

**EVALUATION OF WEB-BASED SAFETY TRAINING AGAINST
INSTRUCTOR-LED CLASSROOM TRAINING METHOD**

A Thesis

by

SAI SRINIVAS M. TELEKEPALLI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2004

Major Subject: Construction Management

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ABSTRACT

Evaluation of Web-Based Safety Training against the Instructor-Led Classroom Training
Method. (December 2004)

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The development of the Internet and the technological advancements in multimedia are some of the breakthroughs the 21st century has witnessed. Innovative ways are being sought for the application of technologies such as the Internet and multimedia, for the development of effective learning methods. The potential for using the Internet in combination with multimedia for teaching and learning is great; we are only beginning to understand and use the advantages it can offer. Web-Based safety training is an innovative self-paced learning aid which provides distinctive advantages over the traditional, instructor-led classroom training.

This study provides an in-depth evaluation of Web-based safety training against instructor-led classroom training. The Web-based safety training uses multimedia such as power point slides with text, images and video clips. This study is designed as an experiment to determine the relative improvement in knowledge of woodshop safety when Web-based safety training is used against instructor-led classroom training. An opinion survey is conducted to determine participant's attitude towards the training methods.

This thesis is dedicated to my family, whose
love, compassion and support
made it possible for me to achieve this goal.

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It is with great appreciation that I acknowledge the contribution of committee members, family, and friends in assisting me to achieve this goal. Without their help and support I could not have accomplished the task.

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1. INTRODUCTION

Safety management is one of the most important aspects of building construction management. Safety management aims to bring the building construction site and personnel in compliance to the Occupational safety and health administration (OSHA) rules and regulations. OSHA requires the contractors in USA to follow the safety and health regulations for construction in accordance to 1926 29 CFR federal code of regulations and 1910 29 CFR for general industry. The safety and health regulations are enforced to ensure safety on the construction site or workshop. Learning safety is the first step towards becoming safety conscious. In order that the principles of construction safety are thoroughly learned, appropriate teaching tools and techniques must be used. New ways are being sort to incorporate the emerging technologies into education (McFarland 1996). These new learning methods must be explored and investigated to find out if they are more effective than the conventional ones.

The importance of safety in the workplace cannot be stressed enough, whether it is a large construction site or a small woodshop. Any negligence towards the safety in a construction site or workshop can result in serious injury or death. Each and everyone involved in the construction site or workshop must be safety conscious. Safety is pivotal to all the members who are involved directly or indirectly in the construction or general industry. Fatal injuries or death on a construction site or workshop can have devastating effect on the project, besides the pain incurred to the victim and his family. This research explores the impact of Web-based multimedia as one of the innovative safety training

This thesis follows the style of *Journal of Computing in Civil Engineering*.

methods, on learning. The principles of safety and their application in the work site are more practical rather than theoretical in nature. Hence, understanding of safety requires practical and interactive learning environment. Web-based multimedia is an interactive learning aid, which may be used for effective and efficient safety training. This study aims to prove that Web-based safety training is an effective tool for teaching safety as compared to the traditional, instructor-led classroom training.

1.1 Purpose of Study

The purpose of the study is to assess the effectiveness of Web-based multimedia as a learning aid for the students of construction management (Department of Construction Science, Texas A&M University) against the traditional, classroom-based instruction during the fall semester of 2004, in understanding the basics of woodshop safety.

1.2 Objectives and Scope of the Research

The primary objective of this research is to evaluate the effectiveness of Web-based safety training against the traditional, classroom-based training in learning safety.

Following are the key research objectives:

1. To develop a Web-based, woodshop safety training program for the students/faculty of College of Architecture (Texas A&M University or TAMU).
2. To test the knowledge of woodshop safety of the test subjects before and after a learning aid is used (Web-based or Classroom-Based Training).

3. To analyze the above test results to conclude if knowledge of woodshop safety is significantly increased when Web-based multimedia learning aids are used in comparison to classroom-based instruction.
4. To contribute towards the development of effective training methods for learning safety and as a consequence reduce the fatalities or injuries in the worksite which usually occur because of the lack of knowledge of safety.

1.3 Significance of the Research

The Web-based safety training program developed for the purpose of experimentation in this study will be used in the safety training of students/faculty of College of Architecture, TAMU who wish to use the woodshop (Langford Bldg B, Texas A&M University) for their projects. Knowledge of safety is pivotal in avoiding accidents in the construction site or the workshop. When effective learning methods are used the knowledge of the learner will be significantly improved. The results of this research will contribute to the development and wide spread usage of innovative safety training programs. Since Web-based safety training is a cost effective and flexible medium of training, the companies in the construction industry by using Web-based safety training programs as compared to the instructor-led safety training programs, can save a lot of money.

2. REVIEW OF LITERATURE

2.1 Introduction

Innovations are being sought for teaching and learning in the 21st century classrooms. The 21st century has seen development of some great breakthroughs in technology. New ways are being sought to incorporate the emerging technologies in teaching (McFarland 1996). According to McFarland these emerging technologies are the various forms of multimedia. Oxford dictionary defines multimedia as; information presented in more than one format, such as text, audio, video, graphics, and images. Inventions such as the computers, World Wide Web and film making have greatly contributed to the cause of multimedia based learning. Multimedia has revolutionized the way information is presented to achieve maximum amount of learning and retention among students.

“Multimedia resources are increasingly embraced in elementary and secondary education. In that sector both the range of products and applications for the technology is expanding rapidly. By contrast, higher education has not demonstrated equal enthusiasm for multimedia, but this does not necessarily mean that multimedia has little to offer” (McFarland 1996). New ways are being sort to incorporate the emerging technologies into higher education. One such technology is Web-based multimedia. It’s a well known fact that a picture or visual can convey so much more effectively than written text in a short span of time. This advantage along with the interactive nature of Internet makes Web-based multimedia an ideal tool for educational purposes. Reynolds and Anderson

(1992) describe the relevance of multimedia to the three objectives of learning as following:

- “Cognitive objectives: Used to teach recognition or discrimination of applicable visual stimuli and audio stimuli.
- Psychomotor objectives: An excellent tool to recreate real world conditions.
- Affective objectives: Interactive multimedia is very useful in the affective domain. The strength of detailed portrayal of situations and interactive participation of the learner increases its usefulness for affective domain objectives.”

According to Columbia University of Art and Science there are four most widely recognized categories of learners, visual learners, auditory learners, tactile learners, and kinesthetic learners. Students usually employ two or more ways of learning. Web-based multimedia aims bring in more of visual and auditory learning into the safety training programs there by catering to both the visual and auditory learners.

2.2 Safety and Safety Training

According to Occupational Safety and Health Regulations for Construction, 29 CFR 1926 Sub Part C – Safety Training and Education, the employer is required to provide safety training to his employees. 1926.21(b) (2) states:

The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to

control or eliminate any hazards or other exposure to illness or injury (OSHA 2001).

The machines used in woodshop can prove to be dangerous to the workers if they are not properly trained in using the tools and machinery safely. “Workers operating the woodworking equipment suffer the following common injuries: laceration, amputation, severed fingers, and blindness. Wood dust and the chemicals used for finishing products are health hazards to wood workers and may cause skin and respiratory diseases” (OSHA 1999). Hence, it is very important that the workers are trained in the correct and safe use of woodworking machinery. Woodshop safety training can be divided into two parts namely, Initial Training and Hands-on Training. Following are the definitions for Initial Training and Hands-on Training according to OSHA 29 CFR 1910.120 Appendix E – Training Curriculum Guidelines:

- Initial Training: Training required prior to beginning work.
- Hands-on Training: Training in a simulated work environment that permits each student to have experience performing tasks, making decisions, or using equipment appropriate to the job assignment for which the training is being conducted (OSHA 2001).

Students can learn “Hands-on Training” only by working with woodshop machinery under the supervision of a trained instructor. Typically Initial Woodshop safety training is taught by lecture. “A lecture is an interactive discourse with a class lead by an instructor; it is typically an oral presentation with little or no use of multimedia. A lecture sometimes might include a demonstration. A demonstration

involves the showing by actual use of equipment or procedures” (OSHA 2001). Students can best learn safety by site visits or demonstrations, but the conventional learning methods (classroom-based training) cannot replace the benefits to be gained by the site visits. “This is because the site visits may not be possible due to the constraints of cost, safety, availability of and access to a variety of suitable construction sites and time” (Bouchlaghem et al. 1999). There is a need for the development of innovative safety training methods which are more efficient and effective learning tools as compared to the training by lecture, especially in cases when the lecture cannot be supplemented by demonstrations. One of the ways effective safety training can be conducted is by using Web-based multimedia, which can mitigate the problem of availability of live demonstrations with the help of online video clips.

2.3 Theory of Learning

The understanding of the learning process is very important in designing and developing a training program. Learning may be defined as: “a relatively permanent change in behavior or in behavioral potentiality that results from experience and cannot be attributed to temporary body states such as those induced by illness, fatigue, or drugs” (Hergenhahn and Olson 2001). According to Merriam and Caffarella (1991) behaviorist, cognitive, humanist, social and constructivist learning are the five basic orientations towards the learning theories. Of the above five orientations towards learning theory Mayer (2001) believes the behaviorist and cognitive approaches, in the context of

multimedia learning are most important. The behaviorist and the cognitive orientations towards active learning are discussed briefly in the following:

- 1. Behaviorist Orientation:** Behaviorist orientation to learning was developed in the early decades of the twentieth century by John B. Watson (Ormrod 1995). The behaviorist approach to learning theory can be summed up by the following three assumptions: “Observable behavior rather than internal thought processes are the focus of study. In particular, learning is manifested by a change in behavior. The environment shapes one's behavior; what one learns is determined by the elements in the environment, not by the individual learner. The principles of contiguity (how close in time two events must be for a bond to be formed) and reinforcement (any means of increasing the likelihood that an event will be repeated) are central to explaining the learning process.” (Merriam and Caffarella 1991). Typically training/teaching methods which allow the students to interactively participate in the learning process by means of hands-on exercises confirm to the behaviorist approach to learning.
- 2. Cognitive Orientation:** Cognition according to the Oxford dictionary is defined as: The process by which knowledge and understanding is developed in the mind. The Gestalts orientation to the theory of learning gained popularity in the mid-twentieth century (Ormrod, 1995). “Gestalt (a German word meaning “pattern or shape”) psychologists proposes looking for at the whole rather than its parts, at patterns rather than isolated events” (Merriam and Caffarella 1991). Cognitivist’s or Gestalts are of the opinion that, “The human mind is simply not a passive

exchange-terminal system where the stimuli arrive and the appropriate response leaves. Rather, the thinking person interprets sensations and gives meaning to the events that impinge upon his consciousness” (Grippin and Peters 1984). Finally the cognitive orientation to learning can be summed up in Hergenhahn and Olson’s (2001) words as,

Learning to a Gestaltist, is a cognitive phenomenon. The organism ‘come to see’ the solution after pondering the problem. The learner thinks about all the ingredients necessary to solve a problem and puts them together (cognitively) first one way then another until the problem is solved. When the solution comes, it comes suddenly, that is, the organism gains insight into the solution of a problem. The problem can exist only in two states: 1) unsolved and 2) solved; there is no state of partial solution in between.

2.4 Safety Training and Theory of Learning

Developing safety training methods using multimedia, according to the learning theory would ensure that the students would understand and hence, learn the theories and principles of woodshop safety thoroughly. The two primary aspects of learning with multimedia according to Mayer (2001) are remembering (Ability to reproduce or recognize presented material) and understanding (Ability to use presented material in novel situations). Further, he is of the opinion that active learning or meaningful learning depends on learner’s cognitive activity in the mind rather than the physical or behavioral activity. In Caldeira’s (2001) research the subjects preferred the non-linear and

interactive nature of presentation of information in the Web-based interface against the linear less dynamic systems by the participants. He also believes that, “information interactivity must be kept in minimal levels in order to not interfere with the learning tasks”. In short the studies of Mayer (2001) and Caldeiro (2001) seem to indicate that effective learning is accomplished by less interactive yet efficient learning interface. Hence it can be concluded that cognitive theory to learning rather than the behavioral theory to learning would be better suited in using to develop the safety training program with Web-based multimedia.

2.5 A Cognitive Theory of Multimedia Learning

“A cognitive theory of multimedia learning assumes that the human information processing system includes dual channels for visual/pictorial and auditory/verbal processing, that each channel has limited capacity for processing, and that active learning entails carrying out a coordinated set of cognitive processes during learning” (Mayer, 2001). The goal of multimedia as a learning aid is to accomplish active learning. Here active learning refers to cognitive process going on in the mind of the student during the safety training, so that maximum understanding or knowledge of woodshop safety is achieved. According to Mayer (1996) three essential cognitive processes involved in active learning are, selecting relevant material, organizing selected material, and integrating selected material with existing knowledge.

Mayer's cognitive theory of multimedia learning is illustrated in Figure 1.

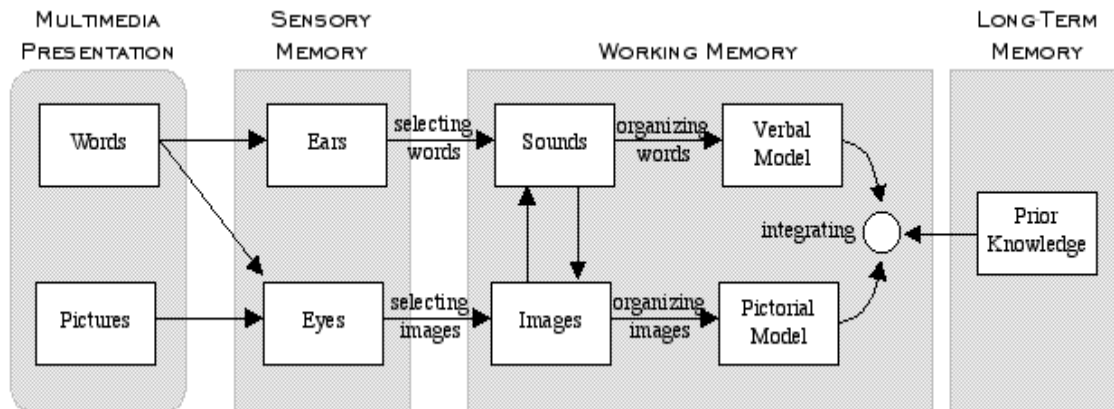


Figure 1. Cognitive Theory of Multimedia Learning

2.6 Effectiveness of Multimedia Learning

Several studies have been conducted to assess the effectiveness of multimedia as a learning aid against the traditional methods of teaching. In the following some of the relevant studies have been discussed in brief to establish that multimedia provides a significant advantage in learning and retention as opposed to teaching methods which do not use multimedia.

Issa et al (1999) in their study, measured the effects of multimedia-based safety education against the traditional, instructor led-classroom learning. The test subjects used were high-school vocational and college construction safety class students. The multimedia used was CD-ROM. According to Issa et al (1999), "...multimedia-based, self-paced learning offers very distinct advantages over traditional, instructor-led

classroom learning. Both-high school and college students exhibited superior retention rates when learning from multimedia-based materials.”

Beckham (1969) in his dissertation, compared self-paced instruction against traditional lecture-demonstration instruction using male undergraduate students. The multimedia used was video tape. The results of his study can be summed up as:

1. ...the self-paced program of instruction was significantly more effective than was the traditional method of teaching of safety in using machine tools in the wood laboratory.
2. ...safety practices in operating woodworking machines may adequately be taught by either method of instruction.
3. ...when self-paced materials were utilized, the instructor was freed for a significant length of time to devote more personal attention to individual students. (Beckham 1969).

Kassay (1970) in his dissertation, evaluated the self-instructional system in teaching students safe and efficient method of operating woodworking machinery. The multimedia used was loop film. According to Kassay (1970), “The findings support the feasibility of having learners teach themselves, through the use of total self-instructional system, how to safely and skillfully operate a potentially dangerous complex system.”.

Based on the above discussion it can be safely concluded that multimedia based self-instructional safety training method which is developed according to cognitive orientation towards learning theory would be much more effective than the traditional, instructor-led classroom training.

2.7 Web - Based Safety Training

One of the greatest inventions in the twenty first century is the development of the Internet. Information on the Internet can be accessed at any time and any place. Information can be presented innovatively and creatively by combining various forms of multimedia such as power point presentations and audio-visual movies on one platform. The above two advantages combined together make the Internet a very powerful education tool. According to Piaget, every student has a different level of functioning of cognitive structure. In order that every student attains intellectual growth, education must be individualized (Hergenhahn and Olson 2001). It is impossible for an instructor in a class of 25-30 students to individualize teaching for every student. Web-based safety training provides information in modules; students can design their own curriculum or individualize the training to fit to their requirements.

Web-based safety training is one of the innovative self-paced safety training methods that can offer distinctive advantages over the traditional instructor-led classroom safety training. “By providing immediate feedback, personal attention, exciting visual displays and gamelike atmosphere, CBI can motivate students to learn in ways traditional instruction may not. There is considerable evidence that students learn from CBI than from traditional instruction, and they do so in shorter period of time” (Herganhahn and Olson 2001). The advantages it can offer can be summed in the following:

1. Superior learning and retention.
2. Flexibility in the choice of time and place of training.

3. Self-paced instruction allows students to learn at their own pace.

2.8 Conclusion

Sufficient research has been done to conclusively prove that multimedia based self-instructional methods of learning are very powerful tools for learning safety. However research in proving, Web-based safety training to be an effective learning aid as opposed to the traditional, instructor-led classroom learning is still to be forthcoming. The potential for using the Internet in combination with multimedia for teaching and learning is great, the academic world is only beginning to understand and use the advantages it can offer. Thus, Web-based multimedia as an effective self-paced instructional method in learning safety needs to be explored.

3. RESEARCH METHOD

Extensive research has been conducted on the effects of multimedia on learning and retention in the past decade. The use of multimedia as a learning aid need not be confined only to the academic environment; it can be used for training in the construction industry. Safety training in the construction industry is one of the areas where multimedia can be used. Web-based safety training presents information innovatively and creatively by combining various forms of multimedia such as power point-presentations and audio-visual movies on one platform. Given the advantages of Internet and multimedia, the Web-based safety training is an excellent choice for use in the construction industry. This study investigates the effectiveness of Web-based multimedia for safety training and explores its viability for use in the construction industry. This section presents the research methodology and instruments, and a description of the statistical methods used to analyze the data.

3.1 Research Methodology and Instruments

A quasi experiment was used to measure the variables. Pre-test and post-test questionnaires were used to test the research hypotheses. The target population is the woodshop users and the study population is the students of construction management (Dept. of Construction Science, TAMU). The test subjects were not chosen at random, they are students of construction management enrolled in the fall semester of 2004 in the COSC 664 Construction Safety Management and COSC 464 Construction Safety classes (TAMU). A total of fifty students participated in the study. Both graduate and

undergraduate students participated in the study. All the graduate students were international students who had no prior experience in the industrial arts. First, the students were given a pre-test prior to the safety training. The students were then randomly allocated to a training program. The detailed composition of the both groups is shown in Table 1. Both the Web-Based safety training and instructor-led classroom training were conducted for approximately a period of forty five minutes. Post-test was administered immediately after the completion of the training. The students took approximately fifteen minutes of time to answer both the pre-test and post-test questionnaires. Finally all the students answered an opinion survey at the end of the experiment. No time limit was imposed on students in answering the questionnaires or on the duration of training program.

Table 1. Composition of the Test Groups

Test Groups	No. Grad Students	No. of Under Grad Students	Test Group Size
Web-Based Safety Training	8	15	23
Classroom Safety Training	7	20	27
Total	15	35	50

Both the pre-test and post-test consisted of thirty questions and these questions were spilt in two sections namely, Section I consisted of multiple choice questions and Section II consisted of true or false questions. See Appendix B for pre-test, post-test questions and answers. A pool of fifty five questions was created. From this pool of fifty

five questions twenty five questions were allocated randomly to pre-test and post-test. For each of the twenty five questions in the pre-test, there was one question in the post-test which pertained to the same topic but different from its counterpart in the pre-test, these questions will be referred to as unique questions here on in the following discussions. Five questions in the Section II are exactly same in both the pre-test and post-test, these questions will be referred to as non-unique questions here on in the following discussions. The order of appearance of the five similar questions in the both the pre-test and post-test was randomized. If the pre-test and post-test were to contain all same questions, then there is a possibility of introducing bias, because the students may look for only information which is useful for answering the questions asked in the pre-test and thus, bias. On the other hand if the all the questions asked in the pre-test and post-test are completely different, then the difference of the scores in the pre-test and post-test, Delta would not be a good measure of the improvement in knowledge of the students. In order that the test instrument accurately measure improvement in knowledge of the students accurately after the training and at the same time not introduce bias, the above mentioned procedure was adopted in devising the test instrument. Statistical tests were conducted to determine if the proportional mean difference between the non-unique questions and unique questions was significantly different or the same to determine the robustness of the test instrument, with no significant difference in the proportional means indicating robustness of the test instruments. The opinion survey consists of ten questions; the survey was taken by the students of both test groups. The survey questions were designed to measure the level of satisfaction among the students towards the

training methods. See Appendix C for the opinion survey. The students took approximately five minutes of time to complete the opinion survey.

3.2 Experimental Setting

The experiment was conducted on Monday the 20th of September, 2004 from 5.30pm to 7.00pm at Langford buildings A and C (Texas A&M University). The pre-test was administered to all the students in the same class room (C105), students selected for the instructor-led class room training stayed in the same room for the training, the post-test and, the opinion survey. The students selected for the Web-based safety training took the training in the computer lab (A105), where they also answered the post test and the opinion survey.

3.3 Description of the Web-Based and Classroom Safety Training Methods

The style and content of presentation for both the training methods was approved by Dr. Nancy L Holland, Associate Professor (Department of Construction Science, Texas A&M University) and Mr. Charles F. Tedrick, Supervisor of Woodshop (College of Architecture, Texas A&M University). The material contained in both Web-based safety training and instructor-led classroom safety training was the same. The material contained in both the training methods was developed using the woodshop safety manual presented in Appendix D, Lewis's (1981), Safety for Carpenters and Woodworkers and OSHA's (2001a), A Guide for Protecting Workers from Woodworking hazards. The web pages for the Web-based safety training program were developed using Dream Weaver.

The types of media used in Web-based safety training are, power-point slides containing text and images of machinery and an audio-visual demonstration video clip. Web-based safety training required the test subjects to go through the online safety course and the woodshop safety manual. The various topics covered in both the woodshop safety training programs are: General Personal Safety, Shop and Job Site Safety, Hand Tool Safety, Stationary Power and, Tool Safety Portable Power Tool Safety.

The Web-Based safety training was spilt into two parts namely; Part I and Part II. Part I consisted of viewing power point slides on the course material and Part II consisted of viewing a nineteen minute long demonstration video clip. The video clip is used to demonstrate the use of equipment used in the woodshop, also it discusses the common hazards associated with them, and the personal protective equipment recommend for each (see the enclosed CD). In addition to safety training the web pages also contain links to the woodshop safety manual presented in Appendix D and links to other websites which provide additional information on woodshop equipment. Example screenshots of the web pages are presented in Appendix E.

The classroom safety training consisted of two parts. First the students were taught the course material by a woodshop instructor on woodshop safety and then the students were each given a hard copy of the safety manual (see Appendix D) to read the material covered in the lecture.

3.4 Data Analysis

The values of delta (Post-test score – Pre-test score) pre-test/post-test experiment are not normally distributed and non-parametric statistics were used to analyze the data to illustrate the differences in the difference of test scores between the test groups (Web-based and Classroom-based). Descriptive statistics were used to analyze the data obtained from the opinion survey to illustrate the differences in participants' satisfaction towards the method of safety training used. Analysis of the proportional mean difference of non-unique questions and unique questions was conducted to determine the robustness of the test instrument (pre-test and post-test questionnaire). The analysis also compared results of this study to similar research studies from the literature (Issa et al. 1999; Kassay 1970; Beckham 1969). Apart from measuring the effectiveness of Web-based safety training over the traditional, instructor-led classroom training, the interaction between the method of training used and the level of education of the students was also observed. The response's for every question in the opinion survey was compared for both test groups to determine the relative level of satisfaction between the two methods of safety training.

3.5 Assumptions and Limitations

It is assumed that the experiment was able to exclude all confounding factors affecting learning by keeping almost all the conditions at the pre-test and post-test similar, so that any change or Delta between the pre-test and post-test scores is attributed as an effect of the training method used. The external validity of the study is weak since

the selection of the research subjects was not randomized. The research measures only surface learning and does not measure retention of knowledge gained by the training methods.

4. RESULTS OF THE STUDY

This section presents analysis of data and findings of the study. A discussion of the student's opinion towards the training methods is also presented. In Tables 9, 10 and 11 the descriptive statistics and frequency tables for pre-test scores, post-test scores and Delta are presented.

4.1 Tests for Normality of the Data

Tests of normality were conducted on the data for Delta (Post test score – Pre test score) and the Proportional delta (proportional mean difference between the means of the non-unique questions and unique questions) to determine if the data is normally distributed. Since the number of unique questions (twenty five) is more than the non-unique questions (five) in the questionnaires, the probability of answering the unique questions will be more than the probability of answering the non-unique questions. To rectify this inequality of the probabilities the values of the SimDelta (difference between non-unique questions) and DiffDelta (difference between the unique questions) are converted to proportions, that is the values of SimDelta were divided by five and the values of DiffDelta were divided by twenty five. The descriptive statistics for Delta and Proportional Delta (PropDelta – the values of proportional SimDelta and DiffDelta taken together) are shown in Tables 2. The tests for normality were conducted using both Shapiro-Wilk and Kolmogorov-Smirnov tests. The null and alternate hypotheses for Shapiro-Wilk and Kolmogorov-Smirnov tests are as follows:

H_0 : Data is normally distributed

H_1 : Data is not normally distributed

H_0 : The data follow a specified distribution

H_1 : The data do not follow the specified distribution

The p-values for the Shapiro-Wilk and Kolmogorov-Smirnov tests are 0.015 and 0.002 respectively as presented in Table 3 - Tests for Normality of Delta, both of these values are less than the significance level, $\alpha = 0.05$. Hence, reject null hypotheses and conclude with a 95% confidence level that, the data for Delta is not normally distributed. The p-values for the Shapiro-Wilk and Kolmogorov-Smirnov tests are 0.000 and 0.000 respectively as presented in Table 3-Tests for Normality of PropDelta, both of these values are less than the significance level, $\alpha = 0.05$. Hence, reject null hypotheses and conclude with a 95% confidence level that, the data for proportional Delta is not normally distributed. The detrended normal Q-Q plots (see Figures 2 and 3) also indicate the same results as above.

Table 2. Descriptive Statistics for Delta and PropDelta

	N	Minimum	Maximum	Mean	σ
Delta	50	-5	7	2.54	2.887
PropDelta	100	-0.60	0.60	0.0892	0.19220

Table 3. Tests of Normality for PropDelta and Delta

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	d_f	p-value	Statistic	d_f	p-value
PropDelta	.152	100	.000	.945	100	.000
Delta	.163	50	.002	.941	50	.015

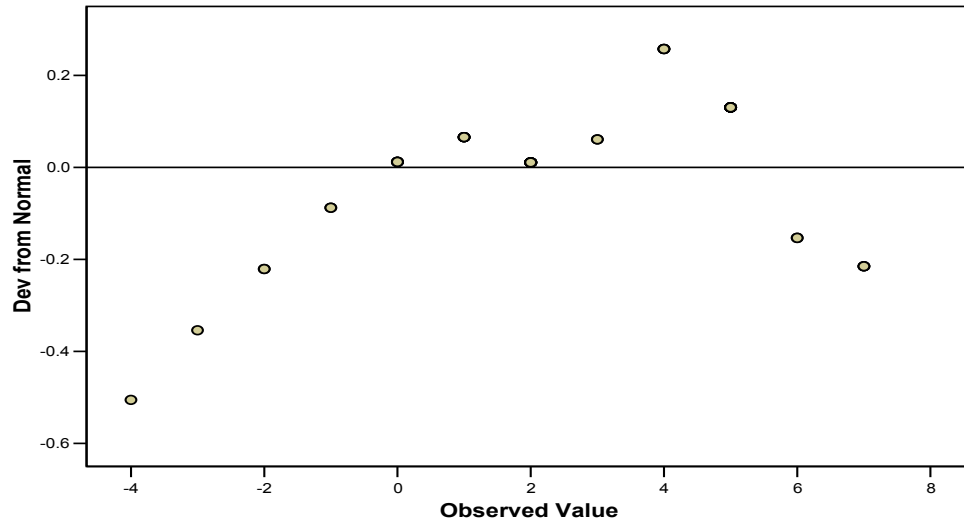


Figure 2. Detrended Normal Q-Q Plot of Delta

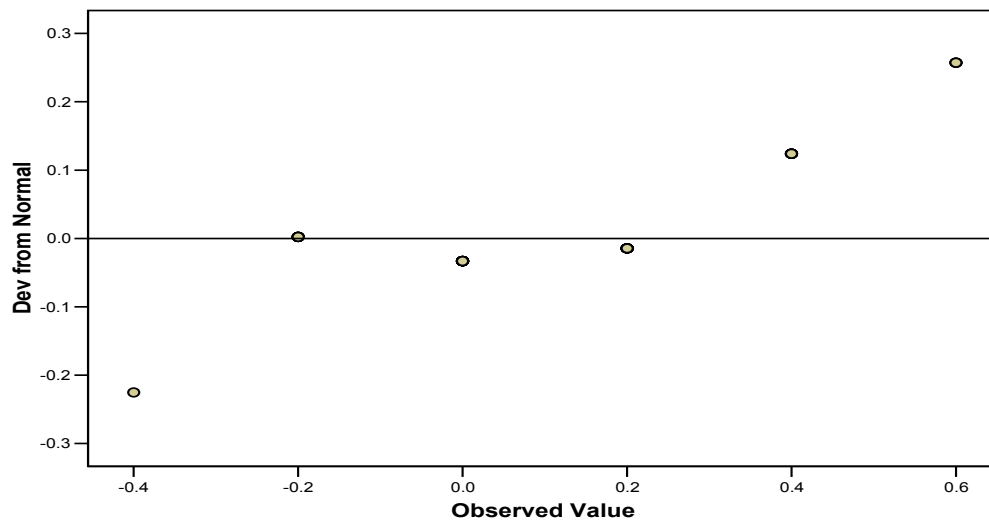


Figure 3. Detrended Normal Q-Q Plot of PropDelta

4.2 Robustness of Test Instrument

It is important to have a robust test instrument to measure the variables, in order to be able to draw meaningful inferences from the analysis of the data. The test instrument should measure what it is supposed to measure accurately. The test instruments used in this study are the pre-test and post-test questionnaires. The robustness of the test instrument can be proved by comparing the mean difference between the scores in unique (DiffDelta) and non-unique (SimDelta) questions. If no significant difference between the means is found, then it can be concluded that the test instrument is robust and the data it yields can be used for analysis to draw meaningful conclusions. The Mann-Whitney test for two independent samples was used to compare the means of SimDelta and DiffDelta. The null and alternate hypotheses for the test are as follows:

$$H_0: \mu_{\text{SimDelta}} = \mu_{\text{DiffDelta}}$$

$$H_1: \mu_{\text{SimDelta}} \neq \mu_{\text{DiffDelta}}$$

The p-value for the hypotheses test is 0.920 (see Table 4) which is greater than the level of significance $\alpha = 0.05$, hence null hypotheses cannot be rejected. Thus, with 95% confidence it can be inferred that the proportional mean difference between the scores in unique (DiffDelta) and non-unique (SimDelta) questions is equal. Thus the test instrument used is robust.

Table 4. Mann-Whitney Test to Compare Means of Proportional SimDelta and
DiffDelta

	PropDelta
Mann-Whitney U	1235.500
Wilcoxon W	2510.500
Z	-.101
p-value (two-tailed)	.920

4.3 Impact of Training on Students' Knowledge of Safety

The first question to be answered before proceeding any further in analyzing the data is whether training (both Web-based and Classroom-Based safety training) had any impact on student's knowledge of safety or not? This question can be answered by comparing the mean scores of the pre-test and post-test. If the post-test score is found to be significantly greater than the pre-test score, then conclude that the student's knowledge of safety was significantly improved. The null and alternate hypotheses for the test are as follows:

$$H_0: \mu_{\text{post-test}} \leq \mu_{\text{pre-test}}$$

$$H_1: \mu_{\text{post-test}} > \mu_{\text{pre-test}}$$

The p-value for the hypotheses test is 0.001 (see Table 5), this p-value is for the two-tailed test, for the above one-tailed test the p-value would be 0.0005 $[(0.001)/2]$ which is lesser than the level of significance $\alpha = 0.05$, hence reject the null hypotheses. Thus, at 95% confidence level it can be concluded that the mean of post-test scores is greater than

pre-test scores. Hence, the student's knowledge of safety was significantly improved by both the training methods.

Table 5. Mann-Whitney Test to Compare Mean Scores of Pre - and Post -Tests

	Pre-Post Test
Mann-Whitney U	782.000
Wilcoxon W	2057.000
Z	-3.237
p-value (two-tailed)	.001

4.4 Comparison between the Web-Based and Classroom-Based Safety Training

Both the training methods contributed towards improvement in student's knowledge of woodshop safety, but still the question, which training method was more effective remains. By the analysis of the Delta's of Web-based and class-based safety training methods it can be determined which training method is more effective. If the Delta of Web-based safety training is found to be significantly greater than the classroom-based safety training, then it can be concluded that the former is more effective than the latter as a safety training method. The null and alternate hypotheses for the test are as follows:

$$H_0: \mu_{\text{Web}} \leq \mu_{\text{Class}}$$

$$H_1: \mu_{\text{Web}} > \mu_{\text{Class}}$$

The p-value for the hypotheses test is 0.056 (see Table 6), this p-value is for the two-tailed test, for the above one-tailed test, the p-value would be 0.028 $[(0.056)/2]$ which is lesser than the level of significance $\alpha = 0.05$, hence reject the null hypotheses. Therefore with 95% confidence it can be concluded that the mean Delta for Web-based training is

greater than that of the classroom-based training. Hence, the Web-based safety training is more effective than the traditional instructor-led, classroom-based safety training method.

Table 6. Mann -Whitney Test to Compare Deltas of Web-based and Classroom-Based Safety Training

	Delta
Mann-Whitney U	213.500
Wilcoxon W	591.500
Z	-1.915
p-value (two-tailed)	.056

4.6 Interaction between the Level of Education and Training Methods

A comparison of pre-test and post-test scores with the help of Wilcoxon Signed Ranks test the interaction between the level of education (Graduate or Undergraduate) and the training method used can be determined. The null and alternate hypotheses for the test are as follows:

$$H_0: \mu_{\text{Post Score}} \leq \mu_{\text{Pre Score}}$$

$$H_1: \mu_{\text{Post Score}} > \mu_{\text{Pre Score}}$$

All the results are conveyed at a 95% confidence level, i.e. significance level $\alpha = 0.05$ and from Table 7 the following conclusions can be made:

1. The p-value (one-tailed) 0.017 is less than 0.05, hence reject null hypotheses, Thus, there is significant improvement in the knowledge of safety in graduate students when Web-based safety training is used.

2. The p-value (one-tailed) 0.246 is greater than 0.05, hence the null hypotheses cannot be rejected, Thus, there is no significant improvement in the knowledge of safety in graduate students when classroom-based safety training is used.
3. The p-value (one-tailed) 0.003 is less than 0.05, hence reject null hypotheses. Thus, there is significant improvement in the knowledge of safety in undergraduate students when Web-based safety training is used.
4. The p-value (one-tailed) 0.000 is less than 0.05, hence reject null hypotheses, i.e. there is significant improvement in the knowledge of safety in undergraduate students when classroom-based safety training is used.

Table 7. Wilcoxon Signed Ranks Test

Education Level	Training Method	Z Value	p-value (2-tailed)	p-value (1-tailed)
Graduate	Web-Based	-2.116	0.034	0.017
Graduate	Classroom-Based	-0.686	0.493	0.246
Undergraduate	Web-Based	-2.726	0.006	0.003
Undergraduate	Classroom-Based	-3.246	0.001	0.000

In order to find out, which training method was relatively more effective in the improvement of knowledge of graduate and undergraduate students, the Mann-Whitney two independent sample test may be used. Following is the hypotheses test which is used to find out if the Web-based safety training was more effective in improving the knowledge of safety among graduate and undergraduate students:

$$H_0: \mu_{\text{Web-Delta}} \leq \mu_{\text{Class-Delta}}$$

$$H_1: \mu_{\text{Web-Delta}} > \mu_{\text{Class-Delta}}$$

All the results are conveyed at 95% confidence level, that is significance level $\alpha = 0.05$.

From Table 8 the following conclusions can be made:

1. The p-value (one-tailed) 0.0541 is greater than 0.05, so the null hypotheses cannot be rejected, however the null hypotheses can be rejected at 0.1 significance level, that is with 90% confidence it can be concluded that the performance of graduate students was significantly improved by the Web-based safety training.
2. The p-value (one-tailed) 0.1105 is greater than 0.05, so the null hypotheses cannot be rejected. Hence, the performance of undergraduate students did not significantly improve by the Web-based safety training. Here too, with approximately 90% (88.95%) confidence it can be concluded that the performance of undergraduate students significantly improved by the Web-based safety training.

Table 8. Mann-Whitney Test to Determine Interaction

	Interaction-UG	Interaction-Grad
Mann-Whitney U	114.000	14.000
Wilcoxon W	324.000	42.000
Z	-1.223	-1.632
p-value (two-tailed)	.221	0.103
p-value (one-tailed)	0.1105	0.051

4.6 Results of the Opinion Survey

The ten statements in the opinion survey were so framed to elicit the opinions of the students on different aspects of the training method used. The opinion survey consists of alternate negative and positive statements. The participants could express their opinion by one of the four choices namely, 1. Strongly agree, 2. Agree, 3. Disagree and, 4. Strongly disagree. In the following the opinions of the students on Web-based and Classroom-Based safety training methods are discussed with respect to each statement using clustered bar charts.

Statement 1: The presentation of the information in the training was very good.

Majority of the students are in agreement with this statement (see Fig.4), that is they felt the information presented in both the training methods was very good. The percentage of agreement in case of Web-based safety training is slightly more than that for classroom-based safety training.

Statement 2: I found the information presented to be overwhelming and

confusing. Majority of the students are in disagreement with this statement (see Fig.5). The students did not feel the information presented to be overwhelming and confusing. The percentage of disagreement in case of Web-based safety training is slightly less than that for classroom-based safety training, indicating that the information presented in the former was somewhat overwhelming than the latter.

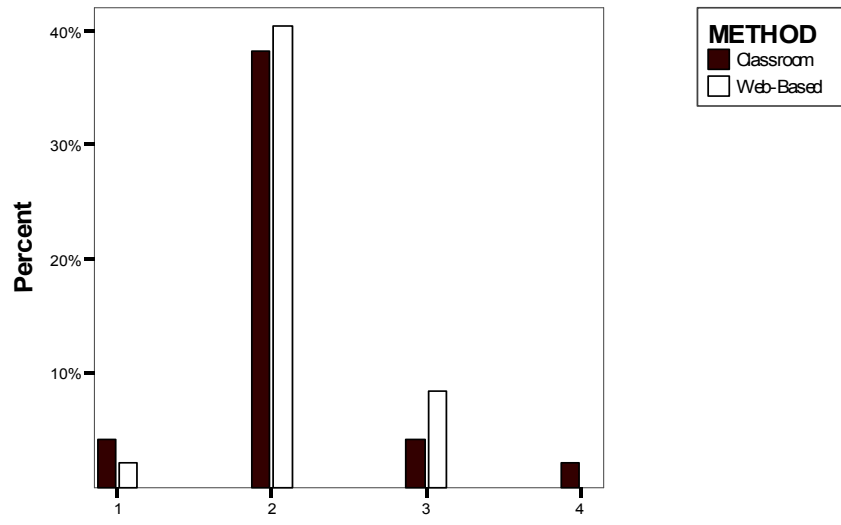


Figure 4. Statement 1

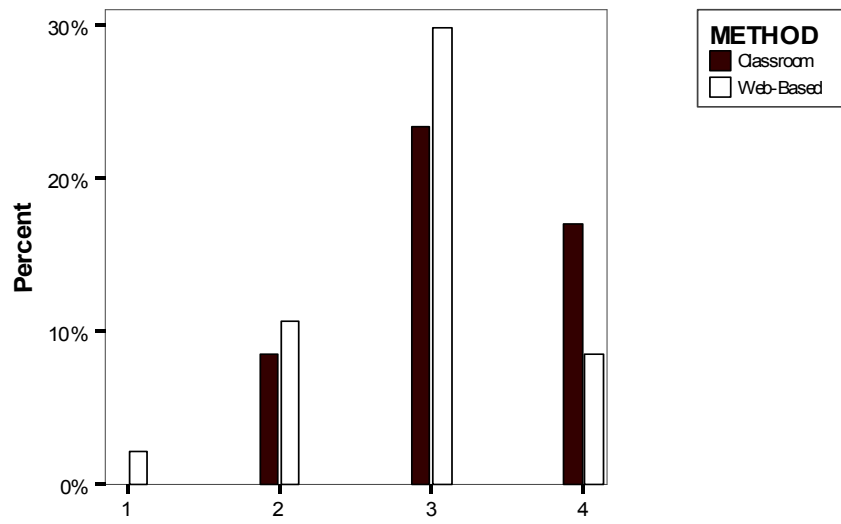


Figure 5. Statement 2

Statement 3: The information was presented in a systematic and well defined format. Majority of the students are in agreement with this statement (see Fig.6). The students felt the information was presented in a systematic and well defined manner, more so in case in case of Web-based safety training, since the percentage of agreement is more than its counterpart.

Statement 4: During the training I felt bored and sleepy. The percentages of agreement and disagreement are almost same for both training methods (see Fig.7); however, the percentage of disagreement in case of Web-based training is stronger than its counterpart. The percentage of agreement in both training methods is almost equal.

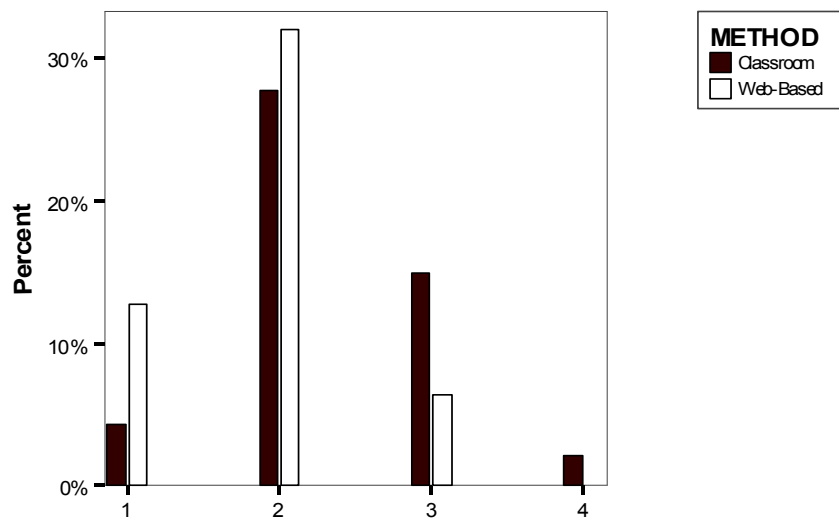


Figure 6. Statement 3

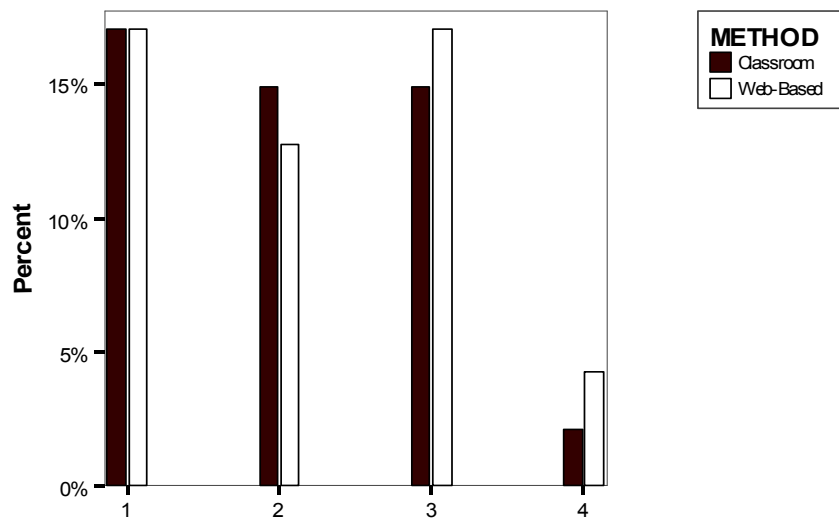


Figure 7. Statement 4

Statement 5: The manner of presentation of information was captivating and stimulating. Majority of the students are in disagreement with this statement (see Fig.8), that is they felt the information presented was not captivating and, more so in case in case of classroom-based than Web-based safety training since the percentage of disagreement is more in the former than the latter.

Statement 6: The use of multimedia for the presentation of information was inadequate. Majority of the students are in disagreement with this statement in case of Web-based safety training (see Fig.9), however as expected the students felt there was inadequate use of multimedia in the classroom-based training.

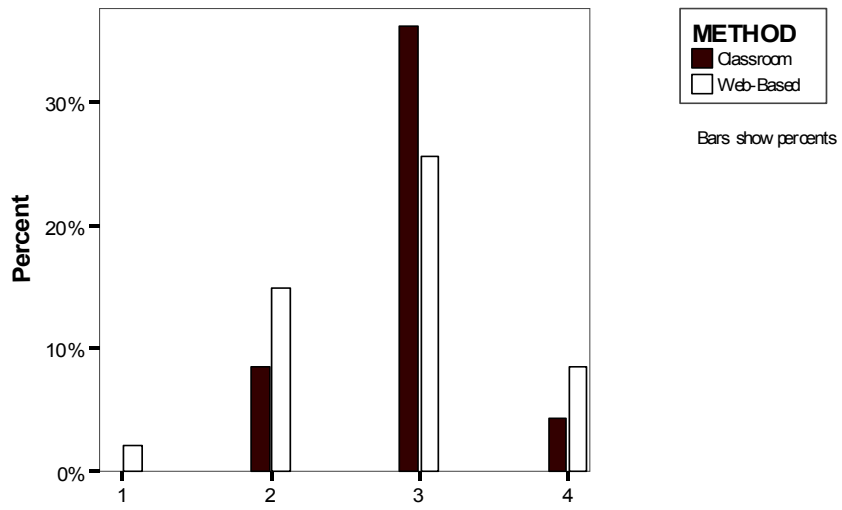


Figure 8. Statement 5

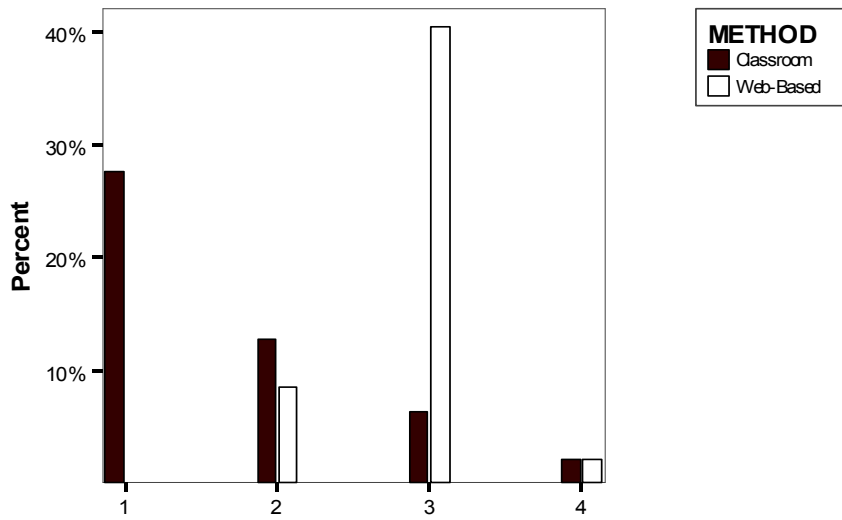


Figure 9. Statement 6

Statement 7: My knowledge on woodshop safety was significantly increased due to the training. Majority of the students are in agreement with this statement in case of Web-based safety training (see Fig.10), however the percentage of disagreement in case of classroom-based training is more than the percentage of agreement.

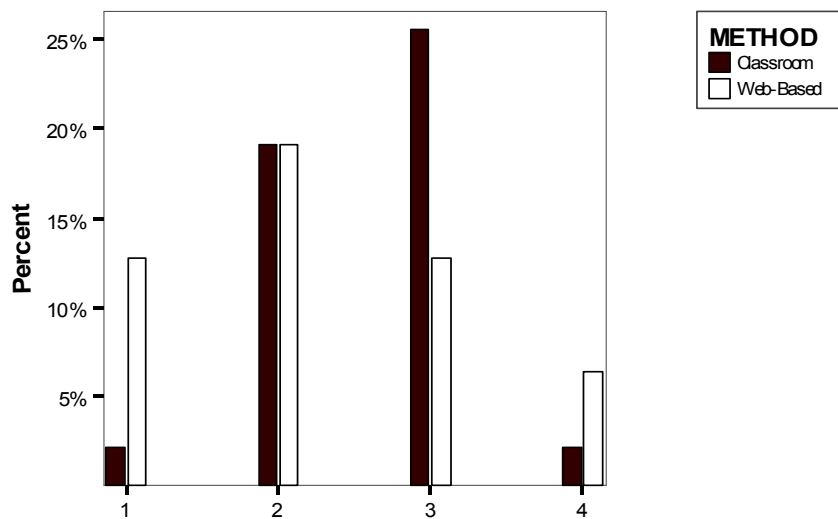


Figure 10. Statement 7

Statement 8: I believe safety training is not really necessary for the proper use of equipment in the Woodshop. Majority of the students are in strong disagreement with this statement (see Fig.11). This shows that students believe that safety training is important to avoid potential accidents and injuries which might happen due to negligence towards safety.

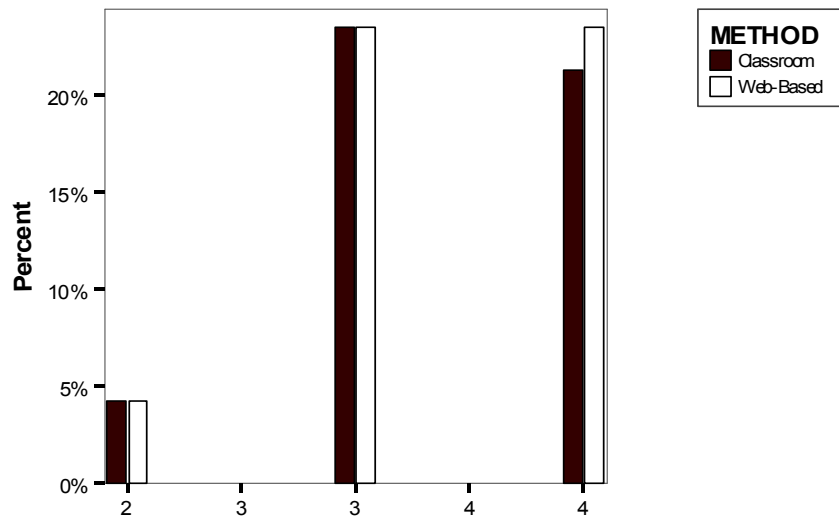


Figure 11. Statement 8

Statement 9: In all the training method was very effective in conveying information on woodshop. Majority of the students are in strong agreement with this statement in case of Web-based safety training (see Fig.12), however in case of classroom-based training the agreement is not as significant as compared to its counterpart.

Statement 10: The material and presentation method for the training should be significantly improved. Majority of the students are in disagreement with this statement in case of Web-based safety training (see Fig.13), however in case of classroom-based training, they felt there was scope for improvement, relatively more than its counterpart.

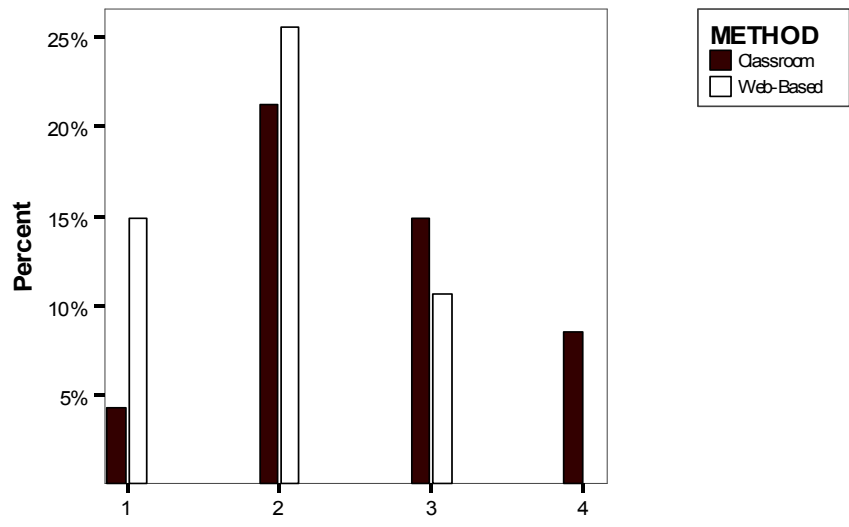


Figure 12. Statement 9

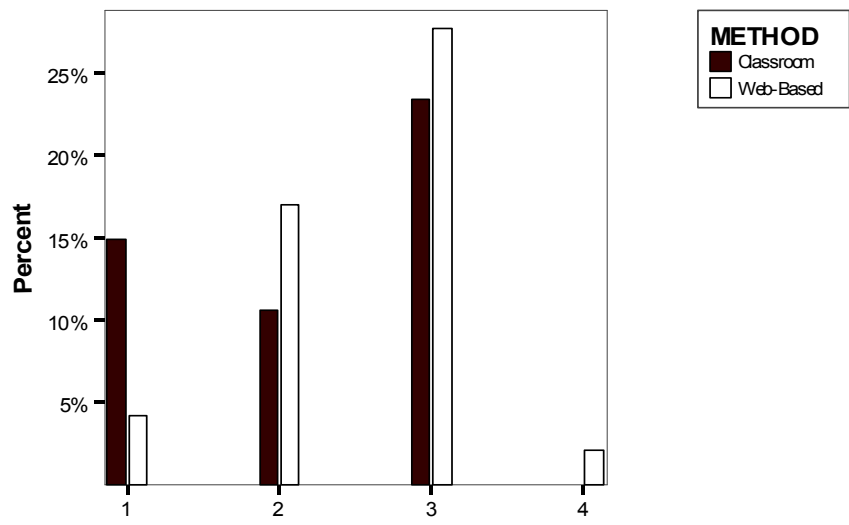


Figure 10. Statement 13

4.6 Summary of Results

A rigorous statistical analysis of the data yielded some interesting results. Sufficient evidence was found to prove that Web-based safety training is a more effective training method than the traditional, instructor-led classroom-based safety training. Key findings of the study are summarized in the following:

1. The test instrument used to measure improvement in knowledge is robust.
2. Both training methods significantly contributed towards improvement of knowledge of woodshop safety; however the Web-based safety training contributed significantly more towards the improvement in the knowledge of safety than the traditional, instructor-led classroom-based safety training.
3. The improvement in the knowledge of graduate students was more pronounced when Web-based safety training was used in comparison to when classroom-based training.
4. The improvement in the knowledge of undergraduate students was not significantly greater when Web-based safety training was used in comparison to classroom-based training.
5. Students found the information in the Web-based training program overwhelming, but in all the attitude of students towards this method of training is more favorable as compared to that towards the traditional, instructor-led classroom-based safety training.

5. CONCLUSIONS

This study aims to serve as a beacon for future research in the field of development of new innovative learning aids in imparting knowledge of safety. This study is merely a step towards proving that Web-based multimedia learning has great potential in the development of effective and efficient safety training programs. Most of the accidents and deaths on the construction site and workshops occur due to the lack of proper knowledge of safety. When knowledge of safety is effectively conveyed using proven methods of training these accidents and deaths can be avoided. This study assesses the effectiveness of one such learning aid, namely Web-based multimedia in learning woodshop safety. The learning aid developed will serve as a training program for the students and faculty of College of Architecture who would use the woodshop for their projects (Langford Bldg B, Texas A&M University).

5.1 Internal and External Validity of the Study

The study done by Issa et al (October, 1999) clearly establishes that there is a causal relationship between the learning aid used and the knowledge of the student in the subject learnt using the learning aid. Hence, it is safe to assume that in this study there is a causal relationship between the learning aid used (self reading or online multimedia course) and knowledge of woodshop safety. The statistical analysis of the data also pointed to the same effect. The variables and operational measures used in the study measure knowledge are specific to woodshop safety, thus construct and content validity are ensured. The allocation of learning aid to the students is randomized. The response to the questions in both the pre-test and post-test can be either correct or incorrect, since all

the questions are of the true/false and multiple choice varieties. Due to the nature of the questions there is no coding bias. Researcher bias is expected to be minimal since randomization is used in almost every aspect of the study. Further the analysis also proved the robustness of the test instrument. Since the study design is of the kind of case study, its external validity is limited. That is to say the findings of the study cannot be generalized beyond the study population (Students of College of Architecture, TAMU). However, by drawing parallels from this study, the concept of Web-based multimedia learning/training could be introduced to the field of safety training in the construction industry and further research may be carried out to prove its effectiveness in the industry.

5.2 Reliability of the Study

The reliability of the operational measures for the dependent variable is expected to be good. Reliability of the operational measure due to the lag of time between the training and testing is unaffected, since the test was administered immediately after the learning aid was used. Since there is no relationship between place of test and knowledge of the student, reliability over the place where the test is conducted is good. Operational measures would be unaffected as to who administers and corrects the test papers because the response to the questions can be either correct or incorrect, since all the questions are of the true/false and multiple choice varieties. Hence, reliability in relation to the person who administers and corrects the test would also be high. Since, reliability over all the dimensions (time, place, person and method) is high the overall reliability will also be high.

5.3 Suggestions for Further Research

This study was not intended to be a large random-sample experiment. The primary goal behind the method of data collection was to obtain insight about the effectiveness of self-paced Web-based multimedia as a technology for safety training. The conclusions that have been presented offer a number of opportunities for further research.

Future research should be conducted in the commercial environment, rather than the academic environment in which this study was conducted. An inquiry into the injuries and fatalities after the completion of the safety training would yield useful data, which can be analyzed to find out the long term effectiveness of the self-paced safety training program.

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APPENDIX A

DESCRIPTIVE STATISTICS AND FREQUENCY TABLES FOR PRE-TEST SCORES, POST-TEST SCORES AND DELTA

Table 9. Descriptive Statistics

Method		PostScore	PreScore	Delta
Classroom	Std. Deviation	4.701	4.351	2.586
	Minimum	8	6	-4
	Maximum	30	25	6
Web-Based	Std. Deviation	4.457	3.878	3.107
	Minimum	13	10	-5
	Maximum	29	26	7

Table 10. Frequency Table - Delta

Method		Frequency	Percent
Classroom	Valid -4	1	3.7
	-2	2	7.4
	-1	2	7.4
	0	3	11.1
	1	2	7.4
	2	7	25.9
	3	1	3.7
	4	3	11.1
	5	5	18.5
	6	1	3.7
	Total	27	100.0
Web-Based	Valid -5	1	4.3
	-3	1	4.3
	0	1	4.3
	1	3	13.0
	2	3	13.0
	3	1	4.3
	4	1	4.3
	5	8	34.8
	6	1	4.3
	7	3	13.0
	Total	23	100.0

Table 11. Frequency Table - Pre-Test Scores

Method			Frequency	Percent
Classroom	Valid	6	1	3.7
		12	1	3.7
		13	1	3.7
		14	1	3.7
		16	1	3.7
		18	2	7.4
		19	3	11.1
		20	4	14.8
		21	3	11.1
		22	3	11.1
		23	3	11.1
		24	2	7.4
		25	2	7.4
		Total		27
Web-Based	Valid	10	1	4.3
		14	1	4.3
		15	3	13.0
		16	1	4.3
		18	1	4.3
		19	2	8.7
		20	1	4.3
		21	3	13.0
		22	4	17.4
		23	5	21.7
		26	1	4.3
		Total		23

Table 12. Frequency Table – Post-Test Scores

Method			Frequency	Percent
Classroom	Valid	8	1	3.7
		12	1	3.7
		16	1	3.7
		17	1	3.7
		18	2	7.4
		20	4	14.8
		21	2	7.4
		22	1	3.7
		23	3	11.1
		24	5	18.5
		25	2	7.4
		26	2	7.4
		28	1	3.7
		30	1	3.7
	Total	27	100.0	
Web-Based	Valid	13	1	4.3
		16	2	8.7
		17	1	4.3
		18	1	4.3
		19	1	4.3
		20	1	4.3
		23	2	8.7
		24	4	17.4
		25	1	4.3
		26	4	17.4
		27	3	13.0
		28	1	4.3
		29	1	4.3
			Total	23

APPENDIX B

PRE-TEST AND POST-TEST QUESTIONNAIRES

The solutions to the pre-test and post-test questions are in bold font, also the five unique questions present in both the questionnaire's are in italics.

Pre-Test Questionnaire

Date: __/__/____

Name: _____

Score: __/____

Grad / UGrad

Section I – Multiple Choice Questions

1. Who is responsible for cleaning up your work area?
 - a. Woodshop supervisor.
 - b. One of the student workers.
 - c. Your mom.
 - d. You.**

2. To whom do you report unsafe conditions in the woodshop?
 - a. Instructor or supervisor.**
 - b. 911.
 - c. A janitor.
 - d. Your friends in the shop.

3. Which saws are free hand saws?
 - a. Miter saw and Band saw.
 - b. Scroll saw and Panel saw.
 - c. Band saw and Scroll saw.**
 - d. Table saw and Scroll saw.

4. When do you turn a saw off?
 - a. When you're ready.
 - b. After you've cut most of the way through the wood.
 - c. After you have completed your cut and the saw blade is clear of your wood.**
 - d. At the end of the day in the shop.

5. Always use a push block on the...
 - a. **Table saw.**
 - b. Band saw.
 - c. Jointer.
 - d. Panel saw.

6. How much weight should you apply to the belt sander while sanding?
 - a. Just enough weight to hold it in place.
 - b. As much weight as possible.
 - c. Not very much weight at all.
 - d. **No weight at all.**

7. Which sander is used to sand edges and the inside of cutouts?
 - a. Finishing sander.
 - b. Palm sander.
 - c. Orbital sander.
 - d. **Spindle sander.**

8. For what material do you use a grinder?
 - a. Steel.
 - b. **All metal.**
 - c. Hard wood.
 - d. Cardboard.

9. What tool is used to cut slots in wood for biscuit jointing?
 - a. Joiner.
 - b. Plate joiner.
 - c. **Biscuit joiner.**
 - d. Slot joiner.

10. When you leave the shop you must...
 - a. Clean up your workplace.
 - b. Put away all tools.
 - c. Put away safety glasses.
 - d. None of the above.
 - e. **All of the above.**

11. Before making a cut on the table saw you should...
 - a. Check blade height.
 - b. Set the fence.
 - c. Make sure nobody is standing behind you.
 - d. **All of the above.**

12. On the jointer, never cut wood shorter than...
- 12" long
 - The length of your arm.
 - 6" long**
 - 3" long
13. The Oscillating Spindle sander is used to sand...
- Flat surfaces.
 - Rounded edges.**
 - 90 degree angles.
 - Upside down
14. On the panel saw, you should always...
- Let go of the saw as soon as you are done cutting and let it spring back into place.
 - Push both sides of the stock you have just cut away from the blade after the cut is completed to avoid a possible kickback.**
 - Stop the saw while touching the wood.
 - Start the saw while touching the wood.
15. You should only plane off ____ inches at a time on the planer.
- 1/8
 - 1/2
 - 1/20
 - 1/16**
16. Too much friction during a cut or while drilling a hole can...
- Cause the wood to spontaneously combust.
 - Cause the wood to burn and ruin the machinery or tool.**
 - Cause the wood to cut faster and more efficiently.
 - Cause the machine to shut down.
17. The random orbital sander differs from the other sanders in that it...
- Is larger.
 - Is harder to control.
 - Produces more severe abrasions.
 - All of the above.**

Section II - True/False

18. *You should push down as hard as you can on all of the sanders to gain a more desired finish. T/F*
19. You only need eye protection when you are using a machine. **T/F**
20. If you get in a bind while cutting on the band saw, simply back out of the cut. **T/F**
21. *Before beginning to use the wood lathe, you should disengage the index pin. T/F*
22. *The belt sander is used to sand many types of larger material, including metal and plastic. T/F*
23. It's all right not to use a fence if you know what you are doing. **T/F**
24. *All types of wood can be milled on the wood lathe. T/F*
25. Putting more weight on the belt sander will make it sand your material better. **T/F**
26. *The oscillating spindle sander can also be used for removing excess material on your stock. T/F*
27. A blade should always be at full speed before beginning any type of cut. **T/F**
28. It is okay to push another piece of wood through the table saw blade right after your first cut is complete. **T/F**
29. As long as you are strong enough to hold your wood still, you do not need to use any type of clamps on the drill press. **T/F**
30. You should always check the jointer fence to make sure it is square before beginning your cut. **T/F**

Post-Test Questionnaire

Date: ___/___/___
Name: _____

Score: ___/___
Grad / UGrad

Training Method Used:

- i. **Web-Based Training**
- ii. **Class Room Training**

Section I – Multiple Choice Questions

1. What are the first things you do when you enter the shop?
 - a. Sign in and talk to your friends.
 - b. Sign in and get safety goggles.**
 - c. Sign in and eat food.
 - d. Sign in and begin building.

2. The most important aspect of a safe shop is a...
 - a. Safe shop.
 - b. Rule book.
 - c. Clean shop.**
 - d. Emergency action plan.

3. When do you turn a saw on?
 - a. Just before you place the wood on the saw blade and begin to cut.**
 - b. When the wood is on the saw blade.
 - c. Five minutes before you plan to cut to let the saw warm up.
 - d. When you're ready.

4. What adjustment should be made to the drill press when using a larger drill bit?
 - a. Use a slower speed.**
 - b. Use a faster speed.
 - c. No adjustment should be made.
 - d. None of the above.

5. How do you decide the speed of the wood lathe?
 - a. Ask your friend.
 - b. Refer to the chart.**
 - c. Guess.
 - d. Test different speeds.

6. Which sander is used to sand in corners and tight places?
 - a. **Detail sander.**
 - b. Half-size sander.
 - c. Mouse sander.
 - d. Spindle sander

7. Why is it not necessary to move the blade guard by hand on a circular saw?
 - a. It does not move.
 - b. You need a special tool to move it.
 - c. **It is designed to self-retract on its own.**
 - d. Your hand will fall off.

8. Power for pneumatic guns is found in...
 - a. Power outlets.
 - b. Battery power.
 - c. **Air hoses.**
 - d. Generators.

9. "Cleaning your work area" means...
 - a. Sweeping up any mess you made.
 - b. Throwing away sawdust.
 - c. Cleaning all tools and machinery you used.
 - d. **All of the above.**

10. When cutting long curves on the scroll saw, you should...
 - a. Do it quickly.
 - b. **Make relief cuts.**
 - c. Do it slowly.
 - d. Back out halfway through the cut and start from the other side to finish the cut.

11. On the drill press, large drill bits should be used at _____ speeds and small drill bits should be used at _____ speeds.
 - a. **Slower, faster.**
 - b. Faster, slower.
 - c. Slower, slower.
 - d. Faster, faster.

12. The Planer is used to...
 - a. Straighten out and bows or warps in your wood.
 - b. Change the outer texture of your wood.
 - c. **Plane your wood to a desired thickness smoothly.**
 - d. Compress wood pieces together.

13. When starting a cut with the miter saw, you should start with the blade...
- Touching the wood where you wish to cut.
 - Up and away from the wood until the blade reaches full speed.**
 - Pushed firmly onto the wood where you want to cut.
 - None of the above.
14. The panel saw is used for...
- Ripping and cross cutting metal.
 - Ripping and cross cutting large sheets of stock.**
 - Ripping and cross cutting small projects.
 - None of the above.
15. When using a drill, you should....
- Push straight in and pull straight out.**
 - Push in and twist and wobble bit as you pull it in and out of the drill hole repeatedly.
 - Drill in reverse direction to cool down motor.
 - Push straight in and drill until all the wood chips are ground into sawdust.
16. When loading or adjusting a pneumatic gun never...
- Disconnect the air hose.
 - Connect the air hose.**
 - Point away from other people or yourself.
 - None of the above.
17. A circular saw is used for...
- Cutting details into stock.
 - Ripping and cross cutting stock.**
 - Smoothing edges on stock.
 - None of the above.

Section II - True/False

18. *The belt sander is used to sand many types of larger material, including metal and plastic. T/F*
19. *The oscillating spindle sander can also be used for removing excess material on your stock. T/F*
20. Only serious injuries need to be reported. T/F
21. *You should push down as hard as you can on all of the sanders to gain a more desired finish. T/F*
22. The more fences you can use, the more secure your wood will be. T/F
23. If boards are the same size, it is okay to stack them and run them through the planer. T/F
24. *Before beginning to use the wood lathe, you should disengage the index pin. T/F*
25. A drill can be turned around and used as a hammer. T/F
26. The table saw should be used only for stock that is less than 4 feet long. T/F
27. Kickbacks are only a problem if the stock or material actually hits someone. T/F
28. *All types of wood can be milled on the wood lathe. T/F*
29. The jointer is used to make joints. T/F
30. The planer is used to clear your stock of imperfections such as knots and protrusions. T/F

APPENDIX C
OPINION SURVEY

**Opinion survey questionnaire for the research study:
Evaluation of Web-Based Safety Training against the Instructor-Led Classroom
Training Method.**

Training method used:

1. Web-Based
2. Classroom Teaching

Q1. The presentation of the information in the training was very good.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Q2. I found the information presented to be overwhelming and confusing.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Q3. The information was presented in a systematic and well defined format.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Q4. During the training I felt bored and sleepy.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Q5. The manner of presentation of information was captivating and stimulating.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

- Q6. The use of multimedia for the presentation of information was inadequate.
1. Strongly Agree
 2. Agree
 3. Disagree
 4. Strongly Disagree
- Q7. My knowledge on woodshop safety was significantly increased due to the training.
1. Strongly Agree
 2. Agree
 3. Disagree
 4. Strongly Disagree
- Q8. I believe safety training is not really necessary for the proper use of equipment in the Woodshop.
1. Strongly Agree
 2. Agree
 3. Disagree
 4. Strongly Disagree
- Q9. In all the training method was very effective in conveying information on woodshop safety.
1. Strongly Agree
 3. Agree
 4. Disagree
 5. Strongly Disagree
- Q10. The material and presentation method for the training should be significantly improved.
1. Strongly Agree
 2. Agree
 3. Disagree
 4. Strongly Disagree

APPENDIX D**SAFETY MANUAL OF WOODSHOP (COLLEGE OF ARCHITECTURE,
TEXAS A&M UNIVERSITY)**

W College of Architecture
WOODSHOP

General

- A. WOODSHOP USE
- B. PROCEDURES
- C. SAFETY
- D. EMERGENCY

Facilities

- A. WOODSHOP
- B. GLUE/PREP ROOM
- C. PAINT/FINISHING BOOTH

Stationary Tool Safety

- A. BAND SAW
- B. BELT/DISC SANDER
- C. COMPOUND MITER SAW
- D. DRILL PRESS
- E. JOINTER
- F. PANEL SAW
- G. PLANER
- H. SCROLL SAW
- I. SHAPER
- J. TABLE SAW
- K. WOOD LATHE

Hand Tool Safety

- A. BELT SANDER
- B. CIRCULAR SAW
- C. DETAIL SANDER
- D. DRILL
- E. FINISHING SANDER
- F. GRINDER
- G. JIG SAW
- H. OSCILLATING SPINDLE SANDER
- I. PALM SANDER
- J. PLATE JOINER
- K. PNEUMATIC GUNS
- L. RANDOM ORBITAL SANDER
- M. ROUTERS

WARNING: Knowledge and understanding of rules and procedures are your responsibility. Woodshop supervisor holds all rights to change and/or modify at any time or for any specific situation. All things are strictly enforced

General

A. WOODSHOP USE

- A. **COLLEGE OF ARCHITECTURE STUDENTS, FACULTY, AND STAFF-** THE WOODSHOP IS OPEN FOR CLASS PROJECTS AND PERSONAL USES.
- B. **WOODSHOP ACCESS-** PRIVILEGES WILL BE EXTENDED AFTER THE COMPLETION OF THE 3-HOUR SAFETY COURSE. STUDENT ID IS REQUIRED FOR ADMITTANCE.
- C. **EQUIPMENT ACCESS-** SAFETY CLEARANCE ALLOWS ACCESS TO ANY TOOL YOU ARE KNOWLEDGEABLE IN. MISUSE OR ABUSE OF A TOOL WILL SUSPEND ITS' AVAILABILITY.

B. PROCEDURES

- A. **CHECK IN-** PRESENT STUDENT/STAFF IDENTIFICATION CARD TO THE FRONT DESK ATTENDANT IN EXCHANGE FOR YOUR NECESSARY EYE PROTECTION. INFORM PERSONNEL OF YOUR PROJECT TYPE AND AREA(S) YOU WILL BE WORKING IN. ALL BAGS AND PERSONAL ITEMS MUST BE STORED AGAINST WALL IN FOYER BEFORE ENTERING THE SHOP AREA.
- B. **TOOL CHECK OUT-** TOOLS WILL BE CHECKED OUT TO INDIVIDUALS FROM THE FRONT DESK. YOU WILL ONLY BE ISSUED TOOLS YOU ARE AUTHORIZED TO USE. EXCESS TOOLS SHOULD BE RETURNED BEFORE NEW TOOLS WILL BE ISSUED.
- C. **CLEAN UP-** YOUR WORK AREA MUST BE CLEAN BEFORE YOU LEAVE. PROJECTS SHOULD BE STORED PROPERLY. FAILURE TO DO SO MAY VOID WOODSHOP PRIVILEGES.
- D. **CHECK OUT-** ANY TOOL YOU HAVE CHECKED-OUT MUST BE RETURNED TO THE FRONT DESK ATTENDANT. YOUR ID. WILL BE GIVEN BACK AND THEN YOU MAY RETRIEVE PERSONAL ITEMS ON YOUR WAY OUT.

C. SAFETY

- A. ACCIDENTS-** REPORT EVERYTHING! WE NEED TO KNOW FOR YOUR SAFETY. INFORM SUPERVISOR OR TRAINED PERSONNEL AS SOON AS POSSIBLE. MINOR INCIDENTS ARE IMPORTANT.
- B. DANGER-** ANYTHING THAT APPEARS TO BE AN IMMEDIATE OR POTENTIAL HAZARD SHOULD BE DEALT WITH IMMEDIATELY. DAMAGED EQUIPMENT SHOULD BE REPORTED.
- C. ELECTRICAL HAZARDS-** KEEP OUT OF ANY ELECTRICAL CONTROL BOXES.
- D. MOVING PARTS-** ALWAYS KEEP YOUR HANDS AND OTHER EXTREMITIES AWAY FROM ALL MOVING PARTS.
- E. EYE PROTECTION-** IMPERATIVE WHEN WORKING WITH OR AROUND ANY TOOLS AND MACHINERY, EVEN IF YOU ARE NOT USING THE EQUIPMENT. THIS IS THE LAW; THERE ARE NO EXCEPTIONS!
- F. FACE SHIELDS-** REQUIRED WHEN USING LATHE, BUT ADVISED FOR ALL MACHINERY.
- G. EAR PROTECTION-** AVAILABLE AND ADVISED.
- H. DUST MASK-** AVAILABLE UPON REQUEST. WHENEVER WORKING WITH WOOD, DUST IS PRODUCED AND CAN BE A HAZARD. CERTAIN WOODS COULD CONTAIN HARMFUL CHEMICALS AND WESTERN RED CEDAR HAS BEEN ATTRIBUTED TO ASTHMA AND NASAL CANCER. WEAR MASK WHEN CREATING HIGH LEVELS OF SAW DUST AND ALWAYS KEEP WORK AREA CLEAN.
- I. CLOTHING-**
 - 1. LONG HAIR MUST BE PULLED BACK AND SECURED.
 - 2. NO HATS ALLOWED.
 - 3. NO LOOSE CLOTHING. LONG SLEEVES SHOULD BE ROLLED UP AND TAILS SHOULD BE TUCKED IN.
 - 4. MUST BE WEARING FULL-LENGTH PANTS.
 - 5. SHOES MUST BE RUBBER SOLED AND CLOSED TOED, NO SANDALS, ETC.
 - 6. NO JEWELRY CAN BE WORN, INCLUDING WATCHES AND DANGLING EARRINGS.
 - 7. BACKPACKS AND OTHER BELONGINGS MUST BE STORED OUTSIDE WOODSHOP AREA. SPACE IS PROVIDED.
- J. NO FOOD, DRINKS, TOBACCO, ALCOHOL, OR DRUGS, LEGAL OR OTHERWISE-** THIS AND ALL THE FACILITIES ARE SMOKE-FREE.
- K. RESPECT YOUR PEERS AND FACULTY-** BE CONSIDERATE AND HELPFUL TOWARDS EACH OTHER. NO RUNNING, YELLING, OR OTHER HORSEPLAY ALLOWED.
- L. ELECTRONICS-** NO HEADPHONES OR CELLULAR DEVICES.

D. EMERGENCY

- A. EMERGENCY SHUT DOWN-** FOR USE ONLY IN AN EMERGENCY. THESE BUTTONS CUT POWER TO ALL MACHINES AND OUTLETS IN THE WOODSHOP. SHUT DOWN SWITCHES ARE ON ALL FOUR WALLS.
- B. FIRE-** EMERGENCY PULL IS LOCATED TO THE RIGHT OF THE OVERHEAD DOOR. EXTINGUISHERS ARE THROUGHOUT THE SHOP.
- C. FIRST AID-** FIRST AID IS LOCATED IN FOYER. HAVE PERSONNEL ASSIST YOU WITH ALL INJURIES.
- D. EMERGENCY ASSISTANCE-** DIAL **9-911** ON CAMPUS PHONES.

II. FACILITIES

- A. WOODSHOP-** THIS AREA HOUSES ALL THE STATIONARY TOOLS THAT ARE CONNECTED TO THE SAWDUST VACUUM COLLECTION SYSTEM. NINE WORKTABLES ARE EQUIPPED WITH ELECTRICAL OUTLETS FOR HAND TOOLS, COMPRESSED AIR NOZZLES FOR EASY CLEAN-UP, AND QUICK RELEASE VISES TO SECURE PROJECTS.
- **CHEMICAL USE IS NOT ALLOWED IN THIS ROOM, THIS IS A FIRE HAZARD.**
 - **SUPERVISION BY TRAINED PERSONNEL IS REQUIRED.**
- B. GLUE/PREP ROOM-** THIS AREA IS SEPARATE FROM THE WOODSHOP DESIGNED FOR ASSEMBLING AND GLUING PROJECTS. ALL SIZE CLAMPS ARE PROVIDED TO USE IN CONJUNCTION WITH TWO TABLES EQUIPPED WITH CLAMP PLACERS. ANY PREP WORK, OTHER THAN SANDING, IS DONE HERE.
- **SANDING SHOULD BE COMPLETE BEFORE PROJECTS ARE BROUGHT HERE.**
- C. PAINT/FINISHING BOOTH-** ALL PAINT, VARNISH, OR OTHER CHEMICAL FINISHES ARE DONE HERE. THIS ROOM IS DESIGNED TO CARRY HAZARDOUS FUMES AWAY FROM USER.
- **THIS AREA IS OCCUPANCY LIMITED BASED ON PROJECTS INSIDE.**
 - **NO POWER TOOLS ARE TO BE USED IN THE BOOTH.**
 - **PERSONNEL SHOULD KNOW WHEN THIS FACILITY IS BEING USED.**
 - **DISPOSE OF CHEMICALS AND ANY HAZARDOUS MATERIALS IN PROPER CONTAINERS.**

III. STATIONARY TOOL SAFETY

- 1. USE MACHINES ONLY AS INTENDED. IF IN DOUBT, ASK FOR ASSISTANCE AND/OR REFER TO USER MANUAL.**
- 2. YOU SHOULD BE INFORMED IN OPERATION AND SAFETY PROCEDURE. IF YOU ARE NOT COMFORTABLE WITH A MACHINE, DO NOT USE IT; ASK FOR ASSISTANCE.**
- 3. FOCUS ON YOUR WORK. LOOK, LISTEN, AND BE IN CONTROL OF WHAT YOU ARE DOING. DO NOT BE DISTRACTED BY OR TALK TO OTHERS AND DO NOT DISTRACT OTHERS.**
- 4. AVOID ACCIDENTAL STARTING.**
- 5. ALL SAFETY GUARDS AND DEVICES MUST BE IN PLACE WHEN OPERATING MACHINES.**
- 6. DO NOT OVERREACH.**
- 7. MACHINE MUST BE AT REST BEFORE REMOVING BYPRODUCTS AND TURNED "OFF" BEFORE LEAVING.**
- 8. RETURN ADJUSTABLE PARTS TO REST POSITION. MACHINE SHOULD BE CLEAN AND CLEAR BEFORE, DURING, AND AFTER IT IS USED.**
- 9. RED KNOBS ARE NOT FOR ADJUSTMENTS. THESE ARE FOR CALIBRATIONS THAT SHOULD ONLY BE DONE BY SUPERVISOR.**
- 10. MAKE ALL ADJUSTMENTS WITH THE POWER BOX SWITCHED OFF!**
- 11. RETURN LOCK TO ELECTRICAL SWITCHES AFTER EACH USE. NEVER OPEN THESE ELECTRICAL JUNCTIONS.**
- 12. ALL ADJUSTABLE PARTS SHOULD BE SECURE BEFORE POWER IS ON.**
- 13. DO NOT USE FORCE. THE TOOL SHOULD DO THE WORK. IF IT DOES NOT PERFORM AS YOU EXPECT, LET TRAINED PERSONNEL KNOW. THERE MAY BE A BETTER WAY.**
- 14. STAY WITHIN REACH OF POWER SWITCH AT ALL TIMES.**
- 15. CHECK FOR WORN AND DAMAGED PARTS. LET TRAINED PERSONNEL CORRECT THESE PROBLEMS. DO NOT ATTEMPT IT YOURSELF.**
- 16. MACHINERY SHOULD NOT BE USED TO CUT USED LUMBER, PLASTER, OR DRYWALL.**

A. BAND SAW- FREE-HAND TOOL DESIGNED FOR CUTTING CIRCLES AND CURVES. CAN ALSO BE USED TO RIP AND CROSSCUT RELATIVELY SMALL PIECES OF WOOD.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. ALWAYS KEEP HANDS AND FINGERS 3" AWAY FROM THE CUTTING EDGE.
2. UPPER GUIDE SHOULD BE ONLY 1/8" ABOVE MATERIAL HEIGHT.
3. ONLY USE WOOD THAT HAS FLAT SURFACES.
4. HOLD WOOD FIRMLY FEEDING IT INTO BLADE AT A MODERATE SPEED.
5. CHECK BAND FOR GOOD TENSION.
6. AVOID BACKING WOOD OUT OF AN INCOMPLETE CUT.
7. BLADE INHIBITS TIGHT TURNS THAT COULD TWIST AND BREAK BAND.
8. CLICKING WHILE BLADE IS IN MOTION INDICATES A HAZARD. INFORM TRAINED PERSONNEL.



B. BELT/DISC SANDER- FREE-HAND TOOL FOR
SANDING SMALL PIECES OF WOOD.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE
DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING
MACHINERY.

1. SAND ONLY IN THE DIRECTION OF THE WOOD GRAIN ON THE
DOWNWARD STROKE OF THE MACHINE.
2. DO NOT APPLY EXCESSIVE FORCE.
3. CHECK SANDING SURFACES FOR TEARS OR HOLES. WORN
SURFACES SHOULD BE REPLACED.
4. CHECK BELT TRACTION WHILE RUNNING.
5. GLOVES SHOULD NOT BE WORN, NEITHER SHOULD YOU HOLD
OBJECT WITH RAG.

C. COMPOUND MITER SAW- 10" COMPOUND
SLIDE MITER SAW- USED FOR CROSS CUTS, MITER AND
COMPOUND MITER JOINTING.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE
DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING
MACHINERY.

1. BLADE SHOULD BE SHARP, RUN FREELY, AND BE FREE OF
VIBRATION.
2. LET BLADE COME TO FULL SPEED BEFORE BEGINNING CUT.
3. HOLD MATERIAL WITH HAND AWAY FROM BLADE AND KEEP
YOUR FINGERS AND THUMB TOGETHER.
4. DO NOT CROSS YOUR ARMS WHILE USING THE SAW.
5. START THE SAW, PULL OUT, PUSH DOWN, AND PUSH BACK.
6. DO NOT ATTEMPT TO CUT SMALL PIECES.
7. DO NOT HANDLE BLADE GUARD. IT IS DESIGNED TO SELF-
RETRACT.



D. DRILL PRESS- 15" VARIABLE SPEED- DESIGNED TO MAKE VERTICAL HOLES OR CREATE MORTISES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. LARGER BITS SHOULD BE USED AT SLOWER SPEEDS.
2. VARY SPEED WITH MOTOR RUNNING.
3. PLACE SCRAP STOCK UNDERNEATH PIECE TO PROTECT BASE.
4. CLAMP PLASTIC AND METAL TO BASE.



E. JOINTER- 8" LONG BED FOR SQUARING AND SHAVING
ALONG THE EDGE GRAIN.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE
DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING
MACHINERY.

1. USE A PUSH BLOCK WHENEVER PROJECT GOES OVER THE
CUTTING SURFACE KEEPING 4" FROM THE CUTTING KNIVES.
2. WOOD SHOULD BE MORE THAN 6" LONG.
3. NEVER ADJUST OUTGOING TABLE.
4. FEED AGAINST BLADE ROTATION. REVERSE DIRECTION CAN
CAUSE SERIOUS INJURY.



F. PANEL SAW- RIPPING AND CROSSCUTTING LARGE SHEETS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. BLADE SHOULD BE AT FULL SPEED BEFORE BEGINNING CUT.
2. SLOWLY RETURN SAW MOTOR TO THE TOP AND TIGHTEN IT DOWN. NEVER LET GO UNTIL IT IS SECURE.
3. BE AWARE OF THE POWER CORD THAT IS DOES NOT FALL INTO PATH OF THE BLADE CRITICAL WHEN RETURNING BLADE TO TOP.



G. PLANER- DESIGNED TO PLANE STOCK TO ANY THICKNESS SMOOTHLY. THIS MACHINE CANNOT STRAIGHTEN BOWS OR WARPS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. USE ONLY WITH PERSONNEL ASSISTANCE.
2. PLANE OFF ONLY 1/16" EACH PASS.
3. KEEP OTHERS OUT OF LINE OF INPUT AND OUTPUT OF TABLE.
4. PLANE ONLY CLEAN CLEAR WOOD. ANY IMPERFECTIONS IN THE WOOD SHOULD BE CHECKED FIRST.
5. ONLY ONE PIECE OF WOOD AT A TIME. DO NOT START A SECOND UNTIL FIRST IS CLEAR AND DO NOT STACK.
6. IF BOARDS STOPS MOVING, TURN POWER OFF IMMEDIATELY, LOWER DECK, AND GET TRAINED PERSONNEL.
7. CLEAR DUST AND WOODCHIPS WITH BRUSH NOT HAND.
8. FEED AGAINST BLADE ROTATION. REVERSE DIRECTION CAN CAUSE SERIOUS INJURY.



SCROLL SAW- FREE-HAND TOOL FOR CUTTING FINE DETAIL DESIGNS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. BE SURE ADJUSTMENT KEYS AND WRENCHES HAVE BEEN REMOVED.
2. ROTATE MOTOR ONCE BY HAND BEFORE USE.
3. LOWER HOLD DOWN CLAMP AGAINST WOOD TO SECURE IT.
4. ONLY USE 1/2" STOCK WOOD OR SMALLER THAT HAS FLAT ONLY SURFACES.
5. HOLD WOOD FIRMLY FEEDING IT INTO BLADE AT A MODERATE SPEED.
6. BLADES SHOULD BE CHANGED BY PERSONNEL BUT ALWAYS CHECK BAND FOR GOOD TENSION.
7. STOP BLADE BEFORE BACKING WOOD OUT OF AN INCOMPLETE CUT.
8. MAKE RELEASE CUTS BEFORE MAKING LONG CURVES.



H. SHAPER- MOLDING, SHAPING, AND JOINING WOOD.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

1. KEEP ALL OBJECTS FROM BETWEEN FENCE AND CUTTER.
9. FEED AGAINST BLADE ROTATION. REVERSE DIRECTION CAN CAUSE SERIOUS INJURY.
2. WOOD BEING SHAPED SHOULD BE 3 TIMES AS WIDE AS THE CUT IS DEEP. SMALL MOLDINGS SHOULD BE SHAPED THEN RIPPED TO WIDTH.
3. SHORT STOCK, LESS THAN 6", REQUIRES THE USE OF A MITER GAUGE OR CLAMP ATTACHMENT.



I. TABLE SAW- RIPPING AND CROSSCUTTING STOCK.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING MACHINERY.

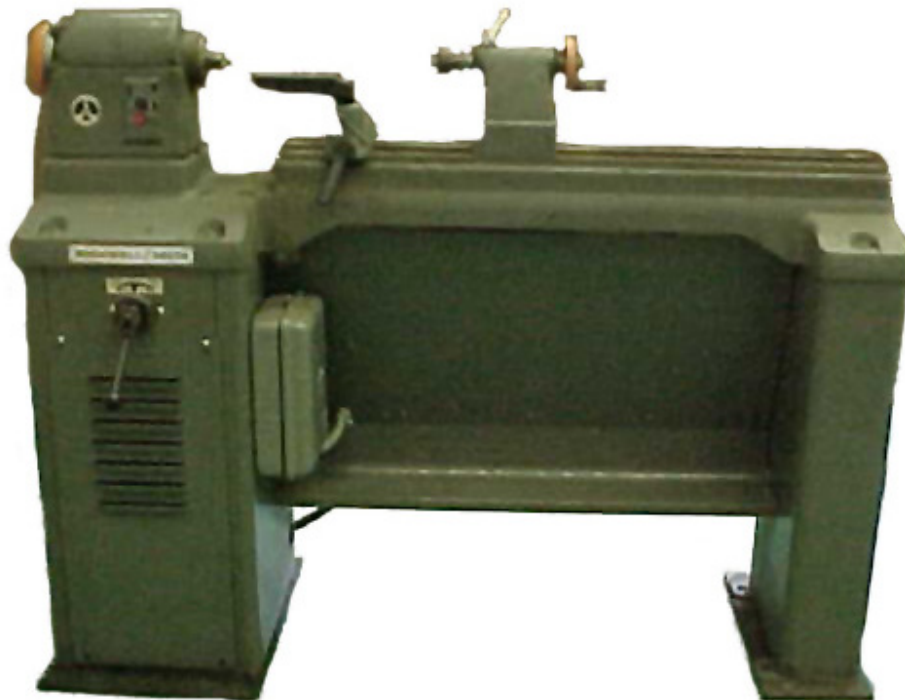
1. USE A PUSH BLOCK WHENEVER PROJECT GOES OVER THE CUTTING SURFACE. KEEP HANDS AT LEAST 4" FROM BLADE.
2. STAND TO SIDE OF WOOD BEING RIPPED.
3. STAY WITHIN REACH OF POWER SWITCH.
4. ONLY USE ONE FENCE OR CROSS CUTTING.
5. BE SURE ADJUSTMENT WRENCHES OR ANY OTHER OBJECTS HAVE BEEN REMOVED FROM TABLE BEFORE USE.
6. HOLD WOOD FIRMLY FEEDING IT INTO BLADE AT A MODERATE SPEED. PUSH WOOD WITH A PUSH STICK UNTIL IT CLEARS CUTTING BLADE.
7. THIS IS NOT A FREE-HAND MACHINE. ALWAYS USE A FENCE OR MITER GAUGE.
8. FEED AGAINST ROTATION. WRONG WAY WILL ACCELERATE WOOD AND CAUSE DAMAGE.
9. NO DEAD-CUTS. CONTINUE RIPPING ALL THE WAY THROUGH YOUR BOARD WITHOUT STOPPING.
10. ONLY USE WOOD THAT HAS FLAT SURFACES.
11. ONLY ONE PIECE OF WOOD AT A TIME. DO NOT START A SECOND UNTIL FIRST IS CLEAR AND NO PIGGYBACKS.



J. WOOD LATHE- MILLING ORIGINAL, SYMMETRICAL WOOD PROFILES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE
DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING
MACHINERY.

1. TOOL REST SHOULD BE AT PROPER HEIGHT AND AS CLOSE TO
WORK AS POSSIBLE.
2. VARY SPEED WITH MOTOR RUNNING.
3. ONLY CERTAIN TYPES OF WOOD CAN BE MILLED. CHECK
WOOD WITH TRAINED PERSONNEL IF UNSURE.
4. CHECK FOR CLEARANCE AND BALANCE BEFORE BEGINNING.
5. TAILSTOCK SHOULD BE TIGHT.
6. TURNING TOOL SHOULD NOT INTERFERE WITH WORK.
7. DO NOT JAM TOOL INTO WORK, ESPECIALLY DURING ROUGH
TURNING.
8. DISENGAGE INDEX PIN BEFORE BEGINNING.
9. REFER TO CHART TO DETERMINE SPEED.



IV. HAND TOOL SAFETY

- 1. USE MACHINES ONLY AS INTENDED. IF IN DOUBT, ASK FOR ASSISTANCE AND/OR REFER TO USER MANUAL.**
- 2. YOU SHOULD BE INFORMED IN OPERATION AND SAFETY PROCEDURE. IF YOU ARE NOT COMFORTABLE WITH A MACHINE, DO NOT USE IT; ASK FOR ASSISTANCE.**
- 3. FOCUS ON YOUR WORK. LOOK, LISTEN, AND BE IN CONTROL OF WHAT YOU ARE DOING. DO NOT BE DISTRACTED BY OR TALK TO OTHERS AND DO NOT DISTRACT OTHERS.**
- 4. ALL SAFETY GUARDS AND DEVICES MUST BE IN PLACE WHEN OPERATING TOOLS.**
- 5. AVOID ACCIDENTAL STARTING. WHEN YOU ARE NOT USING THE TOOL, HOLD IT AWAY FROM THE START SWITCH.**
- 6. TOOL SHOULD BE AT REST BEFORE REMOVING BYPRODUCT AND LAYING IT DOWN. UNPLUG A TOOL THAT IS NOT BEING USED.**
- 7. UNPLUG TOOL BEFORE CHANGING PARTS AND MAKING ADJUSTMENTS. BE SURE THEY ARE SECURE BEFORE USE. MAKE SURE SWITCH IS "OFF" WHEN PLUGGING INTO SOCKET.**
- 8. RETURN ADJUSTABLE PARTS TO REST POSITION. MACHINE SHOULD BE CLEAN AND CLEAR BEFORE, DURING, AND AFTER IT IS USED.**
- 9. DO NOT USE FORCE. THE TOOL SHOULD DO THE WORK. IF IT DOES NOT PERFORM AS YOU EXPECT, LET TRAINED PERSONNEL KNOW. THERE MAY BE A BETTER WAY.**
- 10. DO NOT OVERREACH.**
- 11. EXTENSION CORDS MUST BE 3-PRONG GROUNDED OR POLARIZED. IF A 2-PRONG CORD WILL NOT FIT, FLIP IT OVER.**
- 12. REMOVE PLUGS FROM SOCKETS PROPERLY.**
- 13. USE CLAMPS AND VISES. DO NOT HOLD PROJECT WHEN USING HAND TOOLS.**
- 14. CORDS CAN BE ELECTROCUTION HAZARDS. BE SURE THEY RUN BEHIND YOU, OUT OF THE TOOLS DIRECTION.**
- 15. HOLD BY INSULATED GRIPPING FOR GREATER SHOCK PROTECTION.**
- 16. CHECK FOR WORN AND DAMAGED PARTS. LET TRAINED PERSONNEL CORRECT THESE PROBLEMS. DO NOT ATTEMPT IT YOURSELF.**
- 17. WOOD SHOULD BE FLAT AND CLEAR OF ALL FOREIGN OBJECTS.**

A. BELT SANDER- THIS TOOL IS DESIGNED TO SMOOTH LARGER ITEMS LIKE ROUGH BOARDS, OLD FINISHES, AND SOMETIMES METAL AND PLASTIC.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
2. BELT MUST BE TRACKED PROPERLY BEFORE USE.
3. THE WEIGHT OF THE SANDER IS SUFFICIENT. LEANING ON THE TOOL IS BAD FOR THE MOTOR AND IS LESS EFFECTIVE.



B. CIRCULAR SAW- RIPPING AND CROSSCUTTING STOCK.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
2. DO NOT HANDLE BLADE GUARD. IT IS DESIGNED TO SELF-RETRACT.



C. DETAIL SANDER- THIS TOOL PROVIDES THE ABILITY TO SAND IN CORNERS AND IN OTHER DETAILED SPACES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. A MODERATE HOLD ON THE SANDER IS SUFFICIENT. EXCESSIVE FORCE IS BAD FOR THE MOTOR AND IS LESS EFFICIENT.



D. DRILL- THIS TOOL IS DESIGNED TO DRILL VARIOUS SIZED STRAIGHT HOLES INTO WOOD OR METAL.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. DRILL STRAIGHT IN AND PULL OUT. DO NOT TWIST OR WOBBLE BIT IN A HOLE.
2. BITS CAN BE EXTREMELY HOT AFTER USE.
3. BE SURE TO DRILL WITH MOTOR IN FORWARD DIRECTION. REVERSE DIRECTION COULD EASILY BURN OR IGNITE WOOD.
4. PULL BIT OUT OF DEEP HOLES TO REMOVE DEBRIS. EXCESS CHIPS CAN CAUSE OVERHEATING.



E. FINISHING SANDER- HALF SHEET SANDING FLAT SURFACES FOR FINISHING.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS.
2. THE WEIGHT OF THE SANDER IS SUFFICIENT. LEANING ON THE TOOL IS BAD FOR THE MOTOR AND IS LESS EFFECTIVE.
3. ABRASIVE PAPER SHOULD BE SECURE BEFORE USE.



F. GRINDER- THIS IS A METAL WORKING TOOL FOR GRINDING, AND SMOOTHING ROUGH EDGES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
2. LAY TOOL TRIGGER AND GRINDER SIDE UP.
3. ALWAYS POSITION WHEEL GUARD BETWEEN YOU AND YOUR WORK.



G. JIG SAW- THIS TOOL IS GENERALLY USED FOR PATTERN CUTTING INTO MATERIALS WITH THE MAXIMUM THICKNESS OF 4 1/3" WOOD AND 1 1/4" PLASTIC AND FIBERGLASS, REFER TO MANUAL FOR METAL THICKNESS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. FIND A CLEAR AREA TO WORK WITH THIS TOOL AND SECURE THE MATERIAL.
2. KEEP BASE ON FLAT SURFACE WHEN IN USE.
3. DO NOT USE A BENT BLADE.



H. OSCILLATING SPINDLE SANDER- THIS TOOL IS DESIGNED TO SAND EDGES AND IDEAL FOR INSIDE CUTOUTS AND CURVES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS.
2. A MODERATE HOLD ON THE SANDER IS SUFFICIENT. EXCESSIVE FORCE IS BAD FOR THE MOTOR AND IS LESS EFFICIENT.
3. THIS TOOL IS NOT FOR REMOVING MATERIAL. ONLY SANDING.



I. PALM SANDER- QUARTER SHEET SANDING FLAT SURFACES FOR FINISHING. THIS TOOL IS MANAGEABLE FOR MOST WOODSHOP PROJECTS AND CAN BE FITTED FOR ALL LEVELS OF SANDING.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. A MODERATE HOLD ON THE SANDER IS SUFFICIENT. EXCESSIVE FORCE IS BAD FOR THE MOTOR AND IS LESS EFFICIENT.
2. ABRASIVE PAPER SHOULD BE SECURE BEFORE USE.



J. PLATE JOINER- THIS TOOL IS DESIGNED SPECIFICALLY TO CUT SLOTS IN WOOD FOR BISCUIT JOINING. IT WILL CUT SIZES “FF,” “0,” “10,” AND “20” AT 5/23” THICKNESS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
2. THIS IS NOT FREE-HAND. DO NOT ATTEMPT TO MOVE TOOL WHEN IN PLACE FOR CUT.
3. RELEASE PRESSURE SLOWLY AFTER CUT.



K. PNEUMATIC GUNS- FASTENING TRIM TO SOLID SURFACES.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. MATERIAL MUST BE SUFFICIENT ENOUGH TO WITHSTAND IMPACT OF TOOL.
2. NEVER POINT THIS IN THE DIRECTION OF ANOTHER PERSON. ALSO, NO ONE SHOULD BE IN FRONT OF OPERATOR IN CASE OF ERROR.
3. THIS TOOL IS NOT TO BE USED IN ANY WAY OTHER THAN INTENDED.
4. DO NOT TAMPER WITH CONTACT ELEMENT.
5. THE AIR HOSE IS THE POWER, DISCONNECT WHEN LOADING OR ADJUSTING.



L. RANDOM ORBITAL SANDER- THIS PALM-SIZED SANDER REMOVES MATERIAL MORE RAPIDLY WITHOUT LEAVING THE SWIRL PATTERN OF A SHEET SANDER.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. A MODERATE HOLD ON THE SANDER IS SUFFICIENT. EXCESSIVE FORCE IS BAD FOR THE MOTOR AND IS LESS EFFICIENT.
2. HOLD 5" MODEL WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
3. ABRASIVE PAPER SHOULD BE SECURE BEFORE USE.
4. THIS TOOL IS CAPABLE OF SEVERE ABRASIONS UNLIKE OTHER SANDERS.



M. ROUTERS- USED FOR MILLING AND SHAPING WOOD EDGES AND FREE FORMS.

SAFETY- EYE PROTECTION IS REQUIRED BY LAW. DO NOT BE DISTRACTED BY OR TALK TO OTHERS WHEN OPERATING TOOLS.

1. HOLD WITH BOTH HANDS. THIS TOOL IS EASY TO LOOSE CONTROL OF.
2. BITS CAN BE EXTREMELY HOT AFTER USE.
3. KEEP BASE ON FLAT SURFACE WHEN IN USE.
4. MAKE PROGRESSIVE CUTS TO DESIRED RELIEF.
5. SPEED SHOULD BE REDUCED FOR LARGER BITS.
6. DO NOT "CLIMB-CUT." CUT OUTSIDE EDGES COUNTER-CLOCKWISE AND INSIDE EDGES CLOCKWISE.
 - A. ROUTER (STANDARD)
 - B. PLUNGE ROUTER- IDEAL FOR ROUTING BEGINNING WITHIN THE EDGES.
 - C. LAMINATE TRIMMER- DESIGNED SPECIFICALLY FOR TRIMMING LAMINATE.



Golden **R**ules of the **W**oodshop
Hour mother isn't here!

If you open it . . .	Close it
If you turn it on . . .	Turn it off
If you unlock it . . .	Lock it
If you checked it out . . .	You must check it in
If you use it . . .	Take care of it
If you break it . . .	Report it
If you borrowed it . . .	Return it
If you glued it . . .	Tag it with date and time
If you make a mess . . .	Clean it up
If it is in the way . . .	Move it
If you move it . . .	Put it back
If you are confused . . .	Ask for help
If you are unable to operate it . . .	Leave it alone
If it does not concern you . . .	It's none of your business

APPENDIX E

SCREEN SHOTS OF WEB PAGES AND VIDEO CLIP

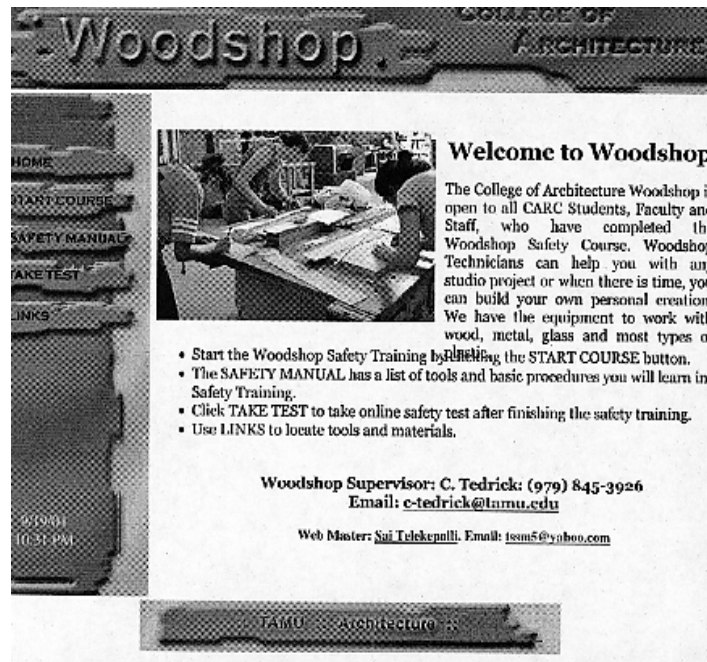


Figure 14. Screenshot of Home Page

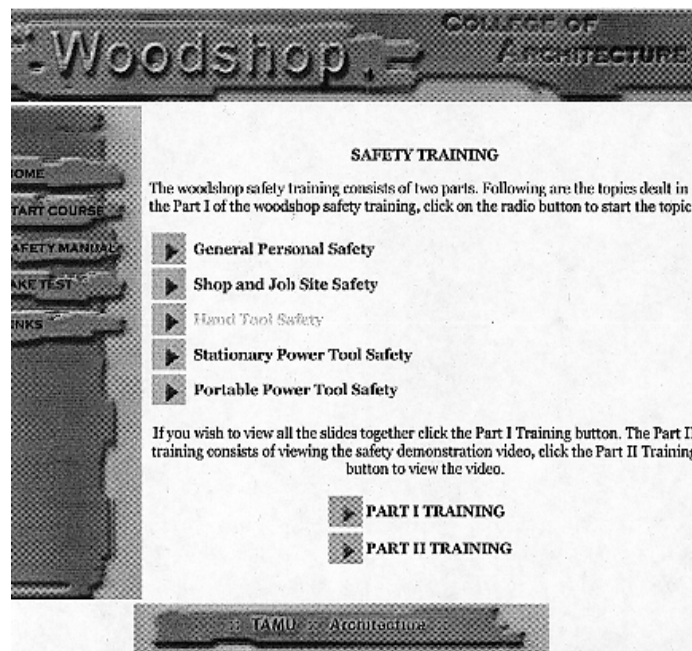


Figure 15. Screenshot of the Training Page

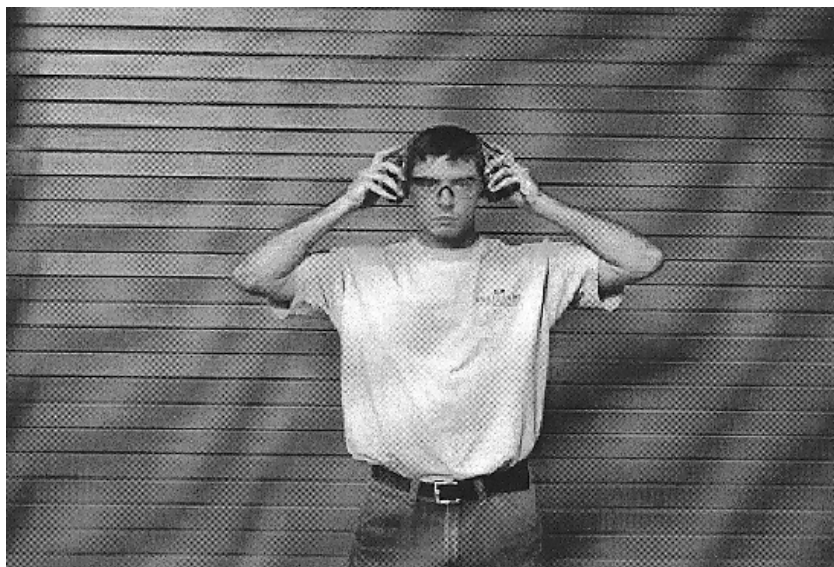


Figure 16. Screenshot of Video Clip Showing PPE

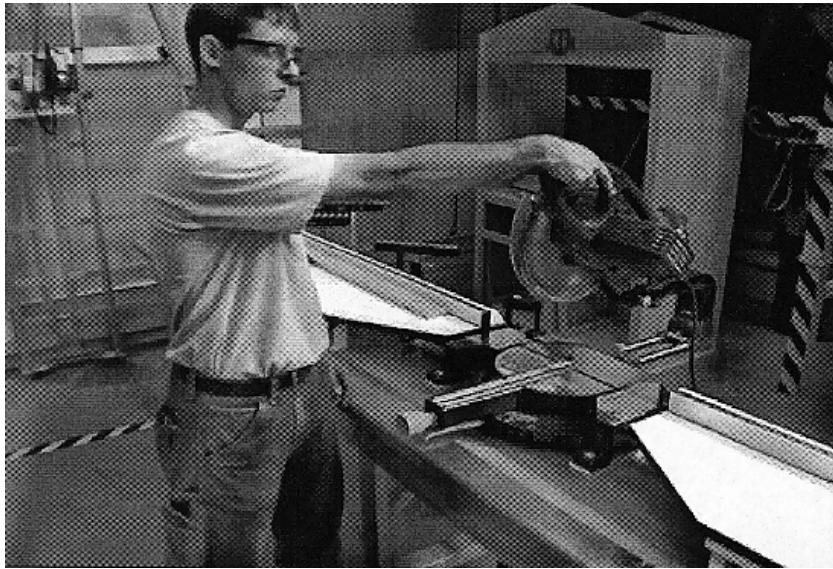


Figure 17. Screenshot of Video Clip Showing Compound Miter Saw

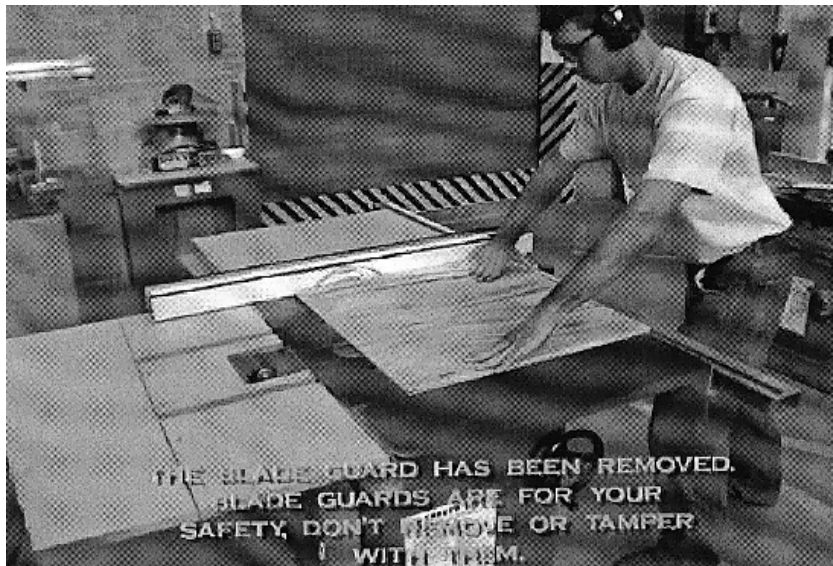


Figure 18. Screenshot of Video Clip Showing Band Saw

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