to bits, we improve communication speed, lower costs and change the complexion of a communication transaction. When you mail a letter, the atoms of the letter are physically transported to another location where the reader opens the physical item and reads the ink printed on the page. In e-mail, the letter is created on a word processor screen. It is then converted to bits of information and transmitted via the Internet to its destination where the bits are again shown to the reader on a screen.

The advantages of speed and ease are obvious and we are improving the technology with a speed unmatched by any other development in humankind. Converting atoms to bits is changing our lives so quickly that we may not understand the impact of the change. We are in danger of
losing our understanding of the physical world. We are replacing our contact with atoms with the processing of bits. Radio, television, and now the Internet have contributed to a dangerous autonomy, where humans may no longer experience nature firsthand.

As Reginer (1996), stated: "It is a real fear that we may someday be totally connected to each other but have nothing of value to say. The advent of the internet and the increasing penetration of personal computers is bringing worldwide interconnectivity to our homes, with our free time increasingly spent on bits instead of atoms" (p. 83).

While many of the CAI criticisms have merit, the author's position is that the best approach is to emphasize the positive effects of technology and minimize the negative effects. Specifically, the tutorial which is the basis for this project was designed with the following characteristics

a. It should cover the steps necessary to complete the required projects.

b. The design should be interactive, where students can choose their direction and review material rather than linear where students start at the
beginning and must follow the same path to the end of the tutorial.

c. The focus will be on visual images rather than the printed word.

**Industrial Arts/Vocational Education**

In North America there are two prevailing trends in industrial arts education, both reflecting the way schools respond to the changing needs in the workplace. The first trend is that some schools attempt to prepare students for the technological workplace of the future by bridging the gap between today's technology and traditional vocational education by integrating computers into shop classes.

In Kirkwood Mo., industrial arts programs have been redesigned to integrate computers with traditional shop classes. According to Kevin Pratt, Industrial arts teacher: "Now we give the student a hands-on feel, but we also have to show him what is going on in industry today with power machinery and computers" (Kravetz, 1994, p. 4). Evidence of this trend is the renewed attention Industrial Arts and technological classes have received at the junior college level. According to Sheppard, (1998) an increasing number of young men and women agree with the statement that: "You go to a university if you want a challenge. You go to vocational school to prepare you for life" (P.58).
Sheppard (1998), cited cost of schooling and availability of employment for graduates as the main reasons behind the allure of the vocational school. As an indicator of this trend, Sheppard, in his study of post-secondary vocational schools in the Toronto area reported up to 30 per cent of students attending these schools already had a university degree.

The second trend in industrial arts education (and unfortunately the most prevalent at the secondary level) is to simply “Close up shop.” At a time when industry is clamoring for trained, skilled workers, school districts are reducing or eliminating vocational offerings. There are two reasons for the decline in vocational education classes. The first is the expectation that every child will be going to college, and the second is the high cost of vocational shop classes compared with other subject areas (Richardson, 1999).

There are some studies that suggest this second trend may not be wise. For example there have been several studies linking vocational education to favorable adult employment outcomes. Hazazi, (1989) found a significant positive relationship between taking one or more vocational classes in secondary school and adult employment. The U.S. Department of Education (1994)
associated two factors with a dramatically lower probability of students with disabilities dropping out of High School in the eleventh and twelfth grades:
Concentration in vocational classes, or having taken a survey vocational education course.

In studies of vocational program effectiveness for students with learning difficulties, Shapiro and Lentz (1991) found after 24 months, no difference between employment rates of students with learning disabilities that attended High School vocational courses, and students without learning disabilities. Schwartz and Taymans (1991) found that 78% of secondary vocational program graduates with learning disabilities were employed, and D’Amico (1991) found that 68% of vocational education students with learning disabilities were employed two years later versus 48% of students with learning disabilities and no vocational education.

The U.S. Department of Labor’s Secretary’s Commission on Achieving Necessary Skills (SCANS, 1991, 1992, 1993) identified the skills necessary for jobs in today’s economy, how they are to be assessed, and how they will affect teaching and learning on the secondary level. SCANS estimated that only half of all High School graduates were employment ready in the modern sense and pointed out that
a high school diploma no longer guaranteed future employment at a livable wage.

The commission identified five competencies and a three part foundation that summarized the skills needed to enter the modern labor market. The competencies include being able to effectively use; resources, interpersonal skills, information, systems, and technology. The foundation consists of basic skills (reading, writing, arithmetic, speaking, and listening), thinking skills, and personal qualities (responsibility, self-esteem, and self-management integrity). The commission further recommended that all school systems make the components of workplace skills explicit objectives of their program. (SCANS, 1991)

The implications of the SCANS report is that in order to be successful in the workplace, students must not only have workplace skills, but the ability to utilize technology and the ability to exercise higher order interpersonal skills.

Higher Order Skills

Students in a correctional setting are generally deficient in basic skills. In addition, they possess attitudes that result in the antisocial behavior which is the cause of their incarceration. Recent literature in
this area indicates a great deal of interest in
"psycoeducation-al theory and applications" which is
declared by Coffey (1994) as programs that teach social,
moral, and/or cognitive skills as part of a school
program, rather than in a treatment context. Correctional
educators have long been aware that teaching juvenile
offenders the three R's without changing their socially
unacceptable behavior is unlikely to have any long-term
impact on recidivism.

The work of Lawrence Kohlberg has led to skills
training in moral reasoning and cognitive development.
Kohlberg indicated that there are three levels (with six
stages) of moral reasoning in human development (Jennings
& Kohlberg, 1983). The earliest level is the
pre-conventional morality level (ages 4-10). At this
level, moral value resides in a person’s own needs and
wants. The child progresses from stage one, where moral
judgment is motivated by a need to avoid punishment, to
stage two, where moral judgment is motivated by a need to
satisfy one’s own desires.

At the next level, the conventional morality level
(ages 10-14), conformity to family, group or nation is
perceived as a good in itself, regardless of consequences.
The child enters this level at stage three, where moral
judgment is motivated by a need to avoid rejection or disapproval of peers. Stage four is the conventional level in which moral judgment is motivated by a need not to be criticized by a legitimate authority figure.

At the highest level, the post-conventional morality (adolescence-adulthood), the adolescent moves from stage five where moral judgment is based upon respect for community to stage six where morals are based upon the individual's conscience.

Research indicates that juvenile offenders often test lower on moral reasoning than non offenders. Morgan et al. (1993) using the Wechsler Intelligence Scale for Children-Revised (WAIS-R) and a test based on nine moral stories, tested delinquent youths, and found that they generally operated on Kohlberg's "preconventional" level with a focus on self and dependence on authority figures in moral reasoning.

Ross and Fabiano (1985), found that offenders often experience delays in cognitive skills. In addition, almost all successful correctional education programs had a component developed to influence the offender's thinking, in addition to the acquisition of knowledge. Their research indicated that effective programs for offenders typically emphasized self-control training, means-end
reasoning, critical thinking and cognitive problem solving.

Duguid (1993), stated that research into successful transition from criminal careers involves the establishment of a "bond" to the conventional world. These bonds may be in the form of friends, loved ones, or employment, and can be the decisive factor in enabling the offender to break with past associates and patterns. Education stressing higher level cognitive skills, such as problem-solving, linking cause and effect, and considering future consequences in making decisions, offers the prisoner-student an alternative identity, complete with career goals, potential social networks, new languages, rituals, and values. The research of Ross and Fabiano, as well as successful experiments by Duguid in adult corrections, led to the Correctional Services of Canada implementing a Cognitive Skills Training Program system-wide in 1990 (Coffey & Gemignani, 1994).

Bloom’s Taxonomy

In reviewing the literature for guidance concerning an appropriate framework for developing the curriculum materials for this project, Bloom’s Taxonomy (1956) was selected as a theoretical framework because his categories suggest a useful sequence to move students from lower
level skills, such as tracing patterns onto wood, to higher level skills, such as drawing a project to scale and preparing an accurate cut list. Bloom indicated that, in theory any student can learn, if provided with appropriate prior and current conditions of learning. Bloom (1976) suggested three unrelated variables that have an impact on student learning:

a. whether prerequisite material has been learned;
b. whether the student is motivated to learn;
c. whether the instructor is appropriate to the learner.

Bloom and his colleagues created a threefold division of educational objectives: cognitive, affective, and psychomotor. They asserted that most teaching objectives can be placed in one of the three major domains or classifications:

1. Cognitive domain: Objectives which emphasize remembering or reproducing something that has personally been learned. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. These objectives involve utilizing and
combining previously learned materials in order to solve problems.

2. Affective domain: Objectives which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. These objectives in the literature are expressed as interests, attitudes and values.

3. Psychomotor domain: objectives which emphasizes some muscular or motor skill.

This study was primarily concerned with the cognitive domain, which according to Bloom, is divided into six levels. The six levels are:

1. knowledge;
2. comprehension;
3. application;
4. analysis;
5. synthesis; and
6. evaluation.

What follows is an explanation of the six levels of the cognitive domain. In the next chapter, their application in the teaching of woodworking will be explained.
The Six Levels of Cognitive Educational Objectives

Knowledge.

In Bloom's taxonomy, knowledge involves the recall of specifics and universals, recall of methods and processes, or the recall of a forgotten structure or setting. For testing of this knowledge, the recall situation involves remembering the facts.

Comprehension.

Comprehension represents the lowest level of understanding which can be assumed to be part of the individual's general fund of knowledge. It emphasizes the process of knowing what has been communicated. Comprehension shows itself in the student's ability to translate and paraphrase what has been taught. Another aspect of comprehension is interpretation which involves a reordering, rearrangement, or overview of the material. The third aspect of comprehension is extrapolation: the extension of trends or tendencies beyond the given data to determine implications or consequences.

Application.

According to Bloom, application is the use of abstractions in particular and concrete situations to find the solution to a problem. The abstractions may be in the forms of general ideas, rules of procedures, or
generalized methods. It may also be technical principles, ideas, and theories which must be remembered and applied.

Analysis.

According to Bloom, the skill of analysis is a more advanced level of cognition than the skills of comprehension and application. In comprehension the emphasis is on the grasp of the meaning and intent of the material. Analysis emphasizes the breakdown of the material into its constituent parts and detection of the relationships of the parts and the method of their organization. Analysis may also be directed at the techniques and devices used to convey meaning or establish the conclusion of a communication.

Synthesis.

Synthesis brings together parts or elements to form a whole. Some examples of this level of cognition would be to create, design, formulate, manage, organize, and/or plan.

Evaluation.

At this stage the student renders judgment about the extent to which the material and methods satisfy criteria. This will include the ability to indicate logical fallacies in arguments. Also, it may include the ability to judge by external standards and to compare a work with
the highest known standards in the field, especially with other works of recognized excellence. Verbs that describe evaluation are compare, judge, predict, support and evaluate.
CHAPTER THREE

METHODOLOGY

In this chapter, the design of the project will be discussed. First, the curriculum for the project will be described as well as the connection to Bloom’s taxonomy. Second, the design of the tutorial and its relationship to the existing curriculum will be described. Third, the factors that were considered in the design of the tutorial will be discussed, and fourth, the criteria for evaluating the tutorial will be outlined.

At Los Pinos High School, the wood program is set up so the student progresses through a series of projects, increasing in complexity in accordance with the categories described by Bloom. In the first four levels, safety and woodworking skills are emphasized, while in the last two, planning and design are the primary focus.

Level One Projects (Hand Tools Only)

Students may choose between one of two offerings: A Pinehurst plant bracket, or a Tulip napkin holder. Skills include using a pattern to recreate a shape, and the proper use of vises, clamps, hand drills and saws. The final project is edge sanded and finished with lacquer. Skills required to complete projects at level one fall into Bloom’s knowledge level.
Level Two

Students select two of three available projects: Cat Bookends, Standard Shelf, or a Toy Train. Students build upon the skills learned in level one and introduce the use of power tools such as the table saw, scroll saw, drill press, edge router, belt sander, finishing sander, and drum sander. By completing the level two series, students are displaying skills at Bloom's comprehension level. Skills learned in level one are used along with acquired level two skills and techniques.

Level Three

Students have a choice of two of three projects: a small open cabinet, five-board stool, or a salt box. In the process of completing these projects, students continue to use skills learned in the previous two levels. In addition, advanced router and assembly techniques are introduced. Students must learn assembly techniques so that edges are straight as well as square. The level three student is operating at Bloom's application level, applying the techniques, principles, ideas and theories learned in the previous levels.

Level Four

This project is a candle holder which involves using the lathe. Most of the students have never before used
this power tool. In this project the student embarks on a series of procedures and techniques that have not been encountered before. Unlike the previous levels, in which the emphasis is on making a project exactly like the example, an element of student design and feeling is entered into this project. A thick, voluptuous candlestick is equal in quality to a thin one if the guidelines of symmetry and balance are observed. At this level the student moves through the first three levels of knowledge, comprehension and application, and begins to enter the analysis level. The student is encouraged to experiment with different shapes in order to personalize his project.

Level Five

Students at this level are familiar with the shop machines and have experience in assembly and finishing. The objective of this project is for students to recreate an existing object, adding their own finishing touches. They are shown a small box with doors and are asked to make one like it. In order to accomplish this, students must measure it, draw it to scale, identify and make a list of the component parts and obtain instructor’s approval prior to assembly. The student then assembles the project and submits it to the instructor for evaluation and release approval. The student participates in the
evaluation and identifies things he will or will not do in future projects. In doing so, the student is operating at Bloom's analysis level where material is broken down into its constituent parts and students become aware of the relationship between the separate parts and the method of their organization.

Level Six Self Designed Projects

The requirements for this project are that the project must be made out of stock on hand, cannot exceed 14" in any one dimension, and is subject to instructor's approval. The students may not make anything gang-oriented, or anything that could be considered a weapon. At this level students take an idea from the concept stage and translate it into reality using the higher cognitive levels of analysis, synthesis, and evaluation as outlined by Bloom.

In my experience, most students move fairly effectively through the first four levels, however at levels five and six, students are required to exhibit skills that they may have not been asked to demonstrate in their educational experience. Many become acutely aware of their deficiencies in basic skills, and without support and encouragement from the teacher, most choose to do simple projects over and over rather than create original
Once this choice is made, the higher level cognitive skills as described in Bloom's Taxonomy are not even attempted, much less mastered.

For these reasons, the author would like to be available to students at this critical point, showing them that they have the skills to plan, design and build an original project and helping them to be successful.

Therefore, the major purpose of this project was to design a computer assisted instruction tutorial to guide students through levels one to four so that the teacher could have more time to support students working on level five and level six projects.

Specifically, a tutorial was created using the Hyperstudio program. This program was chosen over other popular multimedia programs such as Microsoft PowerPoint due to its greater capacity for interactivity and non-linear navigation. With Hyperstudio, a student is able to go directly to the tutorial for a specific project without having to go through all of the previous projects in a linear fashion.

The tutorial content consisted of the principles of basic woodworking and allowed each student to progress through the steps involved in making their required work.
projects. This tutorial covered the steps necessary to build the following projects:

**Level One (Select One)**
- Pinehurst Plant Bracket
- Tulip Napkin Holder

**Level Two (Select Two of Three)**
- Cat Bookends
- Standard Shelf
- Pull-Along Train

**Level Three (Select Two of Three)**
- Small Open Cabinet
- Salt Box
- Five Board Stool

**Level Four**
- Candlestick Holder

The researcher debated including the Level five project in the tutorial. Many of the assembly techniques, such as the installation of the hinges are appropriate subjects for a tutorial. The process of measuring, drawing and preparing a cut list, however, are difficult concepts to master from a tutorial. Accordingly, the decision was made to limit the tutorial to levels one-four, and develop a tutorial for the more advanced levels at a later time.
Features of the Tutorial

The tutorial was constructed so that a student could select the appropriate project and progress at his own speed. At any point, the student could review the lesson. The student could view the tutorial on all possible choices prior to selecting a project. Text, graphics and digital photography were designed to create clear, vivid images of the important steps along the way, as well as the finished project. Students that had completed projects were asked what steps were important in the process, and a storyboard was prepared for each project.

Students assisted the teacher in the taking of digital photographs of each step in the assembly process, by arranging lighting and preparing suitable demonstrations. The students were disappointed with the Probation policy that they could not be photographed in a manner that allows them to be identified, however they were cooperative and enthusiastic about preparing the tutorial’s demonstrations.

The decision was made not to include audio in the tutorial, relying on text, graphics, and digital images. The noise level in the shop is at such a level that an audio component of the tutorial would be difficult to hear. The inclusion of audio as well as video clips could
be introduced in the future, depending upon the success of this project.

The tutorial begins with a home page that directs the learner to buttons for levels one to four. By clicking on these buttons, the learner is presented with the options available at each level. When an option is selected, the learner begins a visual lesson with familiar navigational buttons that guide the learner through the process of completing each project. The student can go on to the next step, start the project over, or return to the home page with the touch of a button. Text size is large (24 to 36 pt.) and easy to understand.

The proposed Computer Assisted Instruction tutorial would be considered successful if the amount of time necessary for students to advance effectively through the initial four levels using CAI approximates the average time necessary to progress through the four levels without CAI. As stated previously, that outcome would allow more time for the teacher to support students completing level five and level six projects.

Specifically, the effectiveness of the project will be evaluated using the following method:

a. The project will be evaluated by calculating the number of days elapsed from the day a student
enters the class until completion of the fourth level using CAI techniques. In addition, for comparison an historic average will be calculated based on the time taken by students to complete this process during the six months prior to the introduction of CAI;

b. The population will consist of new students that enter the Los Pinos Woodshop during the 90 day period from January 1, 2000 to March 31, 2000 and stay long enough to complete their fourth level project. All of these students will use CAI techniques;

c. Only days of attendance in class will be recorded. Days for which the student is given school credit, but is not in class (testing, probation officer visits) will not be counted;

d. The average time it takes for the new students to complete levels one through four will be calculated and compared to the previously described historical average;

e. To evaluate the impact on the students, a questionnaire will be given to students in order to determine their comfort level with the tutorial (Appendix A);
f. The researcher will comment on the effectiveness of the curriculum based on his informal observations during the field testing.
CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The Tutorial (Appendix D) was installed during the year-end recess in December 1999. In this chapter, the author evaluates the effectiveness of the tutorial based upon:

a. A quantitative analysis of data comparing data collected after the implementation of the tutorial to data collected immediately prior to the implementation of the tutorial;

b. A qualitative analysis based upon a survey of student participants;

c. A qualitative analysis based upon the instructors' observations. The chapter will conclude with the author's recommendations for further research.

Quantitative Analysis

A sample of 147 wood shop students in the class during the period July 1, 1999 through December 31, 1999 was used in order to determine the historic average time for a beginning student to progress through project levels one through four (See Table 1). This average was obtained by counting the hours the student was in class from the day of arrival to the date the level four project was
signed off. This information was obtained by accessing the student’s Wood Shop Grade Sheet (Appendix B). Shop hours consist of time the student actually spent in class, and do not include time spent on school or probation department activities for which the student is generally given school credit.

Table 1.

Historical Data

<table>
<thead>
<tr>
<th>No. of hours in program</th>
<th>July-Dec 99 # of students</th>
<th>July-Dec 99 % of students completing level 4</th>
<th>July-Dec 99 Total hours completing level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>3</td>
<td>3.80</td>
<td>54</td>
</tr>
<tr>
<td>20</td>
<td>9</td>
<td>1.39</td>
<td>180</td>
</tr>
<tr>
<td>22</td>
<td>7</td>
<td>8.86</td>
<td>154</td>
</tr>
<tr>
<td>24</td>
<td>10</td>
<td>12.66</td>
<td>240</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>1.27</td>
<td>25</td>
</tr>
<tr>
<td>26</td>
<td>13</td>
<td>16.46</td>
<td>338</td>
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<td>28</td>
<td>6</td>
<td>7.59</td>
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<tr>
<td>30</td>
<td>9</td>
<td>11.39</td>
<td>270</td>
</tr>
<tr>
<td>31</td>
<td>1</td>
<td>1.27</td>
<td>31</td>
</tr>
<tr>
<td>32</td>
<td>7</td>
<td>8.86</td>
<td>224</td>
</tr>
</tbody>
</table>
Of the 147 students, 79 or 53.7% completed the level four project. The average time for these students was 27.34 classroom hours to complete the level four project. The computer tutorial was installed prior to January, 2000 and the students entering after that time were tracked. The elapsed time for this group to complete level four was recorded in the same manner.

Although a 60-day sample was originally planned, a 90-day sample was obtained in order to have a larger sample. Of 101 students that entered wood shop after January 1, 2000, 31 or 31% completed level four by March 31, 2000. The January through March students averaged 27.13 hours to accomplish this. Data from January 1, 2000 to March 31, 2000 for students that used the tutorial to complete project levels one-four is displayed in table 2.

The difference in the completion rate between the July-December average at 54% and the somewhat lower January-March average at 31% is due to several factors. The first factor is seasonal, there are more early
releases during the year-end holiday season than at any other time of the year. As a result, there were more first time students in the class in January than at any other time of the year. Many of these first-time students are unable to adjust to the relative freedom offered at Los Pinos as compared to Juvenile Hall.

Table 2.

<table>
<thead>
<tr>
<th>No. of hours in program</th>
<th>Jan-March 00</th>
<th>Jan-March 00</th>
<th>Jan-March 00</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students Completing</td>
<td>% of students Completing</td>
<td>level 4 completing</td>
<td>Total hours</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>18</td>
<td>4</td>
<td>12.90</td>
<td>72</td>
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<td>2</td>
<td>6.45</td>
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<td>24</td>
<td>1</td>
<td>3.23</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>3.23</td>
<td>25</td>
</tr>
<tr>
<td>26</td>
<td>6</td>
<td>19.35</td>
<td>156</td>
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<td>28</td>
<td>5</td>
<td>16.13</td>
<td>140</td>
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<tr>
<td>30</td>
<td>4</td>
<td>12.90</td>
<td>1220</td>
</tr>
<tr>
<td>32</td>
<td>4</td>
<td>12.90</td>
<td>128</td>
</tr>
<tr>
<td>34</td>
<td>4</td>
<td>12.90</td>
<td>136</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>368</strong></td>
<td><strong>31</strong></td>
<td><strong>841</strong></td>
</tr>
</tbody>
</table>
Often, these new students frequently act out and consequently are removed. A second factor contributing to the lower rate is those students that began their work in November and completed their work in January were counted in the July-December sample, while only those completing their level four project by March 31, 2000 were counted.

Qualitative Analysis-Students

A survey of 39 students that had used the tutorial produced the following responses (Appendix A).

1. Is it easy to understand how to assemble wood shop projects using the computer tutorial?

   Answer      #   %
   Yes         35  89.7%
   No          3   7.7%
   Sometimes   1   2.6% (hand written response)

2. Is the tutorial clear about what you are supposed to do and how you are supposed to do it?

   Answer      #   %
   Yes         36  92.3%
   No          3   7.7%
3. Do you need further assistance from the instructor after viewing the tutorial?

<table>
<thead>
<tr>
<th>Answer</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>2</td>
<td>5.1%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>37</td>
<td>94.9%</td>
</tr>
<tr>
<td>Always</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

4. If you had a choice, which type of instruction would you prefer?

<table>
<thead>
<tr>
<th>Answer</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Instruction</td>
<td>22</td>
<td>59.0%</td>
</tr>
<tr>
<td>Tutorial</td>
<td>16</td>
<td>41.0%</td>
</tr>
</tbody>
</table>

The results of questions one to three of this survey were understandable. The students seemed at ease with the tutorial yet still had questions for the instructor. One immediate result noticed by the instructor/researcher was an improvement in the quality of the students' questions. After viewing the tutorial, the students asked specific questions such as, "Where do I place the clamps?" rather than "What do I do next?"

The response to question four was unanticipated and seemed to indicate a dissatisfaction with the tutorial. The researcher interviewed several students and they all said that while they would prefer to be taught one-on-one
by the instructor, the tutorial was superior to written plans.

Qualitative Analysis-Instructor

The tutorial almost immediately provided the teacher with the intended result of providing additional time for the more advanced students. The students were very comfortable with this form of instruction and most were very positive about utilizing the training resource. (The exception was those students that started under the old system and changed over to the new one).

The teacher made two observations regarding the effectiveness and quality of the tutorial:

1. The students' baseline computer skills were higher than originally anticipated. Not one student had trouble understanding how to use the equipment, or how to navigate back and forth within the tutorial;

2. No detrimental effect on the quality of student's work was found with the tutorial. There are steps in each project where the student must obtain approval in order to go on to the next step. The projects were inspected at these steps and the quality of the work appeared
to be as good as it was prior to implementing the tutorial.

From the beginning of this project, it was assumed that the tutorial would be successful if the time required approximates the historical average. This was the result. In fact, the difference in the average time required to complete level four of .21 hour (twelve minutes) is insignificant. Accordingly, based on the time factor alone the tutorial accomplished its purpose.

The tutorial was designed and implemented for purposes other than speed of delivery. In the responses to the evaluation questions, students found the tutorial easy to understand and use. A high percentage of students (94.9%) reported that they needed further assistance after viewing the tutorial. This is understandable, as the tutorial was never intended to replace the teacher. Additionally, there are many operations (especially on the lathe) that require personal attention, even with an adequate tutorial. Although students favored direct instruction, a full 41% preferred the tutorial. This response may be more indicative of the student’s need for supportive human contact rather than of their comfort with the tutorial.
The tutorial enabled students to progress through Bloom's first three levels of development, knowledge, comprehension, and application. While the instructor still had to spend time with each student on each project, the tutorial did provide additional time for assisting students with more advanced projects where the cognitive skills of analysis, synthesis and evaluation are emphasized.

Recommendations For Further Research

1. This tutorial was effective because of the use of digital photography to provide images of the procedures. While the tutorial was successful in meeting the objectives set forth in this paper as well as successful in the subjective judgment of the author, there is room to improve the product. In my opinion, the inclusion of video clips would enhance the effectiveness of this tutorial. Sound could also be added, however it would have to be delivered via headsets due to the noise level in the woodshop. Los Pinos's population's primary source of information is via video, and the HyperStudio program that was used to create the tutorial can accommodate QuickTime video clips.
2. This paper confirms earlier research that CAI easily addresses the lower level cognitive skills of Bloom’s taxonomy. The author would like to test the hypothesis that additional teacher contact with those students working on projects of their own design improves the higher level skills according to Bloom of analysis, synthesis and evaluation.

3. Like any correctional educator, the author wishes that the students in this class obtain the skills and self confidence necessary to succeed in the world outside the institution. While there are not many woodworking careers in our school’s area, the principles learned in completing the student-designed project apply to many types of occupations, from construction to automobile design. An excellent subject for further exploration would be to compare students that complete 60 hours of wood shop against a control group one year after release to determine how well they adjust to the world of work.
Los Pinos High School
WOOD SHOP

Student Tutorial Evaluation

1. Does the tutorial help you understand how to assemble wood shop projects?
   _____ Yes
   _____ No

2. Is the tutorial clear about what you are supposed to do and how you are supposed to do it?
   _____ Yes
   _____ No

3. Do you need further assistance from the instructor after viewing the tutorial?
   _____ Never
   _____ Sometimes
   _____ Always

4. If you had a choice, which type of instruction would you prefer?
   _____ Written plans and instructions
   _____ Direct instruction (The teacher tells you how to do it)
   _____ Computer tutorial with instructor follow-up
Los Pinos High School
Wood Shop Grade Sheet

Student ___________________________ Date entered ________________
Previous LPHS Woodshop? __________ Date left ____________________
Safety Test Score: First Attempt ______ Date ___-___-01
2nd Attempt __________ Date ___-___-01
3rd Attempt __________ Date ___-___-01

Power Saw Orientation Date ___-___-00

<table>
<thead>
<tr>
<th>Level</th>
<th>Project</th>
<th>Date Completed</th>
<th>Grade</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Pinehurst Plant Bracket</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Tulip Napkin Holder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Standard Shelf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Napkin Holder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Pull-Along Train</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Oceanic Princess</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Adjustable Bookends-Cat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Salt Box W/ Lid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Five Board Stool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Small Open Cabinet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Candle Holder</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Student Designed Projects: Must have approved plan before starting.

<table>
<thead>
<tr>
<th>Date Completed</th>
<th>Description</th>
<th>Grade (Plan)</th>
<th>Grade (Project)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7” x12” Box With Doors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C

STUDENT DESIGNED PROJECT
Los Pinos High School
Student Designed Wood Shop Project
Name of Project

Name: ____________________
Date: ____________________
Approval: ____________________

Draw two (2) views to scale of your project in the space below. One square = one inch.

<table>
<thead>
<tr>
<th>Cut List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>_________</td>
</tr>
<tr>
<td>_________</td>
</tr>
<tr>
<td>_________</td>
</tr>
<tr>
<td>_________</td>
</tr>
</tbody>
</table>

What did you learn while completing this project? ____________________
What would you like to have done better? ____________________
APPENDIX D

COMPUTER ASSISTED INSTRUCTION
Tulip Napkin Holder:
Tools Required:
Hand Drill,
Coping Saw,
Sandpaper and Block,
Hammer,
Small Nails,
Carpenter's Glue,
Clear Finish

Trace the outline on the good side of a piece of 1/4" birch plywood.
(Ask Instructor for a pre-cut piece)
Place a 2"X4" piece of lumber in a wood vise making sure that the top edge is above the level of the bench. Clamp your wood with the pattern to the top as shown. Saw out the outsides using a coping saw.

Drill a hole in each of the inside spaces in the pattern using a hand drill.
Place the blade of the coping saw through the hole you have drilled making sure that the teeth are pointing towards the handle. The pattern should be on the side towards the top of the saw.

Clamp the piece so that the part you are working on is firmly clamped. The closer the saw is to the clamp, the better.
Obtain a small sheet of sandpaper from the instructor. Find a small piece of scrap wood for a sanding block.

After sanding the outside of the napkin holder, fold the sandpaper into thirds and sand the inside spaces.
After sanding the outside of the napkin holder, fold the sandpaper into thirds and sand the inside spaces.

Sand the outside of the napkin holder, using a small piece of wood for a sanding block.
After sanding the outside of the napkin holder, fold the sandpaper into thirds and sand the inside spaces.

Obtain a bottom piece (base) from the instructor. Place the base in the wood vise so that the long side is up.
Apply glue to the base piece.

Center the side on the base and hammer in three small nails, making sure that the bottom of the side is lined up with the base.
Once you have nailed the one side to the base, lay the attached side down on the workbench, apply glue and attach the other side in the same fashion.
Brush your project off to remove dust.
Apply a thin coat of finish and allow to dry.
For best results, let your project dry overnight, resand and apply a second coat.
Pinehurst plant bracket:
Toole Required:
Hand Drill,
Coping Saw,
Sandpaper and Block,
Hammer,
Small Nails,
Carpenter's Glue,
Clear Finish

Trace the outline on the good side of a piece of 1/4" birch plywood.
(Ask Instructor for a pre-cut piece of plywood)
Place a 2"X4" piece of lumber in a wood vise making sure that the top edge is above the level of the bench. Clamp your wood with the pattern to the top as shown. Saw out the outside using a coping saw.

Drill a hole in each of the inside spaces in the pattern using a hand drill. Make sure you drill a hole in the top of the large piece as shown above.
Place the blade of the coping saw through the hole you have drilled making sure that the teeth are pointing towards the handle. The pattern should be on the side towards the top of the saw.

Carefully cut out the inside of each part of the back piece. Make sure that the blade is straight and the teeth are pointing downward. Notice in the picture how the wood is clamped so that the work is near the clamp.
Obtain a small sheet of sandpaper from the instructor. Find a small piece of scrap wood for a sanding block. Sand the edges of all your pieces smooth.

Turn the back piece over. Mark a straight horizontal line across the widest part.
Hammer three small nails into the back piece along the line. The nails should barely go through the wood.

Place the shelf piece in a wood vise with the good side facing away from you and the straight side up. Apply glue to the straight edge.
Align the nails so that they are ready to be hammered into the shelf piece.

Complete the assembly by gluing and nailing the support, using the small nails.
Apply a coat of finish to the assembled product.

Enjoy your plant bracket!
Cat Book Ends

Tools needed:
Scroll Saw
Drum Sander
Take the 7 1/4" wood and cut off a 7" piece.

Lay out template on the board and trace two cats. (Grain should run from top to bottom)
Cut out the cats with the Scroll Saw

Smooth out the inside curves of the cat's ear with the drum sander.
Sand the outside curves of the cat's head and body, using the 1" belt sander. Make sure the wood is flat against the table while sanding.

Drill holes for the eyes and the dowels with a drill press using a 3/4" bit.

It helps to clamp both cat pieces to a piece of scrap wood.
Sand both pieces with a palm sander.

Cut two 12" pieces of 3/4" dowel on the band saw.
Do not apply finish to the dowel bodies. Lightly sand and apply a thin coat of filler to the car at a 45 degree angle. Next, chamfer the edges. Sand it flat. Sandor dowel on the 1” Belt. Place the end of the...
Enjoy your cat bookends!
Saw out the brackets using the same saw. Make sure the blade is tight. Ask the instructor to show you how to adjust the blade.
Shred one piece of the cut-out at a time, place the tracked sheet on the belt sander.

Return to Home

Start Standard Shelf Over

Return to Home

Start Standard Shelf Over

Return to Home

Start Standard Shelf Over
Sand all parts with the palm sander and use to get the edges well blended to remove any grooves or high spots.

Return to Home  Start Standard Shelf Over

Holes are already predrilled in the supports. They should be 2 1/2 inches from the shelf and centered exactly.

Return to Home  Start Standard Shelf Over
Place one bracket in a
vertical line with the current
brackets on either side.
Make sure the support
stays firmly aligned.

Next

Return to Home
Start Standard Shelf Over

Apply glue to the support and wipe
off any glue on the back of the header.
Place the support in the hole above
the top of the header.

Next

Return to Home
Start Standard Shelf Over
Before you continue the second half, use a dry stick to make sure the objects are level with the supports.

Place the supports to a position at the top of the support, to move the level of the supports. Place glue along the bottom of supports and support.
Nail three nails into the support, and set them with a nailset.
Fill the nail holes with wood filler.

Place each bracket into the vise. Nail one nail into each bracket, and set them with a nailset. Fill the holes with wood filler.
When wood filler and glue are dry, lightly sand and apply a thin coat of Deft. Let dry overnight. Rub lightly with steel wool and apply a second coat.

Enjoy your Standard Shelf!
Using scrap wood, trace the five train cars from the patterns. The grain in the wood should run from front to back, not top to bottom.

Cut out the train cars with the scroll saw.
Sand the train car edges using the 1" belt sander. Keep the wood flat against the table.

Cut eleven (11) 2 3/8" axles from the 1/4" dowel stock.
Place the red hole saw in the drill press and tighten the chuck with the chuck key.
Cut two large 6 3/4" holes.

Cut 20 small wheels with the 1 3/8" white hole saw in the same fashion.
Drill 5/16" holes in the train cars according to the pattern.

Place a small amount of glue on the end of each dowel, and with a soft hammer (yellow plastic) tap the dowel through one large and ten small wheels.
When the glue is dry, use the 1" belt sander to sand the wheels. Use a tapered piece of dowel to hold the wheels without axles.

Start the sides of the wheels flat.
Small open cabinet
Tools needed:
Cut-off Saw
Table Saw
Roundover Router
Rabbeting Router
Palm sander
Wooden Clamps
Hammer
Nails
Nailset
Glue
Try Square

Return to Home

Start Small Open Cabinet Over
Cut three pieces out of 7 1/4" stock:
1 piece 13 1/2" long,
1 piece 6 1/2" long,
1 piece 6" long.

Set the rip fence at 3" and rip the 13 1/2" piece into the two side rails.
Set the rip fence at 3 1/2" and rip the 8 1/2" piece into the top and bottom pieces. You must rip both pieces.

Set the rip fence at 2 1/2" and rip the 6" piece into the two shelves. Give the extra piece to the instructor.
Round over the two short ends and then one side of the top and bottom pieces.
(8 1/2" X 3 1/2")

Round over the long sides of the side rails and the shelves.
(13 1/2" X 3") and (6" X 2 1/2")
With the rabbeting router, cut a rabbet into the inside edge of each rail and the top and bottom. Do not do the shelves!

If you were wondering what a rabbet is, it's a square groove such as pictured above.
Sand all pieces with the palm sander.

Be sure you sand the edges well to remove any marks from the router.

Place the two shelves between the side rails and clamp as shown above. Make sure that the rails are flat against the ends of the shelves.
With the rails clamped against the shelves, stand the rails on end as shown. Apply glue to the ends of the rails.

Align the top piece with the back of the rails. Center the top piece and hammer two nails into each rail. Do not hammer the nails completely down, leave them just above the surface of the wood.
With a nail set, sink the nails below the level of the top piece.

Turn the assembly over and apply glue to the bottom. Repeat the same process you used to attach the top piece.
Fill all nail holes with wood filler using a putty knife.

Measure 4" from the inside edge and make a mark on the side rail.
Place the assembly on the corner of a workbench so that the rail is well supported. Align the shelf piece with the marks, and hammer one nail through the rail into the shelf piece. The shelf piece should meet with the inside of the rabbet.

Turn the assembly over and align the other side of the shelf with the mark on the rail. Hammer in one nail. Use a try square as shown to make sure that the shelf is "square" and put a second nail in each side of the shelf.
Install the second shelf in the same manner.

Measure the length and width of the inside rabbets. Cut a piece of 1/8" plywood to fit.
Place the back on the cabinet. Nail into the shelves using the small nails.

Enjoy your Small Open Cabinet!
Five board stool

Tools required:
- Cut-off saw,
- Scroll saw,
- Drum sander,
- 1" belt sander,
- Palm sander,
- Roundover router,
- Hammer,

Start Five Board Stool Over
Cut a 12" piece and two 7" pieces from 7 1/4" stock. Obtain two pre-cut rails from the instructor.

Trace the outline of the legs onto the 7" pieces making sure the grain of the wood goes from top to bottom.
Trace the outline on to the rails using the pattern.

Cut out the legs and the rails on the scroll saw.
With the drum sander, smooth out the inside curves of the legs.

And the round part at the bottom of the legs.
With the drum sander, smooth out the inside curves of the legs.

And the round part at the bottom of the leg.

And the ends of the rails.

With the 1" belt sander, smooth out the outside curves of the legs.
Roundover all four sides of the top piece, top and bottom.

Wear eye protection and be sure your hands are away from the bit.

Do the short sides first.

Turn the leg upside down and mark a line at the level of the rails.
Turn the legs upside down and mark a line at the level of the rails.

Roundover the legs from the line to the bottom of the foot.

Router the curved area between the legs.
Sand all surfaces with a palm sander.

Hammer two nails in each end of the rails as shown. The nails should just barely go through the rails.
Place the legs in a wood vise and apply a small amount of glue on the flat part.

Align the rail with the top of the leg and hammer in one nail.

Place the other leg in the wood vise and attach the other leg in the same fashion.
Turn the assembly over and attach the other rail.

Place the assembly on the workbench. Apply glue to the top of the rails and the top of the legs. Center the top and nail into the rails and the legs.
Apply a coat of finish to the stool.

Enjoy your five-board stool!
Cut 7 1/4" wood into four pieces:
2 pieces 7 3/4" long
1 piece 4 3/4" long
1 piece 4 1/2" long
Take one of the 7 3/4" long pieces and rip (cut with the grain) it into two pieces 3 1/2" wide. This isn't exactly half, so you must run both pieces through the saw.

Cut one of the 3 1/2"
pieces off at 6 3/4"
Cut the other 3 1/2" piece into two pieces each 3 3/4" long.

Trace the pattern onto the 7 3/4" piece.
Cut the pattern out on the scroll saw and sand it. The lid is the larger of the two remaining 7 1/4" pieces.

Carefully router the top on the ogee router. Then router three sides of the top piece on the ogee router.
Your two pieces should look like this when you're finished.

Sand all of your pieces.
Place the two side pieces in Wood clamps as shown. Make sure the grain of the wood goes up and down.

Apply glue to the ends of the two side pieces. Align front piece and nail into the sides.
Take the assembly out of the clamps and lay it down on its side. Apply glue and nail bottom to assembly.

Nail the back to the assembly. With a nailset, sink all exposed nails.
Apply wood filler to nail holes. When wood filler dries, sand with a palm sander.

Measure the inside of the salt box. Cut a piece of 1/8" plywood to fit.
Turn the top over and center it on the box. Mark the position of the insert. Nail and glue the 1/8" plywood insert in place.

Apply a coat of finish to your salt box.
Enjoy your Salt Box!
To find the center of the candlestick base, draw a line from corner to corner on the 5 1/2" block. The point where the two lines meet is the center.

Place the circular pattern so that the crossed lines are visible in the hole in the center of the pattern. Trace around the pattern.
Wear eye protection. Cut the circle out on the band saw.

Place the face plate on the circle that you have just cut out so that the crossed lines are visible in the hole in the center. Use a nail set to create pilot holes.
Screw the face plate to the candlestick base.

Thread the assembly onto the lathe. Ask the instructor to demonstrate how to adjust the tool rest. Rotate by hand.
With a round faced chisel placed firmly on the tool rest, make the candlestick base smooth.

Make marks on the rotating wood with a pencil as indicated.
Begin removing stock from the candlestick base. Compare your work to the diagram on the lathe. Stop often to readjust the tool rest.

Remove the tool rest and finish with sandpaper. Apply the sandpaper to the bottom of the turning piece so that the dust goes away from you.
Use a nail to make a hole in the center of the candlestick shaft.

Place the chuck on the end of the piece of wood so that each blade is on one of the lines.
Hammer the chuck into the wood.

Place an "X" on the wood below the round mark on the chuck.
Insert the tapered end of the chuck into the machine as shown.

Tighten the right side of the lathe into the other end of the wood. The lathe should attach where the two lines cross.
Adjust the tool bar so that the wood rotates freely. Carefully use the half round chisel to make the stock round.

Once the stock is round with no flat spots, use a pencil to mark the places where you will need to remove wood. Use the example on the lathe to guide you.
Use a flat chisel to shape the candlestick shaft.

Remove the tool rest. Sand the candlestick by placing the sandpaper on the bottom of the wood.
Use a 3/4" forschner bit to drill the candle hole in the candlestick shaft.

Use a 1/2" bit with a collar to drill a hole in the candlestick base.
Only drill to the depth of the collar.

Drill the hole completely through with a 3/16" drill.
Ask the teacher for a 1 1/8" screw. Place a small amount of glue on the top of the base. Place the screw through the hole in the base and tighten.

Apply a coat of finish to your Candlestick.
Enjoy your Candlestick!
REFERENCES


Reginer, T. (1996). Technology may make us lose our value of one another: as we shift from atoms to bits we are losing our understanding of the physical world. Minneapolis Star tribune 01-15-96.


