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AN EXPERIMENTAL COMPARISON OF THE DEMONSTRATION-
PERFORMANCE METHOD VERSUS VIDEOTAPE
RECORDING FOR TEACHING SELECTED
WELDING SKILLS

DISSERTATION

Presented in Partial Fulfillment of the
Requirements for the Degree Doctor of Philosophy
in the Graduate School of The
Ohio State University

by

Thomas Andrew Parks, B.S., M.S.

The Ohio State University

1973

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CHAPTER I
INTRODUCTION

Adult level vocational education programs are becoming more and more prevalent as the result of several factors that may be working either independently or as a combined force. The repetitiveness of change, the dominance of technology, the complexity of specialization, the vastness of opportunity, the increase in mobility, along with a viable labor market have caused a tremendous influence on the increase of adult education opportunities. Many adult level, part-time and full-time training activities are now available to adults who are no longer involved in a formal full-time educational program. These part-time programs are to be found at the university, the public and private college, the technical institute, the community college, the community agency, and even in the "little red school house," after the adolescents vacate the facility.

These programs may be identified by various titles such as Adult Education, Continuing Education, Adult Basic Education and Adult Vocational Education. Where once there was little or no opportunity for training after high school graduation other than college-level programs,
there is now an unlimited number of courses, enrichment programs
and classes available to those who want it, with the potential for many
more training programs on the horizon. One may obtain instruction in
almost any activity that has discernible teachable content, from fixing
a leaking faucet to comprehending the complexities of the most advanced
electronic computer.

With the expansion in training opportunities there has been the
obvious increase in the number of individuals who practice part-time
pedagogy with the individuals who have availed themselves of the opportunity
to increase their competence and enrich their lives. The teachers of adult
education classes come from as many walks of life and fields of endeavor
that may be as varied as their student's backgrounds. Housewives to
engineers and moonlighting day-school teachers to experienced craftsmen
are a part of this vast army that is considered the adult education faculty.

Since imitation, based upon one's own educational experiences, is
a valid and a much practiced instructional technique, one is not surprised
to find in this part-time education a teaching situation that reflects the
early educational experience of those who now teach. The teacher remains
behind his or her desk and hopes that the students remain behind theirs.
A practice, that may be the result of the so-called textbook curriculum,
finds the teacher conducting the class from a point that is between five to
ten feet in front of his students. Most if not all education may be and often is imparted by a variation of the frontal approach; the lecture, demonstration, speech, reading or a mixture thereof. The frontal approach is not necessarily a bad practice; for many teachers this is the only method they know. However, there are some authorities that promote the concept that the frontal approach establishes a barrier to learning and if not entirely preventing an interaction process, it at least offers considerable resistance to its growth.

Yet, there are some teachers who have begun to break up their teaching routine carried out from behind their desks, by utilizing electromechanical teaching devices. These devices vary in their configuration and degree of automation. No one single piece of equipment meets both the teacher's and the student's needs but it seems that a combination of the teaching aids, of a lower order, seems to be the most practical from the standpoint of teacher utilization and from the financial point of view. While the use of teaching machines, instructional devices and various visual aids have been on the educational scene for some time and at all levels of education, the wholesale utilization of sophisticated teaching equipment has not found a market in the field of education and may never find a major outlet there. Although at the adult level the practitioner of pedagogy still remains in front of his class, for the most part, there is evidence to
suggest that he might some day be found circulating among his students while at the same time conducting an interesting class via the use of teaching machines.

While the majority of adult education teachers may fit the pedagogical pattern that many of us have experienced and are comfortable with, a cursory examination of the structure of adult education may well generate an uneasy feeling and is certain to raise doubts as to the quality of the adult education programs. The many purposes given for the many adult education programs in existence is so lengthy that the reason for their being has evolved more into a rationalization rather than a valid explanation for such activity. Upon examination of the many purposes of adult education they seem to fall into three basic categories: avocational, vocational, and academic and no matter into which category the educational activity is placed, it must be considered by other criteria, that of its particular level: pre-basic, basic, post-basic, pre-intermediate, intermediate, post-intermediate, and so forth. Another classification of adult education is the length of the class sessions which is dictated primarily by physiological limitation of the students. A certain amount of uniformity exists with the class sessions averaging two and one-half hours in length with a range of two-to-four hours. While the time per class session has reached a state of uniformity the duration of adult education courses varies greatly. Since there may be many different levels or combinations thereof,
it follows that the length of course is tied directly to the level of the activity which has an explicit degree of proficiency attached to it. Most adult vocational education courses have a duration of approximately 60 hours. Sixty hours is the average duration of Adult Vocational Education programs at Eastland Vocational Center where the investigation was carried out.

With the traditional pedagogical approach taken by adult education instructors who are becoming more and more familiar with the utilization and benefits of teaching aids and devices coupled with the brevity of adult education courses leads one to consider the possibility of incorporating teaching devices into the presently structured adult vocational education classes. With more and more adults returning to the classroom and laboratories, the effort should be made to determine if present instructional techniques could be modified to increase student achievement in the brief time the adult student is in contact with the teacher.

Background of the Problem

Welding process have been used in industry for many decades and will continue to play an important part in the future expansion and development of industrial enterprises. "It is almost impossible to name an industry, large or small, that does not employ some type of welding. Industry has found that welding is an efficient, dependable, and economical
means of joining metal in practically all metal fabricating operations."\(^1\)
The adult enrollment in supplementary, preparatory and apprenticeship welding programs in Ohio's 20 joint vocational school districts, several vocational skill centers, and vocational high schools in its eight metropolitan areas has been reported as 1,576 adult level students for fiscal year 1972 and 2,727 adult level students for fiscal year 1973.\(^2\) With the present and future demands for skilled welders and the tremendous effort by public training institutions to supply qualified personnel in this trade it seems practical and feasible to examine present adult training methods relative to improving techniques and thereby securing a higher degree of proficiency. Past methods and/or techniques in training welders have emphasized the traditional lecture-demonstration approach of instruction for performance activities. While the lecture-demonstration method of instruction may have been a satisfactory instructional technique for training welders in the past, it may not be as effective for the future.

As more adults take advantage of vocational education opportunities and as teaching activities increase in content and complexity there may be


\(^2\)Interview, May 17, 1973, with Mr. Bill Ruth, Supervisor of Adult Education, Vocational Education Division, Ohio Department of Education.
a need to change or modify the instructional approach. Either more time will need to be devoted to a given course or more efficient teaching methods of developing skills will be used.

**Statement of the Problem**

The objective of the study was to determine the effectiveness of the adult student learning welding operations by the traditional demonstration method compared with a videotape recording. The effectiveness was measured by student performance.

The problem was broken down into major areas or divisions: designing the experiment, developing the story and script, taping the demonstration, conducting the experiment, evaluating student outcomes, and analyzing the effectiveness of the two teaching techniques.

**Significance of the Problem**

The significance of the problem would lie in the simple fact that any teaching method or technique that may be utilized to more efficiently provide instruction, as compared with present teaching processes, should be significant in itself without further justification. If the laws of learning are taken into account when giving consideration to a videotape recording, perhaps a much stronger case may be established for the significance of the problem.
Three laws of learning are satisfactorily met or have greater significance with the modified technique as compared with the traditional approach. The three remaining laws of learning are affected more by the process of other variables other than the method of teaching. A review of the laws of learning to support this claim is in order: (1) the law of primacy: what is taught must be right the first time. Probably no technique other than films or videotape could meet this requirement more effectively. (2) The law of intensity: a vivid, dynamic learning experience teaches more than a routine or boring experience. It could be argued that an excellent teacher would better satisfy this law of intensity than any other technique but the modified teaching practice can teach more since it will never lose its effectiveness nor change in its characteristics, or appearance. (3) The law of recency: to teach at the earliest opportunity that which is important and recent. The modified technique applies to this law quite well, in that any new process or technological change may be recorded and immediately played back before an audience.

The three remaining laws: readiness, effect and exercise may be indirectly satisfied by a modified technique but may be dependent more upon other variables such as the learner or the structure of the course or program rather than the teacher or the technique used.

There are other factors that give support to the significance of the problem. Adult education programs are designed with a relatively short
duration assigned to a particular course. In order that course, teacher, and student objectives be met in the brief time, it is imperative that the most efficient method be utilized. As technological changes in welding occur in the industrial world subsequent changes in training should be evident in the instructional laboratory. Different skills and more related knowledge may require a new or at least a different approach in teaching adults.

Assumptions

There are certain assumptions made regarding the research undertaken.

(1) The learning that was evaluated in this study was concerned with the product rather than the process.

(2) The prior industrial experience of the students in adult education class 717 was not significant enough to influence the results of the study.

(3) The supervised practice carried out after the initial demonstration was provided to all the students and should not influence the results of the study.

(4) The welding exercises selected for the study were of specific levels of difficulty so that learning could be separate and attributed to the teaching method employed rather than the result of other variables that
may have been active.

(4) Students in adult education class 717 are representative of adults who take welding.

(5) The laboratory facilities available at the Eastland Vocational Center are representative of adult vocational education facilities.

(6) Adult vocational education students have the ability to comprehend the instruction provided.

(7) Adult level education instructors have teaching and industrial experience and sufficient education to provide adequate instruction.

**Hypotheses**

The problem gives rise to several generalizations that can be stated as hypotheses. These hypotheses explain the relationship between variables that exist in the problem and also allow certain statistical tests to be applied in the treatment of the data. As the reader will note, the hypotheses are stated in null form.

**H0\textsubscript{1}** Adult vocational education students learn how to make specific welding operations equally well by receiving instruction by either a videotape recording or by a demonstration-performance technique.

**H0\textsubscript{2}** Adult vocational education students learn how to make a multiple-pass fillet weld in the horizontal position equally well by receiving instruction by either a videotape recording or by a demonstration-performance instructional technique.
Adult vocational education students learn how to make a multiple-pass fillet weld in the vertical position equally well by receiving instruction by either a videotape recording or by the demonstration performance teaching technique.

Adult vocational education students learn how to make a multiple-pass fillet weld in both the horizontal and vertical positions equally well by receiving instruction by either a videotape recording or by the demonstration-performance teaching technique.

**Definition of Terms**

Listed below are several terms that required specific definition for the purpose of this study.³

**Vocational Education**—Those training activities designed to prepare adolescents and adults to enter and maintain employment. The activities relate directly to the development of manipulative skills combined with integral theoretical information relative to success in a specific profession or occupation.

**Adult Vocational Education**—Instructional activities designed for developing occupational skill proficiency, securing related technical information and/or obtaining academic skills for individuals who have terminated their formal education and who maintain an adult status.

Welding 717--The manipulative skill training along with the inherent related information associated with the joining or bonding by an electro-chemical process, of metals of a similar or dissimilar nature. The particular purpose of the instructional program is to provide supplemental skill development, over and above the present level of proficiency.

**Demonstration Performance**--An instructional activity that provides instruction by exhibiting the actual physical steps in the operation (demonstration) while at the same time providing a running commentary or explanation of the specific operations that are performed. Upon completion of the demonstration phase students engage in imitating the activities witnessed (performance) under the guidance of the instructor. This method of teaching usually consists of four phases: preparation (motivation), demonstration, student performance, and evaluation.

**Videotape Demonstration**--The electro-magnetic process whereby an auditory and visual activity is recorded on tape for either an immediate or delayed presentation through a remote audio-visual receiver (television set). The device lends itself to storage of a performance (may be in the form of instruction) for later exhibition or the immediate transmittal of a live performance originating at some distant point relative to the audience.

**Pre-Test**--In this particular case it is defined as the evaluation of performance skills exhibited by the subject. This evaluation was administered to the subject prior to conducting any formal instructional
practice of either the traditional or modified approach.

**Multiple Pass Fillet Weld-Horizontal (Stringer Pattern)**—That weldment that fills the corner area formed by the physical position of the horizontal and vertical members that form the structure to be welded. The filler material is placed in the area in three separate passes or strings of weld.

**Multiple Pass Fillet Weld-Horizontal (Weave Pattern)**—Similar to any fillet weld but the manner in which the weldment is fabricated is the distinguishing factor. Filler material is deposited in a pattern that is best described as a weaving pattern. The fillet weld usually consists of two or more passes or fusions of filler rod. In this instance it was three separate passes.

**Multiple Pass Fillet Weld-Vertical (Weave Pattern)**—Similar to multiple pass fillet weld-horizontal position but the plates to be welded are in vertical rather than horizontal plane therefore the passes must be made in a vertical manner. The method of depositing the filler material is also completed in a weave pattern.

**Non-Destructive Testing**—That process by which the atomic bond between two metal sections that have been joined are analyzed for various characteristics without distortion of the bond. The evaluation may include x-ray, magna-fux, and visual examination. The weld characteristics evaluated are: bead contour, surface porosity, undercutting and
penetration.

**Destructive Testing**—That process by which the atomic bond between two metal sections that have been joined are physically distorted and analyzed for various characteristics which are: inclusion, porosity, grain structure, penetration, and ductility.

**Limitations**

The study is not designed to account for all the variables associated with instruction by the television media. It is, however, constructed to explain those variables directly related to the instructional activities in specific welding operations.

The specific limitations of the study are:

1. The information taught did not exceed the scope of a welding course as developed by the instructors of the course.
2. Two classes of adult vocational education 717 students of the Eastland Vocational Center were used for the investigation.
3. The instruction was provided at the adult level of education.
4. The instruction in welding was considered to be of a supplementary nature.

**Methodology**

The method by which the investigation was carried out is listed below.
(1) Selected the welding exercises that would be included in the research.

(2) The instructors developed lesson plans relative to teaching the procedures in completing the welding exercises.

(3) Story boards were developed that depicted each scene that would be later recorded on videotape.

(4) The instructors rehearsed the presentation that would be recorded on videotape.

(5) The instructor's presentations were recorded on videotape.

(6) The videotape was edited prior to exhibiting the recording to the subjects.

(7) Subjects were enrolled in adult vocational education welding course and were involved in the instructional process.

(8) After a prescribed period the subjects were administered pre-test on a specific welding exercise.

(9) After a prescribed period that included instruction by one method (either videotape recording or demonstration-performance) and a period of supervised practice the subjects were administered the first test.

(10) After a prescribed period that included instruction by one method (either videotape recording or demonstration-performance) and a period of supervised practice the subjects were administered the.
second test.

(11) The test samples were subjected to destructive testing by an independent laboratory.

(12) Data obtained from laboratory testing was analyzed by statistical manner to test previously formulated hypotheses.

(13) Report was written and conclusions and recommendations made.
CHAPTER II
REVIEW OF RELATED LITERATURE

Studies reviewed to date reveal many uses of television as an instructional/informational tool. It has been put to use in such tasks as refining interview techniques, modernizing speech therapy, providing occupational information in career education, or developing counseling techniques. It is utilized as an instructional aid in the humanities, the physical and biological sciences and in the arts.

The review of related literature in this report deals with television relative to: National Educational Television, instruction in higher education, training by business and industry, teacher training and finally a review of multi-media instruction as it relates to completed research studies.

Although videotape instruction is germane to this report, a brief look at television itself as an instructional tool also deserves some attention, for without the development of television there would obviously be no videotape.

National Education Television

As soon as commercial television arrived on the scene in the early
1950's, it immediately came under examination for its educational possibilities and while major network broadcasting still maintains an unmistakable charisma (depending on programming tastes), its function as the instructional vehicle in the classroom had undergone some modification. The basic premise of educational television was that it would be used for enrichment activities and the teacher would shoulder the burden of instructional responsibility. Television was to supplement the teacher not supplant her. Today, where television instruction is used quite frequently, it maintains the major role in providing instruction with the teacher as the source of enrichment.

There are three basic types of educational television: closed circuit, broadcast and commercial.¹

The closed circuit educational television is where the studio is located in one particular school and may serve that school or several in the geographical area.

The broadcast type of educational television is where the schools receive their programming through a local station. This station may be fed by a central system which may receive some of its programming from a regional network. Six such networks in the country serve specific

areas. For example, WNDT in New York City serves 200 school systems.

The third type of educational television system is that of using commercial stations. Some colleges use the facilities of commercial stations. One such example is that of Sunrise Semester that has been aired on a network of 85 to 90 commercial stations.

Ohio's Educational Television Network Commission had eight stations on the air in 1962. In 1969 the State Legislature provided 5.5 million dollars to expand their operation and construct five additional transmitters. The network consists of community sponsored stations, broadcasting facilities operated by boards of education, and by state supported institutions of higher education.

Programming in Ohio's Educational Television Network is devoted to public school education between the hours of 8:00 a.m. and 4:30 p.m. From 4:30 p.m. to approximately 7:30 p.m. programs are devoted to enrichment type productions that are appealing to the adult population. After 7:30 p.m. stations generally carry national network programs. The programming of course varies from station to station and the source of programs may come from national network products, university or college developed productions or from locally produced programs. Ohio presently has 13 stations, throughout the state, devoted to educational
television. The question whether individuals really learn from educational television has not been resolved. There are those who can document significant advancement in academic achievement while there are others who believe that educational television does not increase the overall achievement level of the student. But despite the lack of consensus on

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the value of educational television, educators indicate the future for this method of instruction is hopeful. The possibility of using videotape recorders in the future will enable teachers to gather a wider variety of materials for class use even from commercial sources. 4

The president of the Corporation for Public Broadcasting has urged Congress to support a program of creative television to teach elementary, secondary and adult education courses. He believes that a project like "Sesame Street" founded by a combination of government and private sources could develop programs of vital importance for substantial numbers of Americans. Possibilities include such projects as the "Right to Read" program or high school equivalency courses for veterans as well as for others who lack a high school diploma.5

While there are those who advocate more emphasis in public service broadcasting for all levels of education, there are others who believe more specifically that the higher education curriculum could be changed to become more meaningful to the individual.

---


An undergraduate program that would instruct students in the humanities for their first year, a second phase of the curriculum would be composed of part-time employment and part-time course work and a final phase where the student pursues his education on an individual effort, primarily through the use of video cassettes. The video cassette may someday take the place of the instructional technique that is presently maintained by the correspondence course.6

...It will achieve equality of educational opportunity with respect to age which is affected by scheduling, expense, requirements such as course prerequisites and transcripts, and psychological barriers. Individuals learning in the home as the primary mode of education will be the future thing.7

Television and Higher Education

A second major use of television is that of the instruction carried out by colleges and universities.

An example of this was a consortium of universities and colleges led by Southern Methodist University and including Texas Christian


University and the University of Dallas developed a series of graduate engineering and science courses that were carried to industries scattered over a larger geographical area. The group took the acronym of TAGER: The Association for Graduate Education and Research.

Industry in Texas required upgrading of the existing personnel and with its unsatisfactory practice of bringing personnel in from other industries (poaching) from other sections of the country found that this new educational opportunity was very satisfactory in terms of personnel and management.

TAGER now owns and operates its own television network and its acceptance by industry is cited by the fact that General Dynamics has four television channels in its Fort Worth plant and participating in 63 out of a possible 81 courses. 8

Another example of universities working with industry and the community is that of Stanford University broadcasting to 25 companies in the San Francisco Bay Area. Two hundred fifty-five students (employees) have signed up for 31 credit courses.

An additional benefit from the Stanford Project is that of the companies who are part of the network have formed an Association for Continuing Education (ACE) and use the network facilities to broadcast non-credit courses to employees before and after working hours.9

Industry itself is implementing instruction by the use of television or videotape. The Grange Mutual Casualty Company, Columbus, Ohio, is training its automotive claims investigators via videotape relative to estimating the dollar amount associated with the repair or replacement in vehicular collision cases.10

The Lennox Corporation with training headquartered in Marshalltown, Iowa, and manufacturing plants throughout the United States has added the videotape instruction of the service procedures on the heating and cooling equipment it manufactures and maintains.11

While private industry and universities are using live television and/or videotape transmission in education, small colleges are also

9 "Bringing Graduate School to the Plant," p. 65.

10 Interview with Mr. Robert Cecil, Training Coordinator, Grange Mutual Casualty Company, Columbus, Ohio, May 1973.

11 Interview with Lennox Corporation representatives at the American Vocational Association Annual Convention, Chicago, Illinois, December 1972.
working with videotape in occupational training. One example of the instructional technique is "Project Occupations" developed and placed in operation by East Central Junior College, Union, Missouri. 12

The components of the program, started in 1970, consist of identification of trainees, testing and counseling, production of training materials, placement and follow-up and evaluation.

Seventeen occupations have been recorded on videotape with 415 people being trained and placed since the program began. Participants in the projects have in some cases been picked up and transported to the training location at the junior college while others have been trained at their home or a group meeting in the church basement.

The results, reported by the director of the project, indicated that, of the people placed on jobs, 65 percent are still working.

Television and Teacher Training

Because of its unique characteristics videotape has been utilized extensively in teacher education. With slow motion and stop action capability, its immediate playback feature and monitoring aspect, the video-

tape recording of an instructor (or potential instructor) is definitely an asset to training and evaluating practices.

Kalick\textsuperscript{13} views videotape in teacher training as possessing two primary functions: (1) psychological and social foundations and educational methodology could be done independently and then introduced into discussion in terms of actual classroom behavior students have experienced either live or by videotape; and (2) videotape could help in the selection process; videotape samples of teaching performance would provide a much better indicator to the teacher trainer, and the potential employer whether or not the candidate would be successful.

Training and placement can be improved by quality classroom training, those who are unfit may be redirected to other fields; an adequate sample of the candidate's teaching performance is available on videotape and effectively utilized in his selection and assignment.

Roush\textsuperscript{14} lists the several ways in which videotape has been used in teaching training.


(1) Observational material for a class or an individual student.

(2) Immediate private feedback for a student teacher or counselor trainee concerning his performance.

(3) Evaluation of performance by supervisor and trainee.

(4) Specific preplanned recorded lessons as a basis for methods course.

(5) Situational materials to be used with simulation procedures or case study analysis.

(6) Feedback and supervisor's analysis prior to immediate replication performance.

(7) Both demonstration and feedback in developing specific teaching behavior.

(8) Evaluation of teaching performance on a before and after time lapse basis.

(9) Research analysis of teacher behavior, pupil behavior, or teacher pupil interaction.

(10) Instructor prepared materials for use with closed circuit television, dial access or film loop independent study activities.

**Research Studies Completed in Multi-Media Instruction**

While several studies were examined for their experimental approach to compare teaching methods, relatively few projects were found specifically devoted to videotape instruction. However, many studies that were reviewed investigated teaching techniques that involved various other kinds of audio-visual media, some reported research on instruction by videotape.
Few research studies were involved with adult level subjects but were found to be scattered among college, elementary, and junior high levels.

While many studies have been completed relative to instruction of industrial education subjects in the related information area, there have been several studies in recent years that have dealt with performance activities. Fry stated:

The use of programs to teach psychomotor skills (combinations of mental and physical activity) has proved a useful adjunct to training in the industrial arts.

Those studies that dealt with performance development by providing different teaching methods follow.

Walsner exhibited a slide-tape program to 90 seventh grade industrial arts students in an attempt to compare the amount of transfer from multi tasks to single tasks performance. The variables were the number of tasks, complexity of tasks, time element and the interaction of time and tasks. There were no statistically significant differences


associated with transfer of training as it related to task complexity, time or the interaction process.

Cushing\textsuperscript{17} exhibited 52 various film loops to subjects in two General Metals classes. The objective of the study was to compare film tape presentations with live presentations in teaching machine operations.

The study revealed no statistically significant differences between the techniques and their effect on immediate achievement of knowledge and the retention of knowledge.

A study by Bockman\textsuperscript{18} examined the effectiveness of programmed instruction as compared with the lecture-discussion method. Subjects in the study were 124 college-level students enrolled in metals classes in the industrial arts and technology departments.

The results reported with that significant differences were found between the two methods of instruction. The conclusions indicated that programmed instruction can provide solutions to problems of teaching groups with widely varying ability groups.


St. John\textsuperscript{19} studied the effect of videotape presentation on tasks to be performed; one with commentary, one without, on 48 seventh grade girls. The subjects were rated on performance of tasks after receiving one version of the videotape or the other. The results indicated that subjects exposed to videotape with commentary tend to significantly imitate the model.

Boutwell\textsuperscript{20} indicated that subjects, in an experimentally designed study on the effects of audio-visual order of presentation performed statistically better when they receive an auditory leading visual as compared with a group who were exposed to auditory synchronization. The study was carried out on 52 seventh grade boys in an effort to investigate the extent to which the strength of grip of the learner has an effect on manipulative task performance.

An experiment to determine if 16mm sound animated films compared


with conventional lecture demonstration was carried out by Nystrom.\textsuperscript{21} The comparison of two teaching methods was used in teaching multi-view orthographic projection, primary auxiliary projection, sections and conventions and dimensioning procedures to beginning engineering students.

The results from the study indicated that the experimental method was significant at the .01 level under pretest-posttest comparisons and the retention scores were significantly higher at the .05 level.

Smith\textsuperscript{22} found that no significant difference existed between programmed instruction and lecture-demonstration in teaching descriptive geometry. His study was conducted using 507 subjects and eight teachers at the college level.

Seal\textsuperscript{23} conducted a study that involved the comparison of lecture-


demonstration with programmed instruction and single concept film loops in teaching college freshmen beginning welding. Five null hypotheses were testing for significant differences with only one showing up as different at the one percent level.

Koegenburg\textsuperscript{24} conducted a study whereby college freshmen in drafting were taught by videotape television and programmed instruction. Two experimental groups were taught by the programmed method and the control group received instruction by videotape television. The results indicated that: (1) a difference between treatments did exist; (2) no significant difference in learning was noted between the programmed instruction treatments; and (3) a significant difference in learning did exist between videotape television presentation and programmed instruction.

While the several studies reviewed that were concerned with performance training there were relatively few that reported statistically significant differences between teaching techniques, no matter whether the method was videotape or some other type of multi-media program that was used. However, in several studies the investigators reported positive

results when consideration was given to minor objectives established in their specific study. Teachers involved in the study liked to try new methods in teaching their students, the experimental approach helped motivate the class, the students enjoyed the use of programmed materials, the objectives of the course were met even though a modified teaching technique was used were just some of the positive statements made.

As stated before, most of the studies carried out to date have not been primarily concerned with the adult level student but rather with the adolescent or college level student. The designs of the studies have been involved with examining many different types of audio-visual media integrated into an existing teaching practice and comparing with a conventional or traditional teaching method. Furthermore, those subjects, in the few studies reviewed, were not concerned with occupational proficiency and immediate employment status. That is, those samples and populations included in the studies were not necessarily in a learning situation to satisfy a short-term goal of either upward mobility or initial entry into an occupation.
CHAPTER III

METHODS AND PROCEDURES

This research was conducted in the Trade and Industrial Education Department at the Eastland Vocational Center during 1972 Fall Term of the Adult Education Program. A comparison of student performance was made between the videotape demonstration and the demonstration-performance methods of teaching specific welding operations.

During the summer of 1972 the adult education welding instructors developed detailed lesson plans for the specific welding operation to be demonstrated. (See Appendix B.) From these lesson plans a graphic presentation was developed in the form of story boards. Each individual board represented a scene that was to be filmed by the television camera. After the story boards had been developed for the entire sequence of the videotape demonstration, they were reviewed and compared with the original lesson plans. Changes were made to both the lesson plans and the story boards to make them compatible and to insure the objectives established would be met. (See Appendix C and D.)

Upon the completion of the story boards the teachers rehearsed their performance and refined their demonstration techniques. The
original concept, relative to the videotaping, was to add the commentary after taping the demonstrations, but after several rehearsals it was agreed upon that the sound would be recorded as the video position of the demonstration was taped. This necessitated the use of a script and cue cards. After the teachers rehearsed the demonstration (both audio and video) the television taping was carried out. The videotapes of the demonstration were edited for technical deficiencies and were then ready for exhibition to the subjects (see Appendix C and D for the storyboard and the accompanying video instructions and commentary).

**Selection of Groups**

Two classes of Adult Vocational Education students who enrolled in the fall term for the Supplementary Welding Course 717 were used as the subjects in the study. They were not required to meet any specific criteria for entrance to the program other than that established as guidelines by the Division of Vocational Education, Ohio Department of Education. These requirements are: be at least 16 years of age, not attending a full-time program of education elsewhere and to have had employment experience in the welding trades. The two classes of adult education students used in the study were classified as Group A which met on a Monday and Tuesday evening basis while the students who met on a Wednesday and Thursday evening were considered Group B. There were 14 students enrolled in Group A and 15
students enrolled in Group B.

Two different teachers instructed the classes used in the investigation. In the fall of 1972 the teachers of Group A and Group B each taught welding to his group by means of a videotape recording for one specific welding operation and by the traditional demonstration-performance method for a second specific welding operation. In effect each group received instruction by demonstration-performance method and by a videotape demonstration made by another instructor. See Figure 1.

The two demonstrations were but a small part of the total program of welding instruction in that the entire instructional program covered additional practical exercises in both gas and arc welding. See Appendix A; Course Outline.

<table>
<thead>
<tr>
<th></th>
<th>Horizontal Fillet Weld (Stringer Pattern)</th>
<th>Horizontal Fillet Weld (Weave Pattern)</th>
<th>Vertical Fillet Weld (Weave Pattern)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group A</strong></td>
<td>Pre-Test</td>
<td>Video-Tape Demonstration</td>
<td>Demonstration Performance</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td>Pre-Test</td>
<td>Demonstration Performance</td>
<td>Video-Tape Presentation</td>
</tr>
<tr>
<td></td>
<td>Pre-Test</td>
<td>First Test</td>
<td>Second Test</td>
</tr>
</tbody>
</table>

Figure 1--Instructional Group, by Type of Weld Operation, by Instructional Technique, and by Evaluation
Instructional Procedures

Each group of welding students was treated in an identical manner in that there was no change made in the sequence or scope of practical exercises each encountered during the term of the course.

While the kind and sequence of practical training remained the same for each group, they did meet on different days of the week: Group A met on Monday and Tuesday evenings from 7:00-10:00 p.m., while Group B met on Wednesday and Thursday from 7:00-10:00 p.m. Both groups met a total of 24 sessions, over a twelve-week duration, for a total of 72 hours of instruction.

Group A received an orientation the first three-hour session that included: an awareness of the rules and regulations of the institution, organization of instruction, course objectives, and safety practices. They were also informed about special safety equipment they were required to obtain in order to participate in the course.

On the second session the students were given instruction on the adjustment procedure relative to the various types of electric arc welding equipment in the laboratory. Although previous experience in the welding trade was prerequisite for gaining entrance into the instructional program, it was believed that because the group had such varied employment experience it would be very unlikely that each member of the class would be familiar with every type arc welding available in the welding laboratory. Consequently,
the first hour of the second session was devoted to equipment adjustment procedures. The remaining two hours of the second session were devoted to allowing the student to develop his proficiency in using the different pieces of equipment.

The third session for Group A was devoted to the following instructional practices: review of electrode classification, continuation of proficiency in skill development, and equipment adjustment with the final thirty minutes of instructional time devoted to making a test sample of the multiple-pass fillet weld in the horizontal position using the stringer pattern. It must be emphasized that no formal instruction was provided to the students prior to the administration of the pretest. These students were enrolled for supplementary training which may be further described as enrichment or upgrading the manipulative skills they already possessed. The particular welding operation selected as the pretest exercise was of such an elementary level that each of the students should have experienced the operation many times in their daily routine of welding. While it may be true that some of the students had experienced this welding activity some time in the past (they were no longer employed in the welding occupation per se) they still had sufficient time to review and update their skills in sessions one, two, and three. See Figure 2 for an illustration of the pretest weldment.
The fourth session for Group A (Monday-Tuesday group) was devoted to the following practices: twenty-five minutes of this session were used in presenting the group a videotape recording of the multiple-pass fillet weld in the horizontal position using the weave pattern. Upon
the completion of the videotape demonstration, the students were allowed to practice the multiple-pass fillet weld in the horizontal position utilizing the weave pattern. The time given to practice, under supervision, was for no more than one-hundred minutes. During this practice time, the students paid particular emphasis to control of weld contour, weld penetration and weld undercut.

After the period of supervised practice, the students were furnished with sufficient materials and test plates for executing the first proficiency test; the multiple-pass fillet weld in the horizontal position using a weave pattern. See Figure 3 for an illustration of the first test weldment. The time allowed for the administration of the test was thirty minutes. Although thirty minutes may have been a relatively long period devoted to making a weldment of this type, especially for people with experience, it was believed that the time allowed for testing would give everyone a fair opportunity regardless of his speed and manual dexterity.

The fifth session for Group A was divided into the following: the first thirty-six minutes were devoted to a demonstration performance by the instructor of the multiple-pass fillet weld in the vertical position using the weave pattern. The remaining two hours of the fifty session were given over to supervised practice. Similar to the supervised practice associated with the first test, the students concentrated on control of weld contour,
weld penetration, and weld undercut during the supervised practice session prior to the second test.

The first thirty minutes of the sixth session the students were allowed to warm-up, practicing the multiple-pass weld in the vertical position.
Adding the warm-up period with the previous two hours of supervised practice gave the student approximately one hundred-fifty minutes of supervised practice.

A differential of fifty minutes between the horizontal weld position practice time and the vertical weld position practice time was allowed for the difficulty associated with the position factor.

After the thirty-minute warm-up period during the sixth session had been concluded, the students were given sufficient materials and test plates for executing the second test; the multiple-pass fillet weld in the vertical position using a weave pattern. See Figure 4 for an illustration of the second test weldment. The time allowed for the administration of the second test was forty-five minutes. Again there was a time differential between the administration of test one and two and this was due to the factor of difficulty.

The sequential structure of test administration was developed primarily so that test one and two were given after the demonstration (live or videotape) and a prescribed amount of practice time had been given to each student.

The student may have gained additional experience from the fact that he was employed in a welding occupation and may have been executing one or both of the specific welds as part of his daily routine. However, no
further instruction or practice was given to the student in the study undertaken.

Figure 5 provides an illustration of the time allocated to each activity.
Group B followed the almost same instructional sequence with two exceptions. The first difference was that the instructional techniques were alternated. While Group A received instruction on a specific welding operation via videotape recording, Group B received instruction on the same welding operation by means of a demonstration performance technique. The second difference between the groups was that they met on different evenings of the week.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test</th>
<th>Horizontal Test</th>
<th>Vertical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demo Time</td>
<td>Supervised Practice Time</td>
<td>Test Adm. Time</td>
</tr>
<tr>
<td>Group A</td>
<td>-0-</td>
<td>240 min.</td>
<td>30 min.</td>
</tr>
<tr>
<td>Group B</td>
<td>-0-</td>
<td>240 min.</td>
<td>30 min.</td>
</tr>
</tbody>
</table>

Figure 5—Allocation of Instructional Time by Activity
CHAPTER IV

CONSTRUCTION OF THE MODIFIED TEACHING METHOD

In pursuing this investigation it was necessary to develop videotape films whereby the modified teaching technique could be carried out. Many investigations that have compared different types of modified instruction in various degrees have often relied upon a jury of experts or panel of judges to assist in providing a more valid investigation; this research project did not. The practice followed in this project was one of not using a panel of experts but rather relying primarily upon the expertise of the instructors who taught the course to devise the modified teaching technique.

Theobold indicated that the best way of obtaining a program that would be suitably matched to the target population is to have the teacher prepare his own program. ¹

While the investigation did not use a jury to make suggestions on the improvement of the project, there was the advice and counsel of specific

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technicians and professionals used in the several stages of the project. The use of experts was in addition to the assistance provided by university advisors.

Specific expertise was found by the assistance of videotaping specialists, high-speed photography technicians, lighting technicians, welding equipment specialists and welding certification specialists as well as the expertise of the instructors.

**Supplemental Welding: Course Content**

Specific levels of preparatory skill development training, whether they be beginning or advanced phases, normally have a very structured course that have a commonality of related and practical training activities that differ very little from one training institution to another.

Supplemental skill development training activities also encompass traditional content and performance activities which are common to the trade or professional area and are also incorporated in the course no matter where it is conducted. Yet, beyond standardized training content and/or activities there is the regionalization factor or in some cases a localization factor of employment practices that make for uniqueness in supplemental training. In short, the performance skill development activities are manifestations of the industrial community in which the training is held.

In the determination of the type and kind of skill development that
should be presented to welding students, in the supplementary course, in this project was left basically to the instructors both of whom have taught adult welding courses for a five-year period at the Eastland Center. In addition to relying upon the teaching experience of the instructors, assistance was available from a representative advisory committee that had been established to provide assistance for the day school welding program.

While videotape recording is considered a very different medium from films, the steps in the production of one or the other is not necessarily a disparate activity.

Kemp and Szumski have listed several steps in two categorical divisions in film production labeled as preliminary planning and film planning. Four steps or phases are found in the preliminary planning stage: (1) start with an idea for filming, (2) develop a statement of the objective for the film, (3) determine the needs and characteristics of the audience, and (4) an outline of the subject content of film. Film planning is composed of three steps: (1) develop the treatment of how to handle the content, (2) create story boards that pictorially show the sequences described in the treatment, and (3) develop the script which is based on the treatment and story board and consists of a listing of specific scenes to be filmed with accompanying narration, description of content, and an indication of camera position.²

Developing the Videotapes

Two welding demonstrations were filmed by the video process: a 25-minute presentation on the demonstration of the multiple-pass fillet weld in the horizontal position, and a 36-minute presentation on the demonstration of the multiple-pass fillet weld in the vertical position.

The process by which the demonstrations were filmed has been mentioned briefly before in an earlier chapter, but a more detailed explanation is presented here.

The first stage of the process was to determine the welding operations that would be presented to the subjects. Since the instructors did not want to change the pattern they had been using in the past (the program has met widespread acceptance in the community), it was decided to use three of the existing welding operations that had been offered during the course over the past several years. The three operations that were decided upon were the multiple-pass fillet weld in the horizontal position, stringer pattern (this was the pretest), the multiple-pass fillet weld in the horizontal position, weave pattern (first test), and the multiple-pass fillet weld in the vertical position, weave pattern (second test).

Again it should be pointed out that no formal instruction was provided prior to the pretest. Because of the purpose underlying supplementary training activities and the fact that the difficulty factor associated with the weld operation selected for the pretest exercise, no instruction was given.
Conceptually speaking, the final selection of practical exercises used in the project possessed a considerable amount of commonality. Each test: pretest, first and second tests, were all fillet welds. The pretest was a fillet weld in the horizontal position, stringer pattern. The first test was a fillet weld in the horizontal position, weave pattern. And, finally, the second test was a fillet weld in the vertical position, weave pattern. Basically, the only marked difference among the practical exercises were in the positions in which the weldments were made, the type of welding electrode used, and the manipulative pattern utilized in making the weld. Because of the similarity among the exercises, it would be reasonable to assume that the final test (second practical exercise) would exhibit satisfactory characteristics of welding as a result of the accumulation of learning.

The second stage of the process was to develop lesson plans that would insure that adequate instruction would be offered leading to the ultimate objective of teaching the welding operation. (See Appendix A.) After the lesson plans had been developed they were reviewed and changed to more closely meet the stated objectives.

From the lesson plan development the next step was to develop the scenario which describes both the audio as well as the video portions of the scene that was to be filmed. (See Appendix C and D.) The development of the scenario consisted of illustrating each scene of the videotape on story
boards which provided not only a visual of the activity but gave direction to the cameraman and provided the key points of the commentary that would accompany each scene. The development of the story boards was then correlated with the lesson plans previously written. A continual revision of both the lesson plans and the story board (scenario) took place until each scene that had been planned was accurate and provided a sound educational approach in presenting the lesson.

Upon completing the scenario, the instructors rehearsed their performances. They first made a simulated attempt at taping with all the equipment in position and operational but without actually filming the scene. After the instructors became comfortable with being before the camera, they rehearsed their performance before a live camera. Several minutes of the instructor's performance was filmed and then immediately played back over the monitor to give the instructor an idea of how he would appear on the television receiver. The playback also provided the cameraman with an actual vantage of his method and thereby gave him the opportunity to make the necessary changes in the camera angles and filming and lighting technique.

After approximately 45 minutes of simulated and live rehearsal time the actual filming took place. The ratio of time devoted to the filming of the demonstration was approximately 10 minutes of videotape recording for every one minute of usable videotape. Considerable time was also taken up
by instant editing of the demonstration. Using this particular characteristic of videotaping it was possible to immediately erase an unsuccessful performance or an obvious mistake and retake or refilm the entire scene or a segment of the scene.

Although there were many technical and non-technical problems, that arise during the project, the major ones that gave the most serious problems are listed below.

(1) Overcoming the instructor’s initial fear of being filmed.

(2) Making a transition from one scene to another; both in camera work as well as instructor performance.

(3) Making a physical set-up from one area of the laboratory to another.

(4) Developing the proper filtration and lighting techniques to shield the camera and make an accurate and comprehensive film.

(5) Reducing the verboseness of instructor.

(6) Slowing the performance of the instructor as he demonstrated. It was necessary to reduce the performance that was filmed to slower than normal rate in order that all action was caught by the camera.

(7) Keeping the commentary (audio portion) separate and distinct from noise of welding operation.

Upon either overcoming or circumventing the obstacles associated with videotaping the demonstrations were finally completed with 36 and 25
minute performances captured on videotape. The videotaping was made with a Sony CC-4000 camera with zoom lens. A Javelin X-400 model video-tape recorder was used and the film was monitored on a television receiver with a 10-Inch viewing screen.

The videotapes were further edited and the instructors were given directions on presenting the videotaped lesson to their respective classes. (See Appendix E.)

At a predetermined time during the course each group was assigned to a specific viewing room and assembled in a manner so that each member of the class could view and hear the television receiver without interference.

The instructor indicated to his particular group of students the lesson that was to be exhibited and indicated to them to be alert for specific key points in the exhibition of the videotape.

After viewing the videotape time was allowed for responses in the form of questions to be made by members of the class. When the instructor was relatively certain each member comprehended the instructional session they were then directed to the laboratory where they were allowed to practice under the supervision of the instructor. Upon the completion of the prescribed practice time the subjects were given test material and supplies and allowed to perform a test of their welding skills.

The test samples were later coded according to the specific class or group and by the individual who made the test. These test samples
were submitted to an independent laboratory for a critical destructive evaluation.
CHAPTER V

QUALITATIVE ANALYSIS OF WELDMENTS

After the weld coupons were completed, it then became necessary to devise a method of analyzing the weldments to determine their degree of quality and thereby providing data to establish a relationship with the type of instructional technique used. See Appendix F for weld coupon evaluation and the recorded data.

Obviously a performance type evaluation was made of the subject's ability to weld rather than an achievement test of their knowledge. Granted that the subjects did possess considerable knowledge about welding but the ultimate test was to determine if their manipulative skill was the result of one teaching method over another and by how much.

Seal reported in his study that:

Written tests are not valid for the measurement of manipulative skills. The fact that a student can supply flawless answers to questions about how to cut a mortise and tenons joint does not constitute positive proof that he can actually cut the joint with any acceptable degree of skill.¹

The coupons were delivered to an independent testing laboratory which was considered very expert as materials jointing consultants. The evaluation could have been carried out without benefit of the independent testing laboratory but the factor of objectivity might have been lost or at least distorted.

**Types of Testing**

Two of the most common types of welding evaluations made by testing laboratories are non-destructive and destructive evaluations. Again citing Seals, he reported in his study that:

> For some types of work a visual examination of the weld may be sufficient... the limitation of this kind of examination is that there is no way of knowing if internal defects exists in the welded area. The outer appearance of the weld may be satisfactory, yet porosity, cracking, lack of fusing, or excessive grain growth may be present.\(^2\)

The non-destructive test is simply a visual examination of the weld.

Methods which may be categorized as non-destructive testing include:

1. Visual inspection
2. Magnetic particle inspection
3. Liquid penetrant inspection

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4. Ultrasonic inspection
5. X-ray Inspection
6. Eddy current inspection
7. Mass spectrometer detection
8. Air pressure leak tests
9. Hologen gas leak tests

Methods which may be classified as destructive testing include the following:

1. Tensile strength
2. Chemical analysis
3. Bend test
4. Microscopic test
5. Macroscopic test
6. Hardness test
7. Charpy test
8. Hydrostatic test of destruction

The destructive testing of welds actually distorts the weldment by various means in the determination of the quality of the weld.

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In the qualitative analysis of the weld coupons in this study the destructive type evaluation was carried out. Specifically, the tests were classified as the bend test and the macroscopic test.

The samples (coupons) had approximately one inch of the material removed from each end of the coupon and the weld was then polished and etched with solution of nitric acid. This process provided data for six basic subtests: appearance, undercut, surface porosity, corner penetration and leg dimension (included two parts). See Figure 6 for an illustration of the coupon prior to evaluation.

After the first series of destructive tests were carried out, the main body of the weld sample was further subjected to destructive evaluation whereby the weldment was compressed toward the weld side until the weldment was fractured.

This provided another series of subtests: root fusion, soundness, porosity, slag, and inclusions. See Figure 7 for illustration of the weld coupon prior to the second test.

**Subtest Description**

The following statements are an attempt to describe (not define) the different subtests made on the coupons.

**Appearance**—An overall test or evaluation of the weldment was made in terms of general appearance. This included such factors as bead
Figure 6—Weld Coupon Prepared for Macroscopic Evaluation
Figure 7--Weld Coupon in Second Phase of Destructive Testing
contour, bead formation, bead deposit, bead width and general conformation of the weld.

**Undercut**—That physical characteristic that indicates that the parent metal has been oxidized or cut away by the welding process. This process tends to weaken the overall weldment and its specific degree of severity is a realiable indicator of the quality of the weld.

**Surface Porosity**—That characteristic that exhibits a smooth unbroken surface of the weldment. Various factors that effect this condition: too rapid oxidation of the filler material, the inclusion of gaseous substance into the surface of the weld and the inclusion of slag, or other foreign material within the weld.

**Corner Penetration**—The atomic bonding or fusion of the filler material and the base metal particularly at the corner section. That is the fusion of the weld as viewed from a radial axis rather than from a longitudinal axis or plane.

**Macroscopic Inspection**—Is that characteristic that exhibits the amount of the base and vertical legs of the weldment that are covered in the welding operation. Approximately the same amount (thickness) of the plates being welding should be included in each leg of the weld. For example: plates with a dimension of 3/8, welding by a fillet weld, should have a dimension of the vertical leg and base leg of no more than 3/8" for each leg.
The second phase of the coupon evaluation made by the laboratory included an examination of specific characteristics of the quality of the weld after a second destructive test was made on the sample coupon.

**Root-Fusion**--The degree of or amount of fusion the weld has made with the material being joined. Sometimes this characteristic is described as the atomic bonding that is present. Usually this evaluation is made upon the first pass of the weld in a multiple pass weldment such as a fillet weld.

**Soundness**--That characteristic that describes the weld in terms of quality that may be further analyzed to ascertain absolute qualitative data. Tests that may be used to describe the soundness of the weld are tensile strength, ductility, fusion, penetration and crystalline structure.

**Porosity**--That characteristic that would describe the weldment as containing pockets or vacant areas within the weldment. Like surface porosity, these pockets may be caused by too rapid oxidation during the weld operation or the inclusion of foreign material, either as gaseous or in solid form. Unlike surface porosity these occur in the body of the weld.

**Slag**--That characteristic that exhibits that an amount of foreign material (oxidized flux) became included in the weldment. Usually occurs due to lack of proper cleaning the weld as additional electrodes are added to the weldment.

**Inclusions**--That characteristic that describes the fact that foreign
material is included in the weldment. Examples of such are: slag, scale, oxidation, and gas pockets.
CHAPTER VI

ANALYSIS OF DATA

In an effort to analyze the weld samples (the test coupons) completed by the students, nineteen different sets of weld samples were submitted to an independent testing laboratory for destructive type evaluation of each of the samples.

There were six students who each completed three different samples from Group A (Monday/Tuesday section) and thirteen students who each completed three different weld specimens from Group B (Wednesday/Thursday section).

A total of 57 different weld coupons were analyzed for different characteristics that indicated the degree, or lack of degree, of the quality of the weldment. (See Appendix F.)

Each student's weld coupons represented a pretest of a multiple-pass fillet weld in the horizontal position using the stringer pattern, the first test of a multiple-pass fillet weld in the horizontal position using the weave pattern, and the second test a multiple-pass fillet weld in the vertical position using a weave pattern.
Each test sample was subjected to two destructive tests each having a series of five subtests. The results of the total of ten tests were recorded and the data was transmitted to the statistics department, The Ohio State University, for further analysis.

The data was analyzed by two types of statistical treatment: Analysis of Covariance and the Wilcoxon-Mann-Whitney Two Sample Test.

Downie and Heath state a condition under which the experimenter may use Analysis of Covariance to test a hypothesis.

It sometimes happens that the experimenter cannot completely control all of the variables relevant to his research. For example, he might randomly assign high-school physics students to each of two types of instruction—one with films and the other without the use of such aids. Even though student assignment has been random, it may be that the two groups of students differ significantly in academic ability. To test for the significance of any difference in physics achievement, it is necessary to account for the influence of differences in prior ability.

A method is available for testing the significance of differences among means which have been influenced by one or more uncontrollable variables. This method is called analysis of covariance. In effect, analysis of covariance adjusts the means for the effect of the uncontrolled variable (academic ability in our example) and makes the necessary modifications in sampling error. The correct sampling error is then used to test for the significance of differences among adjusted means.\footnote{N. M. Downie and R. W. Heath, \textit{Basic Statistical Methods}, New York, Harper and Row Publishers, 1965, p. 186.}
Kerlinger reported that:

One of the major difficulties of educational and sociological research is our inability to set up experimental groups at will. Administrators and teachers, for example, are understandably reluctant to break up classes. The investigator often must use classes intact. Through the analysis of covariance it is often possible to control class or other group differences statistically.  

The second statistical test used in the analysis of the data was the Wilcoxon-Mann-Whitney Two Sample Test. This is a modification of the Mann-Whitney U Test.

Siegel reported that one of the most powerful of the nonparametric tests is the Mann-Whitney U Test.

When at least ordinal measurement has been achieved, the Mann-Whitney U Test may be used to test whether two independent groups have been drawn from the same population. This is one of the most powerful of the nonparametric tests, and it is a most useful alternative to the parametric t test when the researcher wishes to avoid the t test's assumptions, or when the measurement in the research is weaker than interval scaling.  

Analysis of Pretest Scores

Prior to making an Analysis of Covariance Test on the data for significant difference, a statistical test of Analysis of Variance was carried


out to determine if there was any similarity or difference between the two groups on the pretest scores. Table 1 illustrates the results from the statistical test.

**TABLE 1**

**ANALYSIS OF VARIANCE OF TOTAL PRETEST SCORES**

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>D.F.</th>
<th>Mean Square</th>
<th>Observed F</th>
<th>Tabulated Values (.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11,055.50</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Mean</td>
<td>10,345.45</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>0.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6.04</td>
</tr>
<tr>
<td>Demonstration</td>
<td>0.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6.04</td>
</tr>
<tr>
<td>Subjects</td>
<td>695.25</td>
<td>17</td>
<td>40.89</td>
<td>12,528.1</td>
<td>2.65</td>
</tr>
<tr>
<td>Group</td>
<td>14.74</td>
<td>1</td>
<td>14.74</td>
<td>4,588.59</td>
<td>6.04</td>
</tr>
<tr>
<td>Residual</td>
<td>.055</td>
<td>17</td>
<td>.0032</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above Analysis of Variance table, it is evident that there is a significant difference of the pretest scores between the two groups, $4,588.59 > 6.04$ and a significant difference of the pretest scores of the subjects (students) within the group $12,528.1 > 6.04$.

Since the two groups of students were not selected on any specific basis and the purpose of the adult vocational education course was one of supplemental or upgrading, it was not surprising to find that there was a significant difference between pretest scores.
The variation of experience and education, and many other variables not controlled in the study may well have effected the large variation.

Upon completion of the Analysis of Variance, the data was subjected to Analysis of Covariance statistical techniques.

Analysis of Covariance

The following hypothesis was tested by means of Analysis of Covariance.

\( H_0 \) Adult vocational education students learn the techniques of specific welding operations equally well by receiving instruction either from a videotape recording or by a demonstration-performance technique.

\( H_1 \) Adult vocational education students learn the techniques of specific welding operations significantly better by receiving instruction from one type of teaching technique as compared with another instructional method.

The statistical model of analysis of covariance used to test the hypothesis is described below.

\[
E \ Y_{i,j,k,l} = u + g_i + t_j + d_k + p_{1(l)} + \epsilon_{ijkl} \]

\( E = \) Expected value

\( Y_{i,j,k,l} = \) observed value corresponds to group \( i \), test \( j \), demonstration \( k \) and subject \( l \);
or = the score of the student i in group l taking test j under demonstration k.

\[ z_{ijkl}(i) = \text{pretest score for subject } i(i) \text{ in group } l \text{ taking test } j \text{ under demonstration } k \]

Where

- \( u = \text{grand mean} \)
- \( g = \text{group, } l = \text{group A or group B} \)
- \( t = \text{test, } j = \text{test 1 or test 2} \)
- \( d = \text{demonstration, } k = \text{d}_1 \text{ video/live, } d_2 \text{ video/live} \)
- \( p = \text{subject, } i(i) \)

The following is the Analysis of Covariance table for the above model.

### TABLE 2

RESULTS FROM THE ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>D. F.</th>
<th>Mean Square</th>
<th>Observed F</th>
<th>Tabulated Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group effect</td>
<td>12.96</td>
<td>1</td>
<td>12.96</td>
<td>1.00</td>
<td>2.40 (1, 36:05)</td>
</tr>
<tr>
<td>Test effect</td>
<td>5.16</td>
<td>1</td>
<td>5.16</td>
<td>0.39</td>
<td>2.40 (1, 36:05)</td>
</tr>
<tr>
<td>Demonstration effect</td>
<td>5.02</td>
<td>1</td>
<td>5.02</td>
<td>0.68</td>
<td>2.99 (1, 16:05)</td>
</tr>
<tr>
<td>Pretest effect</td>
<td>9.00x10^-6</td>
<td>1</td>
<td>900x10^-6</td>
<td>0</td>
<td>2.92 (1, 17:05)</td>
</tr>
<tr>
<td>Residual effect</td>
<td>118.13</td>
<td>16</td>
<td>7.38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The observed value of F for group effect was obtained by dividing the M.S. of the group effect by the M.S. of the residual effect after group effect was taken into account.

The observed value of F for the test effect was obtained by dividing the M.S. of the test effect by the M.S. of the residual effect after taking test and group effect into account.

The observed value of F for the demonstration effect was obtained by dividing the M.S. of the demonstration effect by the M.S. of the residual effect after the demonstration effect, test effect, and group effect were taken into account.

Finally the F value for the pretest effect was obtained by dividing the M.S. of the pretest effect by the M.S. of the residual effect after taking into account the demonstration effect, test effect and group effect.

The criterion for acceptance or rejection of the hypothesis is as follows:

If the observed F value for a particular hypothesis is greater than the corresponding tabulated F (v₁, v₂:05) value we reject the null hypothesis and accept the alternative at 5 percent level of significance for a two-tailed test, otherwise we reject the alternative and accept the null hypothesis.

Based on this criterion and the information given in the Analysis of Covariance table the following conclusion is obtained.

When taking all the variables of the experimental design into account,
through Analysis of Covariance, there is no significant difference between instruction by videotape recording and live demonstration performance in learning specific welding operations. The null hypothesis was accepted in this situation.

**Additional Hypotheses Tested**

After the determination that no significant difference existed between the two different teaching techniques, as brought out by the Analysis of Covariance test further analysis was carried out using the second statistical technique; that of the Wilcoxon-Mann-Whitney Two Sample Test. The following hypotheses stated in both the null form and the alternate form were tested.

\[ H_0 \quad \text{Adult vocational education students learn the techniques of completing a multiple-pass fillet weld in the horizontal position equally well by either a videotape recording or by a demonstration performance technique.} \]

\[ H_1 \quad \text{Adult vocational education students learn the techniques of completing a multiple-pass fillet weld in the horizontal position significantly better by means of one type of teaching technique as compared with another instructional method.} \]

The statistical method used to test the hypothesis was the Wilcoxon-Mann-Whitney Two Sample Test and is described by the following method.
Where $W$ is the observed Wilcoxon value from the data and $\text{E}(W)$ and $\text{Var.}(W)$ are defined as the expected value and the variance of $W$ respectively.

$$W^* = \frac{151 - 130}{\sqrt{11.4}} = \frac{21}{11.4} = 1.842$$

Since the sample size is large enough, the technique of large sample approximation is applicable. The normal approximation of $W$ is

$$W^* = \frac{W - \text{E}(W)}{\sqrt{\text{Var.}(W)}}$$

The reason behind this fact is that when the sample becomes larger and larger, $W^*$ behaves more and more like a standard normal curve.

The observed value of 1.842 is compared with the upper 5 percent critical value of the standard normal table which is 1.64. If $W^* > 1.64$ the null hypothesis is rejected, otherwise we accept it. In our example:
So, \( H_0 \) is rejected and hence the alternate hypothesis \( H_1 \) is accepted at the .05 level of significance.

In this particular situation, where Group A and Group B received instruction by videotape recording and live demonstration performance respectively, on test number one, it was found that the live demonstration performance was significantly better.

To state it another way, under given conditions, it is more effective to teach adult vocational education students the welding operation associated with the multiple-pass fillet weld in the horizontal position by the traditional live demonstration-performance method than by a videotape recording technique.

\( H_0 \) Adult vocational education students learn the technique of completing the multiple-pass fillet weld in vertical position equally well with either a videotape recording or by the demonstration performance method.

\( H_1 \) Adult vocational education students learn the technique of completing a multiple-pass fillet weld in the vertical position more effectively by means of one teaching technique as compared with another instructional method.
\[ W = u + \frac{n(n+1)}{2} \quad m = 13 \]
\[ W = u + \frac{6(6+1)}{2} \]
\[ W = 26 + \frac{6 \times 7}{2} = 47 \]
\[ E(W) = \frac{n(m+n+1)}{2} = \frac{6(13+6+1)}{2} = \frac{6(20)}{2} = \frac{120}{2} = 60 \]
\[ \text{Var.}(W) = \frac{mn(m+n+1)}{12} \]
\[ \text{Var.}(W) = \frac{13 \times 6(13+6+1)}{12} = \frac{6 \times 13 \times 20}{12} = 11.4^2 \]
\[ W^* = \frac{W - E(W)}{\sqrt{\text{Var.}(W)}} = \frac{47 - 60}{11.4} \]
\[ W^* = 1.14 < 1.64 \]

This null hypothesis was accepted since 1.14 < 1.64 is not significant.

In this case either method of instruction might have been effective in teaching welding skills.

Lack of any significant differences between the videotape recording and the demonstration performance method might also be the result of two other factors. (1) There was a great deal of similarity between the pretest, test number one, and test number two. It just may have been that the manipulative operations were so alike among the tests that the instructional treatment had little or no effect or stated another way, that the treatment effect could
not be discernible by present statistical methods.

(2) The second factor that might have been in play during this section
test was that of the additive factor. Because of the previous time spent on
supervised practice and test administration the subjects accumulated an
amount of learning or in this case performance of manipulative skills to such
a degree so as to cancel out any effect from a teaching technique.

\[ H_0 \quad \text{Adult vocational education students learn the techniques of completing the multiple-pass fillet weld in both the horizontal and vertical position equally well with either a videotape recording or by the demonstration performance technique.} \]

\[ H_1 \quad \text{Adult vocational education students learn the technique of completing a multiple-pass fillet weld in both the horizontal and vertical position significantly better by means of one teaching technique as compared with another instructional method.} \]

\[
W = u + \frac{n(n + 1)}{2} \\
W = 200 + \frac{19(20)}{2} \\
W = 200 + 190 = 390 \\
E(W) = \frac{n(m + n + 1)}{2}
\]
\[ E(W) = \frac{19 \cdot (19 + 19 + 1)}{2} = \frac{19 \cdot (39)}{2} = 370.5 \]
\[ \text{Var.}(W) = \frac{mn(m+n+1)}{12} \]
\[ \text{Var.}(W) = \frac{19^2 \cdot 39}{12} = \frac{361 \cdot 39}{12} = 1173.25 \]
\[ W^* = \frac{W - E(W)}{\sqrt{\text{Var.}(W)}} = \frac{390 - 370.5}{\sqrt{1173.25}} = \frac{19.5}{34.26} = .5692 \]
\[ W^* = .5692 < 1.64 \]

Like the preceding null hypothesis, this one too was also accepted since the calculated value of .5692 was less than the value associated with significance; that of 1.64. In this particular situation neither method of instruction was significantly effective over the other. Learning the techniques of welding, in this case, could have been done equally well by either teaching method.
CHAPTER VII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine whether or not adult vocational education students could be effectively instructed in specific welding operations by two different teaching techniques.

Two independent groups of male students, who enrolled in adult vocational education supplementary welding course, acted as the subjects in the research study. Each group was administered a pretest covering a basic welding operation and were then given instruction relative to two additional welding operations: one operation was taught by means of a videotape recording and the other operation was taught by traditional demonstration-performance method.

The two instructors, who taught the course, had each made a videotape recording of one of the welding operations that was later used as an instructional vehicle to a group of students not his own. Each instructor also taught the second of the two operations by the demonstration-performance method.
After the instruction (by each of the two methods) was given, the subjects participated in a period of supervised practice and were then administered a performance test to ascertain the effectiveness of the teaching technique used.

The three specific welding operations on which the subjects were evaluated were: pretest; multiple-pass fillet weld in the horizontal position using a stringer pattern; first test, a multiple-pass fillet weld in the horizontal position, using a weave pattern; and the second test, a multiple-pass fillet weld in the vertical position, using the weave pattern.

The three test samples of each of the subjects were submitted to an independent test laboratory where the samples were subjected to destructive type evaluation.

Conclusions

From the information provided by the testing laboratory, several hypotheses that had been generated earlier were tested by two different statistical tests: Analysis of Covariance and the Wilcoxon-Mann-Whitney Two Sample Test.

The four hypotheses, stated in null form, that were formulated in the study and the results from the statistical tests to which they were subjected follow.
**Hypothesis**

$H_0$ Adult vocational education students learn specific welding operations equally well by receiving instruction either from a videotape recording or by a demonstration-performance teaching technique.

**Result**

When taking all the variables of the experimental design into account through Analysis of Covariance, there is no significant difference between instruction by videotape recording and live demonstration performance technique in learning specific welding operations. The null hypothesis was accepted in this situation.

**Hypothesis**

$H_{01}$ Adult vocational education students learn how to make a multiple-pass fillet weld in the horizontal position equally well by either a videotape recording or by a demonstration performance technique.

**Result**

Since the observed value of 1.842 was larger than the tabulated value of 1.64 ($1.842 > 1.64$) then the null hypothesis was rejected. This was at the 5 percent critical value of the standard normal table.

In this particular situation, the traditional demonstration performance teaching technique was better than videotape recording for teaching a
multiple-pass fillet weld in the horizontal position.

**Hypothesis**

$H_{02}$ Adult vocational education students learn how to make a multiple-pass fillet weld in the vertical position equally well with either a videotape recording or by the demonstration performance method.

**Result**

The null hypothesis was accepted in this case since the observed value of 1.14 was less than the tabulated value of 1.64 ($1.14 < 1.64$).

**Hypothesis**

$H_{03}$ Adult vocational education students learn how to make a multiple-pass fillet weld in both the horizontal and vertical positions equally well with either a videotape recording or by the demonstration-performance technique.

**Result**

Since the observed value of 0.5692 was less than the tabulated value of 1.64 ($0.5692 < 1.64$) the null hypothesis was accepted.

In all but one situation the null hypotheses were accepted. In general, it may be equally effective to teach specific welding operations by either videotape recording or by the traditional demonstration performance method.
Apart from the instructional effectiveness, the fact that videotape recordings are used may well save instructional time, provide for tutorial assistance and provide a motivational factor that may be missing in traditional teaching practices.

**Recommendations**

From the results of the study it is recommended that:

1. That videotape recordings be utilized as the initial instructional technique in other occupational and professional training activities,

2. The study be replicated with preparatory level subjects rather than with experienced trainees,

3. That the study or variation of the study might be carried out at the secondary level of occupational training.
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Unpublished Works


APPENDIX A

Course Outline for Adult Vocational Education 717: Welding
Outline for
Adult Education 717
Welding

I. Orientation

A. Rules and regulations
B. Organization of instruction
C. Course objectives
D. Safety
   1. Oxygen and acetylene
   2. Electric arc welders
      a. arc burns (eyes)
      b. burns from spatter and slag
      c. shock treatment
   3. Hood and goggles
   4. Proper clothing
      a. gloves
      b. shoes
      c. special protective clothing

II. Orientation to Electric arc welding

A. Types of welder
   1. Hobart
   2. Miller
   3. Westinghouse
B. Familiarization practice
   1. Running beads (stringer pattern)
   2. Correct current setting
   3. Technique for filling crater
   4. Types of electrodes

III. Multiple pass welding-horizontal position

A. Electrode classification
B. Running multiple passes (stringer pattern)
   1. Correct current setting
   2. Utilizing different electrodes
      a. E-6010, 1/8" diameter
      b. E-6011, 1/8" diameter
c. E-6013, 1/8” diameter

3. Utilizing different polarity

C. Pretest

IV. Multiple pass welding-horizontal position

A. Demonstration: videotape/live
B. Running multiple passes (weave pattern)
   1. Control of weld contour
   2. Control of weld penetration
   3. Control of weld undercut

C. First test

V. Continuation: multiple pass welding-vertical position

A. Demonstration: videotape/live
B. Running multiple pass (weave pattern)
   1. Control of weld contour
   2. Control of weld penetration
   3. Control of weld undercut

VI. Continuation: multiple pass welding-horizontal position (weave pattern)

A. Warm-up period
B. Second test
C. Running passes with E-6010 and E-6011, 5/32” diameter electrodes
D. Manipulation of electrode

VII. Continuation: multiple pass welding-horizontal position

A. Control of weld contour
B. Control of weld penetration
C. Control of weld undercut
D. Manipulation of electrode

VIII. Continuation: multiple pass welding-vertical position

A. Current setting
B. Polarity
C. Control of weld contour
D. Control of weld penetration
E. Control of weld undercut

IX. Continuation: multiple pass welding-vertical position

A. Control of weld contour
B. Control of weld penetration
C. Control of weld undercut

X. Exhibition of film: "Welding in the Overhead Position"

XI. Continuation: multiple pass welding-overhead position

A. Running passes with E-6010 and E-6011, 1/8" diameter electrodes
B. Control of weld contour
C. Control of weld penetration
D. Control of weld undercut

XII. Continuation: multiple pass welding-overhead position

A. Manipulation of electrode

XIII. Acetylene torch-cutting procedures

A. Controls on torch mechanisms
B. Regulator setting-oxygen
C. Regulator setting-acetylene
D. Lighting the torch
E. Adjustment of flame
F. Cutting techniques

XIV. Acetylene torch-welding without filler rod

A. Tip sizes
B. Regulator setting-oxygen
C. Regulator setting-acetylene
D. Torch controls
E. Adjustment for correct envelope
F. Manipulation of torch-running beat without filler rod
XV. Acetylene torch-lap weld with filler rod
   A. Preparation of metal
   B. Setting up torch
   C. Making weld on 16 gauge metal

XVI. Acetylene torch-lap weld with filler rod
   A. Preparation of metal
   B. Setting up torch
   C. Making weld on 16 gauge

XVII. Acetylene torch butt weld without filler rod
   A. Preparation of metal
   B. Setting up torch
   C. Making the weld

XVIII. Acetylene torch-butt weld with filler weld
   A. Preparation of metal
   B. Setting up torch
   C. Making the weld

XIX. Acetylene torch-brazing-running beads
   A. Preparation of metal
   B. Flux
   C. Control of heat
   D. Manipulation of torch

XX. Acetylene torch-brazing-lap joint
    A. Preparation of metal
    B. Flux
    C. Setting up torch
    D. Making the weld

XXI. Acetylene torch-welding stainless steel
    A. Characteristics
    B. Preparation of metal
C. Setting up torch
D. Making the weld

XXII. Acetylene torch-welding aluminum

A. Characteristics of metal to be joined
B. Preparation of metal
C. Setting up torch
D. Making the weld

XXIII. Acetylene torch-welding cast iron

A. Characteristics of cast iron
B. Pre-heating
C. Setting up torch
D. Making the weld

XXIV. Special welding processes

A. Metal inert gas welding
B. Tungsten inert gas welding
APPENDIX B

Lesson Plans: Demonstration Performance
Fillet Weld-Horizontal
Fillet Weld-Vertical
LESSON PLAN

(Demonstration-Performance Method)

LESSON TITLE:  Making Multiple Pass Fillet Weld; Horizontal Position

COURSE:  Adult Education; Supplemental Training

INSTRUCTOR:  Walter Kefauver

LESSON OBJECTIVE:  The objective of this lesson is for each student to be able to weld correctly a horizontal fillet weld.

DESIRED LEARNING OUTCOMES:

Each student should --

1. Know the characteristics of E-6010 electrode
2. Know and exhibit correct electrode speed, angle tolerance during the welding operation
3. To execute the correct root pass (1st pass)
4. To execute the correct 2nd pass
5. To execute the correct 3rd pass
6. To properly adjust the amperage section of the welder
7. To perform an adequate weld that usually exhibits correct bead contour, penetration, and no excessive undercut

INSTRUCTOR REFERENCES:

1. Welding Skills and Practices

INSTRUCTOR AIDS:

1. Chalkboard and chalk
2. Supply of materials to be welded
3. ARC Welder (220 amp capacity)
4. Welding hood, chipping hammer, pliers, and wire brush
5. Supply of E-6010 electrodes
HANDOUT MATERIALS: None

STUDENT PREPARATION: None

TIME REQUIRED: 25 minutes

PLAN OF PRESENTATION:

After the introduction, the instructor will explain specific terminology as he develops various views of the metal plates on the chalkboard. He will then simulate the welding operation before the group and emphasize the important points of the operation. He will then adjust the arc welder and proceed to make an actual weld, joining two pieces of material. Students will practice this operation at their respective work station under the supervision of the instructor.

---

1 Instructor will review the key points and the welding operation.

2 Each student's proficiency will then be assessed in a final welding operation.
### PART II

**Student Outcomes** | **Student Activity** | **Instructor Activity**
--- | --- | ---

A. **INTRODUCTION**

1. **Becomes attentive and focus on the subject at hand.**
   - 1. Listens to instructor discuss and explain the particular weld operation.
   - 1. Discuss the reason for this type of weld.

2. **Realizes the need for learning the correct welding technique.**
   - 2. Listens and projects himself into situations where this weld operation will be needed.
   - 2. Illustrates the weld operation on the chalkboard.

3. **Realizes that he will learn the skill by the end of the session.**
   - 3. Listens and realizes the plan of instruction.
   - 3. Explains objectives of the session and outlines procedures.

   a. become familiar with electrode classification

   b. understands factors that effect the quality of the weld

   c. hear a running commentary during the demonstration
Part II — continued

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Student Activity</th>
<th>Instructor Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>d. practice under supervision</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e. complete sample for evaluation</td>
</tr>
</tbody>
</table>

B. DEVELOPMENT

Explanation Demonstration

1. Know the symbols and their meaning of the specific electrode and can relate it to other electrodes.
   1. Listen, observe, and understand the alpha and numeric symbols.
   1. Illustrates on the chalkboard by a breakdown of the E-6010 Code.
      a. has the class explain code of the E-6010 Code.

2. Knows and understands his procedures for the correct electrode position; angle held, clearance maintained.
   2. Observes and comprehends the factors.
   2. Simulates weld and operation and exhibits the correct angle and clearance.
      a. uses chalkboard illustration to reinforce concept.

3. To know, understand the correct speed or rate of electrode movement.
   3. To observe and comprehend the demonstration.
   3. Simulate the rate of electrode movement.
Part II -- continued

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Student Activity</th>
<th>Instructor Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. To know and understand and execute the correct method of making a root pass weld operation.</td>
<td>4. To observe and comprehend the demonstration.</td>
<td>4. Simulate a root pass weld operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. execute a root pass weld.</td>
</tr>
<tr>
<td>5. To know, understand and be able to execute the correct method of making a second pass weld operation.</td>
<td>5. To observe and comprehend the demonstration.</td>
<td>5. Simulate a second pass weld operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. illustrate the weave pattern on the chalkboard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. simulate the weave pattern of the second pass weld operation.</td>
</tr>
<tr>
<td>6. To know, understand and be able to correct method of making a third pass weld operation.</td>
<td>6. To observe and comprehend the demonstration.</td>
<td>6. Simulate the third pass weld operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. illustrate the weave pattern on the chalkboard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. simulate the weave pattern of the third pass weld operation.</td>
</tr>
<tr>
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<td>Instructor Activity</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>7. To know, understand and be able to execute the correct setting of the welding equipment.</td>
<td>7. Observe and comprehend the adjustment of the welding equipment.</td>
<td>7. Execute the adjustment of the welding equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. adjusts the major amperage control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. adjusts the minor or fine control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. selects the correct polarity setting.</td>
</tr>
<tr>
<td>8. To know, understand and be able to execute the correct method of making a root pass weld operation.</td>
<td>8. To observe and comprehend the demonstration.</td>
<td>8. Execute the correct method of making the root pass weld operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. adjusts the welding equipment for demonstration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. executes a root-pass weld.</td>
</tr>
<tr>
<td>9. To know, understand and be able to execute the correct method of making a second pass weld operation.</td>
<td>9. To observe and comprehend the demonstration.</td>
<td>9. Executes the correct weave pattern in making the second pass weld operation.</td>
</tr>
</tbody>
</table>
Part II -- continued

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<thead>
<tr>
<th>Student Outcomes</th>
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<th>Instructor Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. To know, understand and be able to execute the correct method of making a third pass weld operation.</td>
<td>10. To observe and comprehend the demonstration.</td>
<td>10. Executes the correct weave pattern in making the third pass weld operation.</td>
</tr>
</tbody>
</table>

**SUMMARY**

1. Recalls the definitions of the alpha and numeric symbols of the welding electrode.

2. Remember the rate of travel, the angle of electrode and the clearance between electrode and weld.

3. Recalls the ampere setting; major and fine adjustment.

4. Can evaluate the weld configuration, penetration, and undercut.

1. Listens and understands the coding system.

2. Listens and mentally checks factors that will effect weld.

3. Observes and visualizes the methods of adjustment.

4. Observes and can visualize the completed weld.

1. Reviews the coding of the electrode.

2. Reviews the rate of travel, the angle of the electrode and the clearance factor.

3. Review the proper procedure for setting the welding controls.

4. Reviews weld operations; root pass, 2nd pass and 3rd pass.
<table>
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<tr>
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<th>Instructor Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Recognizes that the lesson is complete.</td>
<td>5. Realizes that the lesson is complete.</td>
<td>5. Established closure, exhibiting correct weld specimen.</td>
</tr>
</tbody>
</table>

**Supervision**

1. Be able to execute the weld operation: root pass, 2nd pass, and 3rd pass.

   1. Practices the welding operations.

   1. Assigns students to specific stations in the laboratory and have them to practice the proper welding operation.

2. Be able to obtain adequate weld configuration, sufficient penetration with minimum undercut.

   2. Instructor checks weld operations for adequacy. Answers questions regarding operations.

**Evaluation**

1. Be able to execute the multiple pass fillet weld in horizontal position without supervision.

   1. Carry out the specific steps in the welding operation.

   1. Instructor collect weld samples to be later subjected to destructive tests.
LESSON PLAN

(Demonstration-Performance Method)

LESSON TITLE: Making Multiple Pass Fillet Weld; Vertical Position

COURSE: Adult Education; Supplemental Training

INSTRUCTOR: Kenneth Reed

PART I

LESSON OBJECTIVE:

The objective of this lesson is for each student to execute a multiple pass fillet weld in the vertical position.

DESIRED LEARNING OUTCOMES:

Each student should:

1. Be familiar with the characteristics and coding system of electric arc welding electrodes.
2. Know and exhibit the correct rate of travel, the correct electrode angle and the correct clearance between electrode and weld with reference to the specific weld operation.
3. Be able to properly adjust the welding equipment; both major and minor settings.
4. Be able to execute a satisfactory first pass (root pass) weld.
5. Be able to execute a satisfactory second pass weld.
6. Be able to execute a satisfactory third pass weld.
7. Be familiar with the characteristics of a satisfactory weld: bead contour, penetration, and undercut.

INSTRUCTOR REFERENCES:

1. Welding Skills and Practices
2. Modern Welding/Althouse-Turnquist
3. Electrode Selection Charts/Bowditch
INSTRUCTOR AIDS:

1. Chalkboard and chalk
2. Material to be welded
3. Electric arc welder (220 amp capacity)
4. Safety equipment: gloves, welding hood, gas welding glasses, and safety glasses
5. Tools: wire brush, chipping hammer and pliers
6. Supply of E-6010 electrodes

HANDOUT MATERIALS: None

STUDENT PREPARATION: None

TIME REQUIRED: 36 minutes

PLAN OF PRESENTATION:

After the introduction the Instructor will explain the specific terminology and reference words as he develops an orthographic view of the weld operation on the chalkboard. Next, the instructor will simulate the weld operation before the groups emphasizing the key points of the weld operation. The instructor will adjust the welding equipment and proceed to perform the actual multiple pass weld in the vertical position. The instructor will then summarize the preceding demonstration bringing out the key points and will provide ample time for questions posed by the students.

The students will then practice the weld operation at their work station under the supervision of the instructor. After the prescribed length of practice time, each student will weld a sample that will evaluate for quality.
<table>
<thead>
<tr>
<th>Student Outcomes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Becomes attentive and focuses on the subject at hand.</td>
<td>1. Listens to the instructor discuss and explain the specific weld operation.</td>
<td>1. Discusses the use of this type of weld.</td>
</tr>
<tr>
<td>2. Realizes the need for learning the correct welding technique.</td>
<td>2. Listens and projects himself into situation where this particular skill will be utilized.</td>
<td>2. Explains the weld operation by a chalkboard illustration.</td>
</tr>
<tr>
<td>3. Realizes that he will learn the skill by the end of the session.</td>
<td>3. Listens and understands the plan of instruction.</td>
<td>3. States objective and outlines procedures.</td>
</tr>
</tbody>
</table>

1. 

- a. become familiar with electrode classification.
- b. understands factors that effect the quality of the weld.
- c. hear a running commentary during demonstration.
- d. practice under supervision.
Part II -- continued

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>e. complete sample for evaluation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. DEVELOPMENT

Explanation-Demonstration

1. Know the classification and meaning of electrode symbols.  
   1. Listen, observe and understand the alpha and numeric classification.  
   1. Illustrates on the chalkboard the coding of electrodes.

   a. request that class members be able to transfer knowledge to other electrodes.

2. Know and understand the correct electrode position: angle held and clearance maintained.  
   2. Observes and comprehends the factors involved.  
   2. Simulates the weld operation and exhibits the correct angle and clearance.

   a. uses chalkboard illustration to reinforce the idea.

3. To know and understand the correct speed or rate of movement associated with the electrode.  
   3. To observe and comprehend the instruction.  
   3. Simulate the rate of electrode movement.
Part II -- continued

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<tbody>
<tr>
<td>4. To know, understand and execute the correct method for making a root pass weld operation.</td>
<td>4. To observe and comprehend the instruction.</td>
<td>4. Simulate a root pass weld operation.</td>
</tr>
<tr>
<td>5. To know, understand and execute the correct method for making a second pass of the multiple weld.</td>
<td>5. To observe and comprehend the demonstration.</td>
<td>5. Simulate a second pass weld operation.</td>
</tr>
<tr>
<td>6. To know, understand and execute the correct method of making a third pass of the multiple pass weld operation.</td>
<td>6. To observe and comprehend the demonstration.</td>
<td>6. Simulate the third pass weld operation.</td>
</tr>
</tbody>
</table>

- a. execute a root pass weld.
- b. simulate the weave pattern of the second pass weld operation.
- a. illustrates the weave pattern on the chalkboard.
- b. simulate and demonstrate the third pass weld operation.
### Student Outcomes

7. To know, understand and execute the correct adjustment of welding equipment.

8. To know, understand and be able to execute the correct method of making a root pass weld operation.

9. To know, understand and be able to execute the correct method of making a second pass weld operation.

### Student Activity

7. To observe and comprehend the adjustment of welding equipment.

8. To observe and comprehend the demonstration.

9. To observe and comprehend the demonstration.

### Instructor Activity

7. Executes the adjustment of the welding equipment.

   a. adjusts the major amperage control.

   b. adjusts the minor of fine control.

   c. selects the correct polarity setting.

8. Execute the correct method of making the root pass weld operation.

   a. adjusts the welding equipment for demonstration.

   b. executes a root pass weld.

9. Executes the correct weave pattern in making the second pass weld operation.
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<td>10. To observe and comprehend the demonstration.</td>
<td>10. Executes the correct weave pattern in making the third pass weld operation.</td>
</tr>
<tr>
<td>SUMMARY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Recalls the definition and meaning of the alpha and numeric symbols of the electrode.</td>
<td>1. Listens and understands the coding systems.</td>
<td>1. Reviews the coding classification of the electrode.</td>
</tr>
<tr>
<td>2. Recalls the rate of travel, the angle of the electrode, and the clearance between electrode and weld.</td>
<td>2. Listens and mentally checks the factors that will effect the weld.</td>
<td>2. Reviews the rate of travel, the angle of the electrode and the clearance factor.</td>
</tr>
<tr>
<td>3. Recalls the methods of adjustments the welding equipment; major and minor settings and polarity settings.</td>
<td>3. Observes and visualizes the method of adjustment.</td>
<td>3. Reviews the procedure for setting the welding equipment.</td>
</tr>
<tr>
<td>4. Is able to evaluate a satisfactory weld; bead configuration penetration and undercut.</td>
<td>4. Observes and can visualize a satisfactory weld.</td>
<td>4. Simulates the three passes in the weld operation.</td>
</tr>
</tbody>
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<td>5. Recognizes that the lesson is complete.</td>
<td>5. Realizes that the lesson is complete.</td>
<td>5. Establishes closure; exhibits correct weld specimen.</td>
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**SUPERVISION**

1. Be able to perform the multiple pass fillet weld in the vertical position.
   
   1. Practices the weld operation; root pass, second pass, third pass.
   
   1. Assigns students to specific stations in the laboratory and directs them to practice the proper welding techniques.

2. Be able to obtain adequate weld configuration, sufficient penetration.

   2. Practice the weld operation: root pass, second and third passes.

   2. Instructor checks weld operation for adequacy. Answers questions regarding the operation.

**EVALUATION**

1. Be able to execute the multiple pass fillet weld in the vertical position without supervision.

   1. Carry out the specific steps in the welding operation.

   1. Instructor collects weld samples to be analyzed.
APPENDIX C

Story Boards for Multiple Pass Fillet Weld-Horizontal Position (Weave Pattern)
Scene 1

EASTLAND VOCATIONAL CENTER

Scene 2

DEMONSTRATION
1 MULTIPLE PASS FILLET WELD - HORIZONTAL POSITION
INSTRUCTOR: WALTER KEFAUVER

Scene 3
SCENE 1

Video
Open with close-up of title board.

Audio
No sound.

SCENE 2

Video
Cut to close-up of title board.

Audio
No sound.

SCENE 3

Video
Cut to three/fourths shot of the instructor.

Audio
"Good evening gentlemen, I will be your instructor for this demonstration of the multiple-pass fillet weld in the horizontal position."
Scene 4

MULTIPLE PASS FILLET WELD—HORIZONTAL POSITION

Scene 5

Scene 6
SCENE 4

Video
Cut to close-up of chalkboard with the title of the demonstration.

Audio
"Gentlemen, this is the name of the weldment I will demonstrate this evening."

SCENE 5

Video
Cut to the four illustrations on chalkboard. Instructor will direct attention to each illustration as he speaks.

Audio
"Before we move into the actual demonstration there are several important factors that will be explained.
Upper left: Illustrates severe undercutting.
Upper right: Illustrates correct deposit of filler material.
Lower left: Illustrates multiple-pass fillet weld weave pattern.
Lower right: Illustrates multiple-pass fillet weld stringer pattern."

SCENE 6

Video
Pan to close-up of chalkboard illustration showing plates to be welded.

Audio
"You should understand that the specific area of the plate included in the weldment is termed the 'leg' of the weld. This refers to the dimension of the weld in the vertical and horizontal plate. In this weld the 'leg' should be three lengths (3/8) an inch on each plate."
SCENE 7

Video
Pan to close-up of chalkboard illustration showing plates to be welded with severe undercut condition.

Audio
"Another important factor you must consider in welding is that of undercutting. This may be caused by incorrect polarity setting, incorrect electrode, too high current setting, or faulty welding technique."

SCENE 8

Video
Pan to close-up of chalkboard illustration showing plates to be welded with the stringer pattern condition.

Audio
"Many fillet welds are made with the stringer pattern technique. This type of weldment is where each succeeding weld deposit covers a large part of the proceeding weldment as shown in the illustration."

SCENE 9

Video
Cut to close-up of the chalkboard illustration showing plates to be welded with weave pattern condition.

Audio
"--Welding authorities disagree on which weldment is better: stringer pattern versus weave pattern. This evening I will demonstrate the multiple-pass fillet weld in the horizontal pattern (weave pattern). This weldment is where each succeeding weld is deposited so that each preceding weld is covered."
Scene 10

E-6013

ELECTRIC WELDING
MINIMUM STRENGTH OF WELD IN
P.S.I. X 1,000
ALL POSITION ELECTRODE
EITHER A.C. OR D.C. AND
EITHER POLARITY

Scene 11

Scene 12
SCENE 10

**Video**

Pan to close-up of chalkboard illustration showing electrode classification.

**Audio**

"The electrode classification will now be reviewed for anyone who may be in doubt about the coding: the alpha character designates electric arc welding. The first two digits represent the tensile strength of the weld, the third digit represents position in which the rod may be used, and the fourth digit represents special electrode characteristics."

SCENE 11

**Video**

Pan to close-up of chalkboard illustration showing materials to be used in the demonstration. Instructor will direct attention to illustration and cover the dimensions as he speaks.

**Audio**

"The material to be joined together is 3/8" x 4" x 6" hot rolled mild steel plate. The physical appearance and dimensions are illustrated on the chalkboard."

SCENE 12

**Video**

Pan to close-up of chalkboard illustration of the plates set in position prior to demonstration of weld procedure.

**Audio**

"The plates to be joined are positioned at right angles to each other with the vertical plate flush with the horizontal one."
SCENE 13

**Video**

Cut to close-up of the chalkboard illustration of materials in position prior to welding. The instructor directs the attention of the group to the specific factors as he speaks.

**Audio**

"---Most important to the success of the completed weldment is that of: the clearance between the electrode and the weld (length of arc) which should be approximately 1/2 the diameter of the electrode, the position of the electrode in its relationship to a vertical plane, which should be 10 degrees forward of a true vertical plane, the speed at which the electrode travels, and the fact that the electrode bisects an angle between the plates at 45 degrees."

SCENE 14

**Video**

Cut to close-up of the actual material for a welding simulation. Instructor directs attention to plates in position prior to welding as he speaks.

**Audio**

"---We have covered several of the important factors of: electrode classification, the material to be used, the clearance and position of the electrode relative to this particular fillet weld. I want to continue by first simulating the weldment and explaining additional factors that you should know. With the plates in position there are tacked at each corner."

**Video**

Fade out.
SCENE 15

**Video**

Fade in to close-up of the instructor simulating start of the welding procedure.

**Audio**

"After tacking, the arc is started approximately 3/16" from the plate and approximately 1/4 to 3/8 inch from the corner. Once the arc is established the electrode is moved to the corner and the clearance is decreased to approximately 1/16"."

**Video**

Fade out.
Scene 16

Scene 17

Scene 18

2nd Pass operation

Weave Motion

Rout Pass Completed
SCENE 16

Video

Fade in to close-up of the instructor holding the weldment and simulating the procedure used in the first-pass operation. Fade out.

Audio

"--The first pass (root pass) is made the entire length of the plates. It usually requires at least two electrodes to complete the root pass. Whenever there is an electrode change the weldment must be cleaned with the chipping hammer and wire brush to insure complete bonding."

SCENE 17

Video

Fade in to close-up of instructor simulating the manipulation of electrode in the second pass operation.

Audio

"--After the first pass (root pass) has been completed, it is necessary to thoroughly clean the entire weldment with the chipping hammer and wire brush prior to making the second pass. The second pass is started in the same manner as the first. The electrode is manipulated as I am doing, I direct your attention to the illustration on the chalkboard.

Video

Fade out.

SCENE 18

Video

Cut to close-up of the chalkboard illustration of the pattern used in depositing first pass (root pass) and second pass. Instructor directs attention to illustration as he speaks.
Audio

"---As the second pass is made the electrode should be manipulated in a weaving motion that conforms to the letter "Z" turned 90°. The first pass (root pass) must be completely covered by the second pass."
Scene 19

Scene 20

Scene 21

3rd Pass operation

Weave Motion

2nd Pass Completed
SCENE 19

**Video**

Pan to close-up of the illustration of the weave pattern used in the second pass.

**Audio**

"--Here is an exaggerated illustration of the weave pattern used in the second pass. For purposes of demonstration, the second pass does not run the length of the plates."

--- Fade out

SCENE 20

**Video**

Cut to close-up. The instructor simulating the third pass procedure.

**Audio**

"--As in the case of the second pass the preceding pass was cleaned thoroughly with chipping hammer and wire brush. This must be completed to insure proper bonding (penetration) of each succeeding pass."

--- Fade out

SCENE 21

**Video**

Cut to close-up of chalkboard illustration of the weave pattern used in the second and third passes.

**Audio**

"--I call your attention to the weave pattern used in the second pass and to the pattern used in the third pass operation. It begins at the bottom, moves in an arc toward the top and then is held in a vertical line on the downward stroke. It must completely cover the second pass."
SCENE 22

**Video**

Pan to close-up of exaggerated illustration of third pass on the chalkboard.

**Audio**

"---The illustration on the chalkboard gives the manipulative technique that should be used in depositing the filler material."

SCENE 23

**Video**

Pan to close-up of chalkboard illustration of the third pass weave pattern and the method for preventing excessive weld deposit in the bottom leg. Fade out after audio.

**Audio**

"---As the weave pattern is maintained, as illustrated, on the chalkboard, there is the chance that filler material will start to deposit in an excessive amount on the bottom leg. By changing the angle of weave pattern as shown in the illustration this situation can be overcome."

SCENE 24

**Video**

Fade in. To close-up of the chalkboard illustration of example of excessive deposit of material on bottom leg.

**Audio**

"---The illustration exhibits the problem that I have just described, where improper electrode manipulation will result in excessive deposit build-up on the bottom leg."

**Video** -- fade out
SCENE 25

Video

Fade in to close-up of the electric arc welder. The instructor will direct attention to various controls on the welder as he speaks.

Audio

"---I now direct your attention to the electric arc welder that will be used in making the demonstration. The four controls that are adjusted prior to making the weldment arc: major current control, minor (fine) current control, polarity control, and the power switch."

SCENE 26

Video

Zoom to close-up of the major current control. The instructor directs attention to the specific areas as he speaks.

Audio

"---The particular electrode that I will use in the demonstration has been identified as an E-6013. This particular electrode will burn satisfactorily between 100-115 amperes of current. The major control is set by activating the 60 amp and the 40 amp switches. To gain the final amperage setting I will adjust the minor control after the arc is established."

SCENE 27

Video

Pan to close-up of the minor control. The instructor will direct attention to this control as he speaks.

Audio

"---After the major current control has activated, the correct polarity set, and the power switch turned 'on,' the final current adjustment is made. This adjustment is usually carried out after the arc is established but may initially be set at 10 amperes."
Scene 28

A.C.

D.C. REVERSE
D.C. STRAIGHT

POLARITY - SWITCH
do not switch under load

Scene 29

POWER
ON
OFF

Scene 30
SCENE 28

Video

Pan to close-up of polarity control. The instructor will direct attention to the control as he speaks.

Audio

"---Another control that must be considered is the polarity switch. The E-6013 electrode may either alternating (AC) or direct current straight polarity (DC straight)."

SCENE 29

Video

Pan to close-up of the power switch. The instructor directs attention to the switch as he speaks.

Audio

"---The power switch is simply an on/off control. When the other adjustments have all been made, then the power switch is moved to the 'on' position."

SCENE 30

Video

Fade in to close-up of chipping hammer. Instructor will direct attention to its use in the demonstration as he speaks.

Audio

"I have covered the keypoints in making the weldment and the equipment necessary to carry out the demonstration. Now I want to discuss the tools necessary to complete the demonstration. First there is the chipping hammer used in removing flux and foreign particles from the weld---."

Video -- Fade out
SCENE 31

**Video**

Fade in to close-up of the wire brush. The instructor will direct attention to its use as he speaks.

**Audio**

"---Second there is the wire brush, needed to clean the weld more thoroughly. Cleanliness is very important in welding, especially when changing electrodes."

SCENE 32

**Video**

Fade in to close-up of the electrode holder. The instructor directs attention to its use as he speaks.

**Audio**

"---Although the electrode holder may be considered as part of the equipment it still should be thought of as an important tool in the welding operation."

SCENE 33

**Video**

Fade in to close-up of the welding shield. The instructor directs attention to the filter elements within the shield as he speaks.

**Audio**

"---Another important tool is the welding shield. This must be worn to protect the welder from harmful ultraviolet and infrared rays developed from the burning electrode."
SCENE 34

**Video**

Fade in to close-up of the pair of leather gloves. The instructor directs attention to the protection they afford as he speaks.

**Audio**

"---Still another tool is the pair of leather gloves. They must be worn to prevent burns that may be caused by sparks generated in the welding process."

SCENE 35

**Video**

Cut to close-up of the major controls. Instructor will direct attention to panel as he speaks.

**Audio**

"---I have covered the important factors involved with completing a satisfactory weldment, and covered the equipment and tools necessary in making the weld. I will now demonstrate the multipe-pass fillet weld in the horizontal position. First the major controls are set to 100 amps of current."

SCENE 36

**Video**

Pan to close-up of the minor current control. The instructor directs attention to the control as he speaks.

**Audio**

"---Next the minor control is initially set at 10 amps. This control may be adjusted after the arc is established to gain the final adjustment. The E-6013 electrode will burn effectively at approximately 110-115 amps."
Scene 37

Polarity Switch
do not switch under load

Scene 38

Power on/off

Scene 39
SCENE 37

**Video**

Pan to close-up of the polarity control. The instructor directs attention to the various settings as he speaks.

**Audio**

"---After the major and minor current settings have been made, the polarity control is moved to the proper position. It may be set at either alternating current (AC) or direct current straight polarity (DC straight)."

SCENE 38

**Video**

Pan to close-up of main power switch. Instructor directs attention to the control as he speaks.

**Audio**

"---The final control is the power switch. It is moved to the 'on' position. With the welding equipment correctly adjusted the demonstration will proceed."

SCENE 39

**Video**

Cut to close-up of the electrode holder. The instructor directs attention to the electrode in the holder as he speaks.

**Audio**

"---With the equipment properly adjusted the electrode is placed in the holder at a position that is somewhat greater than 90° to the holder."
SCENE 40

Video
Cut to close-up of the material to be welded. The instructor directs attention to tacking the plates at each end prior to running first pass as he speaks.

Audio
"---The plates are set at right angles to one another and tacked together by simply establishing an arc at each corner momentarily. After tacking the plates they should be examined for squareness. And adjusted to maintain a 90° angle between plates."

SCENE 41

Video
Cut to close-up of the start of the first pass. The instructor directs attention to the establishment of the arc as he speaks.

Audio
"---After the plates have been tacked together and arc square the first pass is begun. The arc is established a fraction of an inch from the corner and then moved back to the edge to deposit the first pass."

SCENE 42

Video
Cut to close-up of the weldment to be cleaned. With the chipping hammer. The instructor directs attention to cleaning process as he speaks.

Audio
"---When the electrode has been expended the flux coating and slag accumulation must be removed with a chipping hammer. All foreign material should be removed before weld is continued."
SCENE 43

**Video**

Cut to close-up of weldment being cleaned with wire brush. The instructor directs attention to cleaning procedure as he speaks.

**Audio**

"---After removing as much flux and slag as possible with the chipping hammer the weldment should then be cleaned with the wire brush as indicated before cleanliness is a very important operation in welding."

SCENE 44

**Video**

Cut to close-up of the continuation of the first pass. Instructor directs attention to the establishing of the arc as he speaks.

**Audio**

"---With a new electrode the first pass is continued. The arc should be established behind the end of the weldment and moved into the end of the completed weld as correct burning is maintained."

SCENE 45

**Video**

Cut to close-up of the completion of the first pass. The instructor directs attention to the procedure for finishing the first pass as he speaks.

**Audio**

"---As the weld nears the end of the pass the arc should be extinguished and established several times to prevent severe undercutting at the corner area."
SCENE 46

Video

Cut to close-up of weldment being cleaned with chipping hammer. Instructor directs attention to cleaning procedure as he speaks.

Audio

"---When the first pass weld is completed it should be clean with the chipping hammer. As in the case where an electrode change was made the foreign material must be removed."

SCENE 47

Video

Cut to close-up of weldment being cleaned with wire brush. The instructor directs attention to cleaning procedure as he speaks.

Audio

"---After removing as much flux and slag as possible with the chipping hammer the weldment should then be cleaned with the wire brush. As indicated before cleanliness is very important operation in welding."

SCENE 48

Video

Cut to close-up of the completed weldment. The instructor directs attention to the characteristics of a satisfactory first pass as he speaks.

Audio

"---Gentlemen, this is the completed first pass. Note the weld configuration or contour, the appearance of adequate penetration and the absence of any undercutting condition."
SCENE 49

Video

Cut to close-up of the start of the second pass. The instructor directs attention to procedure for making the second pass as he speaks.

Audio

"---I will now demonstrate the second pass. With a new electrode in the holder the arc is established like the first pass situation; in from the edge then back to the edge of the plates. Once the electrode is burning correctly the weaving motion is begun. In a pattern comparable to the letter "Z" the electrode is deposited. The second pass must completely cover the first pass."

SCENE 50

Video

Cut to close-up of the weldment being cleaned with a chipping hammer. The instructor directs the attention of the group to the proper cleaning procedures as he speaks.

Audio

"---Once the electrode is expended (for this demonstration I will only make a fraction of the second pass) it must be cleaned with a chipping hammer. All flux and slag should be removed with this tool."

SCENE 51

Video

Cut to close-up of the weldment being cleaned with the wire brush. The instructor directs the attention of the group to the proper cleaning procedure as he speaks.

Audio

"---Then the wire brush is used to more thoroughly clean the weldment. All foreign material should be removed from the weld with the brush."
Scene 52

Video

Cut to close-up of the completed second pass weldment. The instructor directs the attention of the group to the characteristics of a satisfactory second pass as he speaks.

Audio

"---Like the first pass weldment I call your attention to the characteristics of this second pass: the weld contour, the appearance of adequate penetration, the absence of any undercutting and a complete coverage of the first pass."

Scene 53

Video

Cut to close-up of the start of the third pass. The instructor directs the attention of the group to the manipulation procedure used in making the third pass as he speaks.

Audio

"---Finally the third pass of the multiple-pass fillet weld in the horizontal position is started. The weave pattern is maintained to insure that the second pass is covered completely and to insure that no excessive material is deposited on the bottom leg of the weld."

Scene 54

Video

Cut to close-up of the cleaning of the weldment with the chipping hammer. The instructor directs the attention of the group to the proper cleaning procedure as he speaks.

Audio

"---After the first electrode is expended on the first pass (I will demonstrate a fraction of the third pass) the weldment should be cleaned with a chipping hammer. All flux and slag should be removed with this tool."
SCENE 55

Video

Cut to close-up of the weldment being cleaned with the wire brush. The Instructor directs the attention of the group to the proper cleaning procedure as he speaks.

Audio

"---And as in the case of the two previous passes the weld is also cleaned with a wire brush. A thorough cleaning is necessary to remove any remaining foreign material which would prevent any subsequent bonding."

SCENE 56

Video

Cut to close-up of the completed third pass weldment. The instructor directs the attention of the group to characteristics of a satisfactory third pass as he speaks.

Audio

"---The characteristics of a satisfactory weld is again called to your attention: the weld contour, apparent penetration, absence of undercutting and the complete coverage of the second pass."

SCENE 57

Video

Cut to a close-up of the chalkboard illustration of the materials in position prior to making the weld. The instructor directs attention of the group to specific factors as he speaks.

Audio

"---Gentlemen that concludes the actual demonstration of the multiple-pass fillet weld in the horizontal position. Before we close I believe a brief review of the key points is in order. Remember that the clearance between the electrode and weld should be
approximately 1/2 the diameter of the electrode. That the electrode is held approximately 10 degrees forward of a true vertical line. That the electrode is manipulated in specific weaving pattern, and that the speed of travel is critical to making a successful weld."
AMPERES:
MAJOR 100
MINOR 10-15
POLARITY
EITHER AC OR DC STRAIGHT
POWER SWITCH "ON"

EASTLAND VOCATIONAL CENTER
SCENE 58

**Video**

Cut to close-up of the chalkboard illustration of the welding equipment adjustment. The instructor will direct the attention of the group to specific setting as he speaks.

**Audio**

"---The welding equipment is also very important to the success of the weld. Set the major current control to 100 amps, and the minor current control to approximately 10-15 amps, set the polarity control to either AC or DC straight polarity and turn the power switch to the 'on' position."

SCENE 59

**Video**

Cut to three/fourths shot of the instructor.

**Audio**

"---Gentlemen that concludes the demonstration for this evening, thank you for your attention."

SCENE 60

**Video**

Cut to close-up of title board of "Eastland Vocational Center."

**Audio**

No sound.
APPENDIX D

Story Boards for Multiple Pass Fillet Weld-Vertical Position (Weave Pattern)
Scene 1

EASTLAND VOCATIONAL CENTER

Demonstration 2
Multiple Pass Fillet Weld - Vertical Position
Instructor: Kenneth Reed

Scene 2

Scene 3
SCENE 1

Video
Open with close-up of title.

Audio
No sound.

SCENE 2

Video
Cut to close-up of title board listing the demonstration.

Audio
No sound.

SCENE 3

Video
Cut to three/fourths shot of instructor.

Audio
"Good evening gentlemen, I will be your instructor for this demonstration of the multiple-pass fillet weld in the vertical position."
Scene 4

MULTIPLE PASS
FILLET WELD-
VERTICAL
POSITION

Scene 5

VIRTUAL UP POSITION
MULTIPLE PASS WELD

Scene 6

2-PCS
3/8"X4"X16"

6"

3/5

4"
SCENE 4

**Video**

Cut to close-up of chalkboard with the title of the demonstration.

**Audio**

"Gentlemen, this is the name of the weldment I will demonstrate this evening." Repeat the title before the group.

SCENE 5

**Video**

Pan to three/fourths shot of the instructor positioned to the left of the chalkboard.

**Audio**

"---This is simply a fillet weld where the plates (material) to be joined are in a vertical or upright position. Some of you may have experienced this type of weldment in your occupation."

SCENE 6

**Video**

Pan to close-up of the chalkboard illustration of the plates to be used in making the weldment. Instructor will point to illustration and cover the dimensions as he speaks.

**Audio**

"Gentlemen, before I perform the actual demonstration there are several important points I wish to cover. First, the material to be joined together is 3/8" x 4" x 6". Hot rolled mild steel plate. The physical appearance and dimensions are illustrated on the chalkboard."
SCENE 7

Video

Pan to close-up of the chalkboard illustration of electrode classification. Instructor will point to illustration and identify the specific areas of the classification as he speaks.

Audio

"---Second, the welding electrode that will be used in the demonstration will be E-6010. You will recall that the alpha designation represents electric welding. The first two digits represent the tensile strength of the rod, the third digit represents the position and the fourth digit represents special electrode characteristics."

SCENE 8

Video

Cut to close-up of the chalkboard illustration of the plates set in position prior to performing the weldment. Instructor will point out the position of the plates as he speaks.

Audio

"---You will notice that the plates to be joined are positioned at a right angle and that the one plate is positioned approximately in the center of the second plate."

SCENE 9

Video

Cut to close-up of chalkboard illustration of the plates the three areas of the weldment. Instructor will point to the specific areas of the weldment as he speaks.

Audio

"The weldment consists of three areas which I will refer to as the specific passes made by the electrodes. The first pass is termed the root pass, the second (2nd) pass and the third is termed the third (3rd) pass."
Scene 10

Scene 11

Scene 12
SCENE 10

Video

Cut to three/fourths shot of the instructor.

Audio

"---I have now covered three important factors of this weldment. The material to be welded, the electrode to be used, and the position of the plates. I now will continue with a simulation of the welding operation and will emphasize several additional factors that you must understand in order to make an adequate weldment."

SCENE 11

Video

Cut to close-up of the two pieces of plate that will be used in making the weld. Instructor will place plates in correct position as he speaks.

Audio

"Again I call your attention to the plates to be joined in the weld, they are 3/8" thick, 4" wide, and 6" long. They will be in a vertical position with one plate lying approximately in the center of the other."

Video -- Fade out

SCENE 12

Video

Fade in to close-up of metal plates in position for welding with instructor simulating the "tacking" of the pieces prior to making the complete weld as he speaks. Fade out after audio.

Audio

"Prior to making the weld you should first join (tack) the plates at the top and bottom. Just a momentary fusion will secure the plates in the correct position. After tacking you should insure a right angle is maintained between the plates this may be accomplished by setting a steel square on the plates."
SCENE 13

**Video**

Fade-in to close-up of the plates in position for welding. The instructor will simulate correct electrode angles as he speaks. Fade out.

**Audio**

"The position of the electrode in making the weld is most important. First, the electrode should intersect the plates at a 45° angle. And second, the electrode should be 80°-85° from the horizontal plane. That is, the electrode will be inclined as it is fed into the weld."

SCENE 14

**Video**

Cut to close-up of chalkboard illustration of the clearance between electrode and weld. Fade out.

**Audio**

"A distance of approximately one-half (1/2) the diameter of the electrode should be maintained between the weld and the electrode. Since I am using an E-6010 electrode of one-eighth (1/8) inch diameter the clearance should be one-sixteenth (1/16) inch.

SCENE 15

**Video**

Fade-in to close-up of the instructor simulating the weave pattern as electrode is fed into weld.

**Audio**

"Gentlemen, the electrode is manipulated from side-to-side as you feed the electrode into the weld, starting from the bottom of the plates if a new electrode is needed to complete the pass it will become necessary to clean the flux and slag from the weld with a chipping hammer and wire brush before continuing."
SCENE 16

**Video**

Cut to close-up of the instructor pointing to a sample of a correctly executed root-pass. Instructor will point to specific areas of the bead as he speaks. Fade out.

**Audio**

"Here is an example of a satisfactory weldment. Notice the contour of the bead and the fact that there is no undercutting either at the start or end of the weld or anywhere along the weldment and the appearance of penetration."

SCENE 17

**Video**

Fade-in to close-up of the plates in position for welding the second pass. The instructor will simulate and call attention to correct electrode angles and clearance as he speaks. Fade out.

**Audio**

"As in the root pass (1st pass) the electrode should intersect at a 45° angle and should be between 80° and 85° from a horizontal plane. In addition to the correct angles being maintained the electrode should remain approximately 1/16 inch from the weld."

SCENE 18

**Video**

Fade-in to close-up of instructor simulating the second (2nd) pass. The instructor will move the electrode from side to side in a weaving pattern as he speaks. Fade out.

**Audio**

"As you make your second (2nd) pass you again make a weave pattern from side to side as you progress from the bottom to the top of the weldment. After the second pass is completed the weld should be cleaned to remove any flux and slag. This should be done with a chipping hammer and wire brush."
SCENE 19

**Video**

Fade-in to close-up of the instructor pointing to a sample of a correctly executed second (2nd) pass. Instructor will call attention to specific bead characteristics as he speaks. Fade out.

**Audio**

"Please examine this sample of a satisfactory second (2nd) pass. Note the contour of the beading, the lack of undercutting at the corners or along the bead, and the appearance of adequate penetration."

SCENE 20

**Video**

Fade-in to close-up of the plates in position for welding the third (3rd) pass. The instructor will simulate and call attention to the correct electrode angle and clearance as he speaks. Fade out.

**Audio**

"As in the root (1st) pass and second (2nd) pass the electrode should be maintained between 80° and 85° from a horizontal plane and intersect the weld at 45°. A clearance of approximately 1/16 inch should be maintained between the weld and electrode as in the case of the previous two passes."

SCENE 21

**Video**

Fade-in to close-up of chalkboard illustration that illustrates the three passes of the weldment. The instructor will call attention to the specific areas as he speaks. Fade out

**Audio**

"I again call your attention to the three areas of the weldment which are the root (1st) pass, the second (2nd) pass, and the third (3rd) pass. Note each pass covers the succeeding pass."
SCENE 22

Video

Fade-in to close-up of instructor calling attention to the weave pattern used in the third (3rd) pass illustrated on chalkboard. The instructor simulates weave pattern as he speaks. Fade out.

Audio

"As in the case of the two succeeding passes it is necessary to manipulate the electrode from side to side as you feed the electrode into the weld as the upward progress is made."

SCENE 23

Video

Fade-in to close-up of instructor calling attention to a sample of a completed third (3rd) pass. The instructor directs attention to the characteristics of a satisfactory weld as he speaks. Fade out.

Audio

"Once again, the weldment should exhibit correct bead contour and no undercutting at the corners or anywhere along the weld. And the weld should appear to have adequate penetration."

SCENE 24

Video

Fade-in to close-up of the electric arc welder. The instructor will direct attention to the major controls as he speaks.

Audio

"Now that I have covered the three passes of the weldment I wish to discuss the equipment I will use in making the demonstration. The specific areas that are important are: the main power switch, the major current setting control, the minor current setting control, and the polarity control."
Scene 25

OFF CURRENT - AMPERES

Scene 26

CURRENT CONTROL

Scene 27

POLARITY - SWITCH
do not switch under load
SCENE 25

**Video**

Zoom to close-up of the major current control. The instructor directs attention to the specific area as he speaks.

**Audio**

"The particular electrode that I will use in the demonstration has been identified as an E-6010. This particular electrode will burn satisfactorily between 100-115 amperes of current. The major control is set by activating the 60 and 40 switches. To gain the final amperage, I will adjust the minor control after the arc is started."

SCENE 26

**Video**

Pan to close-up of the minor current control. Instructor will direct attention to this control as he provides explanation.

**Audio**

"After you have selected the major current settings, selected correct polarity, and activated the main power switch the final current adjustment should be made. This final adjustment is usually carried out after the arc has been established. However, the minor control may be initially set at 10 amps."

SCENE 27

**Video**

Pan to close-up of the polarity control. The instructor will direct attention to the control device as he speaks.

**Audio**

"Another control that must be considered is the polarity switch. The E-6010 electrode requires that the polarity control be positioned on direct current/reverse polarity (DC/reverse)."
SCENE 28

Video

Pan to close-up of the power switch. The instructor directs attention to the switch as he speaks.

Audio

"This power switch is simply an on/off control. When the other adjustments have all been made then move the power switch to the "on" position."

SCENE 29

Video

Fade-in to close-up of chipping hammer. Instructor will direct attention to its use in the demonstration as he speaks. Fade out.

Audio

"I have covered the key points in making the weldment and the equipment necessary to carry out the demonstration. Now I want to discuss the tools necessary to complete the demonstration. First there is the chipping hammer used in removing flux from the weld and foreign particles."

SCENE 30

Video

Fade-in to close-up of the wire brush. Instructor will direct attention to its use in the demonstration as he speaks. Fade out.

Audio

"Second, there is the wire brush, needed to clean the weld more thoroughly. Cleanliness is very important in welding especially when changing electrodes."
SCENE 31

Video
Fade-in to close-up of pliers. Instructor directs attention to the use of the pliers in the demonstration as he speaks. Fade out.

Audio
"A pair of pliers are also necessary in handling the hot metal and naturally preventing burns."

SCENE 32

Video
Fade-in to close-up of welding shield. Instructor directs attention to filtration elements within the shield as he speaks. Fade out.

Audio
"Another important piece of equipment is the welding shield. This must be used to shield the welder from the harmful ultraviolet and infrared rays developed from the burning electrode."

SCENE 33

Video
Fade-in to close-up of pair of leather gloves. The instructor directs attention to the protection afforded by the gloves as he speaks. Fade out.

Audio
"Finally, the last item of equipment will be a pair of leather gloves. They must be worn to provide the protection against sparks generated from the welding operation."
SCENE 34

Video
Fade-in to three/fourths shot of instructor. Fade out.

Audio
"Gentlemen, I have now covered all the important points necessary to make the weldment. I will now demonstrate an actual welding operation of the multiple-pass fillet weld in the vertical position."

SCENE 35

Video
Cut to close-up of the electric arc welder.

Audio
"First a review of the controls of the electric arc welder: major current control, minor current control, polarity switch, and main power switch are the four controls you should be familiar with."

SCENE 36

Video
Zoom to close-up of the major current control. The instructor directs attention to control setting as he speaks.

Audio
"Set the major current control to 100 amperes of current. This can be accomplished by activating the 60 amp and 40 amp control."
Scene 37

Scene 38

Scene 39
SCENE 37

Video
Pan to close-up of the minor current control. The instructor directs attention to minor current control as he speaks.

Audio
"In addition to the major current setting there is the minor current control. This control may be adjusted after you begin the welding operation to obtain the correct amperage level but an initial setting of approximately 10 amps may be made."

SCENE 38

Video
Pan to close-up polarity control. The instructor directs attention to the various positions of the control as he speaks.

Audio
"After the major and minor current settings have been made the polarity setting is carried out. The E-6010 electrode requires a direct current/reverse polarity setting."

SCENE 39

Video
Pan to close-up of the main power switch. The instructor will direct attention to control as he speaks. Fade out.

Audio
"The current and polarity controls have been adjusted, now it is time to supply power—simply engage or activate the main power switch."
SCENE 40

Video

Fade-in to close-up of instructor tacking the plates prior to making root (1st) pass. Instructor directs attention to top and bottom of plate configuration and the squareness of the plates as he speaks. Fade out.

Audio

"With the welder adjusted, the safety equipment in place, an arc is struck at the top and bottom of the plates in order to tack them prior to starting the root (1st) pass. After tacking plates I make certain that the plates are square."

SCENE 41

Video

Fade-in to close-up of instructor beginning the root (1st) pass. Instructor directs attention to the angles maintained, clearances, speed of travel and weaving pattern as he speaks. Fade out.

Audio

"When I'm satisfied that the plates are true the root (1st) pass is begun. Keeping the electrode at the correct angles and clearance I begin to feed the electrode into the weldment. A slight weaving motion is made as the weld progresses."

SCENE 42

Video

Fade-in to close-up of instructor cleaning weld with chipping hammer.

Audio

"When the electrode has burned to within one-to-two inches from the end the arc is extinguished. A new electrode is inserted in the electrode holder and the flux, slag, and foreign matter is driven off with the chipping hammer."
SCENE 43

**Video**

Fade-in to close-up of instructor completing the cleaning of the weldment with wire brush. The instructor directs attention to proper cleaning procedure as he speaks. Fade out.

**Audio**

"After the chipping hammer has been used the weldment is thoroughly scrubbed with a wire brush. The removal of all foreign matter from the weldment is very important."

SCENE 44

**Video**

Fade-in to close-up of instructor continuing the root (1st) pass. The instructor directs attention to the weaving pattern or motion as he speaks. Fade out.

**Audio**

"With a new E-6010 electrode in holder an arc is struck just before the end of the succeeding electrode. While the arc is maintained it is moved into the weld crater and the root (1st) pass is continued, again maintaining a slight weave motion."

SCENE 45

**Video**

Fade-in to close-up of the instructor cleaning weld with a chipping hammer. Fade out.

**Audio**

"When the root (1st) pass nears completion care is exercised so as to prevent undercutting at the corner, when sufficient filler material has been deposited the arc is withdrawn. Then with a chipping hammer all foreign material is removed."
Scene 46

Scene 47

Scene 48
SCENE 46

Video

Fade-in to close-up of the instructor completing the cleaning of the weldment with a wire brush. He directs attention to the proper cleaning procedure as he speaks. Fade out.

Audio

"After cleaning the 1st pass as thoroughly as possible with a chipping hammer the weldment is cleaned still more thoroughly with a wire brush. This is carried out until all traces of foreign material are removed."

SCENE 47

Video

Fade-in to close-up of instructor exhibiting the completed root (1st) pass. He directs attention to weld characteristics as he speaks. Fade out.

Audio

"This then is the completed root (1st) pass. Again your attention is directed to the contour of the bead, lack of undercutting and penetration."

SCENE 48

Video

Fade-in to close-up of instructor beginning second (2nd) pass. Fade out.

Audio

"I am now ready to begin the second pass. With a new electrode in holder an arc is struck at the base of the plates and a weaving motion is immediately begun. The second (2nd) pass will completely cover the root (1st) pass."
SCENE 49

**Video**

Fade-in to close-up of the instructor making the second (2nd) pass. The instructor directs attention to the weaving pattern as he provides commentary. Fade out.

**Audio**

"The electrode is moved from side-to-side as the weldment progresses from the base. The weaving pattern should completely cover the root (1st) pass and penetrate the plate on both sides of the weldment."

SCENE 50

**Video**

Fade-in to close-up of the instructor cleaning the second (2nd) pass with a chipping hammer. Fade out.

**Audio**

"After the electrode is expended the weld is cleaned of foreign matter with a chipping hammer."

SCENE 51

**Video**

Fade-in to close-up of the instructor cleaning the weldment with a wire brush. Fade out.

**Audio**

"When foreign material can no longer be removed with the aid of a chipping hammer a wire brush is used to thoroughly clean the weld and remove all traces of foreign substance."
SCENE 52

Video
Fade-in to close-up of the instructor exhibiting the root (1st) pass and the second (2nd) pass. Fade out.

Audio
"Here is a partially completed second (2nd) pass. Note that on an actual job the second (2nd) pass would run the entire length of the plates--This partial weld is only for demonstration. Also note the weldment in terms of bead contour, undercutting and penetration."

SCENE 53

Video
Fade-in to close-up of the instructor beginning the third (3rd) pass. Fade out.

Audio
"I will now demonstrate the third and final pass. With a new electrode in the holder an arc is struck and as it is maintained a very pronounced weave pattern is carried out as the weld progresses from the base. The weaving pattern should cover the second (2nd) pass thoroughly and penetrate the plates on both sides."

SCENE 54

Video
Fade-in to extreme close-up of the weldment with the instructor directing attention to the third (3rd) pass and the weaving motion. Fade out.

Audio
"While the weldment is very large, consideration should be given to the fact that it covers two succeeding weld passes. Like the second (2nd) pass the third (3rd) pass is made only a fraction of the entire length of the plates. In actual practice the weldment would run the total length of the plates."
SCENE 55

**Video**

Fade-in to close-up of the instructor cleaning the weld.

**Audio**

"Like the second (2nd) pass this final pass is only partially completed. And in all welding activities the weld should be cleaned ---first with a chipping hammer."

SCENE 56

**Video**

Cut to close-up of the weldment being cleaned with wire brush. Instructor will direct attention of the group to the proper cleaning procedure.

**Audio**

"---After the weldment has been cleaned with the chipping hammer the wire brush is then used on the weld to continue the removal of flux and foreign material."

SCENE 57

**Video**

Cut to close-up of the completed weldment being exhibited before the group. The instructor directs attention of the group to characteristics of the weld.

**Audio**

"---Like the two proceeding passes this third weld should exhibit certain weld characteristics: weld contour, apparent penetration, absence of undercutting, and the fact that the third pass completely covers the second pass."
Scene 58

Scene 59

Scene 60

AMPERES:
MAJOR - 100
MINOR - 10-15
POLARITY A.C.
POWER ON
SCENE 58

**Video**

Cut to close-up of plates in position prior to welding. The instructor will direct attention to the various electrode positions.

**Audio**

"---That concludes the actual demonstration of the multiple-pass fillet weld in the vertical position. Before we close a review of key points is in order. The electrode should be held at approximately 80°-85° from the horizontal plane. The electrode should also bisect the angle between the plates at 45°."

SCENE 59

**Video**

Cut to close-up of the chalkboard illustration of clearance between electrode and weld.

**Audio**

"Another important point is that of the clearance between the electrode and the weld which should be approximately 1/2 the diameter of the electrode."

SCENE 60

**Video**

Cut to close-up of the chalkboard illustration of welding equipment adjustment. The instructor will direct the attention of the group to specific settings as he speaks.

**Audio**

"---The welding equipment is also very important to the success of the weld. Set the major current control to 100 amps, and the minor current control between 10-15 amps, set the polarity to direct current reverse polarity and turn the power switch to the 'on' position."
Scene 61

Scene 62

EASTLAND VOCATIONAL CENTER
SCENE 61

**Video**

Cut to three/fourths shot of the instructor.

**Audio**

"---Gentlemen, that concludes the demonstration for this evening. Thank you for your attention."

SCENE 62

**Video**

Cut to close-up of the board of "Eastland Vocational Center."

**Audio**

No sound.
APPENDIX E

Instructors to Teachers
INSTRUCTIONS TO TEACHERS

There are three welding operations that the students will be tested on and have analyzed to determine the difference, if any, in the instructional technique used during the course.

While this is a type of experiment, make no reference to this fact and carry out the instruction by whichever method as if it was the traditional manner by which welding operations are taught.

Please review the various tests and factors associated with them so that they will be interjected smoothly into the course of instruction. Be specifically aware of the time allocated for instruction, supervised practice and test administration and plan accordingly.

Pretest: A multiple-pass fillet weld in the horizontal position using the stringer pattern.

Material: 3/8" x 4" x 6" hot rolled plate

Electrode: E-6010, 1/8 inch diameter

Duration of Time of Instruction: None

Type of Instruction: Review and illustrate, do not demonstrate weld operation

Duration of Practice Time: 240 minutes

Date of Test Administration: The last thirty minutes of the third instructional session
Remarks: The 240 minutes of supervised practice time will consist of the familiarization with the various pieces of welding equipment found in the laboratory and with increasing proficiency by running weld passes using the stringer pattern.

Instructors encourage the students to use each different piece of equipment in the laboratory in making the weld passes.

First Test: A multiple-pass fillet weld in the horizontal position using the weave pattern.

Material: 3/8" x 4" x 6" hot rolled plate

Electrode: E-6013, 1/8 inch diameter

Duration of Instruction: First twenty-five minutes of instructional session number four.

Type of Instruction: Mr. Reed will exhibit a videotape recording of the weld operation. Mr. Kefauver will present a demonstration performance of the weld operation.

Duration of Practice Time: 100 minutes

Time of Test Administration: The last thirty minutes of the fourth instructional session.

Remarks: Instructors will alert the students to key points that will be covered in the instruction (either live demonstration or videotape recording).

Instructors will answer specific questions, relative to the instruction, raised by the students after the instruction is given.

Instructors will answer specific questions, relative to the supervised practice activity, raised by students during the practice time. Instructors will point out obvious mistakes that students are making during supervised practice.

Instructors will not perform or repeat any part of the demonstration again.
Exhibition of the videotape recording will be set up and operated by a technician.

The videotape recording was based upon a specific lesson plan which should also be the basis for the demonstration performance instruction.

**Second Test:** A multiple-pass fillet weld in the vertical position using the weave pattern.

**Material:** 3/8" x 4" x 6" hot rolled plate

**Electrode:** E-6010, 1/8 inch diameter

**Duration of Instruction:** The first thirty-six minutes of the fifth instructional session.

**Type of Instruction:** Mr. Kefauver will exhibit a videotape recording of the weld operation. Mr. Reed will present a demonstration-performance of the weld operation.

**Duration of Practice Time:** 150 minutes

**Time of Test Administration:** 45 minutes into the sixth instructional session

**Remarks:** Instructors will alert the students to key points that will be covered in the instruction (either live demonstration or videotape recording).

Instructors will answer specific questions, relative to the instruction, raised by the students after the instruction is given.

Instructors will answer specific questions, relative to the supervised practice activity during the practice time.

Instructors will point out obvious mistakes that students are making during the supervised practice time.

Instructors will not perform or repeat any part of the demonstration again.
Exhibition of the videotape recording will be set up and operated by a technician.

The videotape recording was based upon a specific lesson plan which should also be the basis for the demonstration performance instruction.
APPENDIX F

Results from Weld Coupon Evaluation
# Weld Coupon Evaluation

## Destructive Examination

### Group A

<table>
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<tr>
<th>Test Position</th>
<th>Coupon Code</th>
<th>Appearance</th>
<th>Macro</th>
<th>Legend</th>
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| Pretest Horizontal | 1B | 1 | 1 | 2 | 2 | 1 | "- 3 pass Stringer"
| Horizontal* | 2B | 1 | 2 | 2 | 2 | 2 |
| Vertical | 3B | 3 | 1 | 2 | 2 | 1 |
| Pretest Horizontal | 1C | 1 | 1 | 2 | 2 | 2 |
| Horizontal* | 2C | 1 | 1 | 1 | 2 | 2 |
| Vertical | 3C | 1 | 1 | 1 | 1 | 1 |
| Pretest Horizontal | 1D | 1 | 1 | 2 | 2 | 2 |
| Horizontal* | 2D | 1 | 1 | 2 | 2 | 1 |
| Vertical | 3D | .5 | 2 | 1 | 2 | 2 |
| Pretest Horizontal | 1F | 1 | 1 | 2 | 2 | 1 |
| Horizontal* | 2F | 1 | 1 | 1 | 1 | 1 |
| Vertical | 3F | 1 | 2 | 1 | 1 | 2 |

*Video Demonstration*
## DESTRUCTIVE EXAMINATION

### WELD COUPON EVALUATION

**GROUP A**

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*Video Demonstration*
### DESTRUCTIVE EXAMINATION

#### WELD COUPON EVALUATION

**GROUP B**

#### TYPE OF TEST

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**Video Demonstration**

---

202
## WELD COUPON EVALUATION

### GROUP B

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**Video Demonstration**
## Destructive Examination

### Type of Test

- **Weld Coupon Evaluation**

### Group B

#### DESTRUCTIVE EXAMINATION

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#### WELD COUPON EVALUATION

**Legend:**

1. Pretest Horizontal
2. Horizontal
3. Vertical
- 3 pass Stringer
- 3 pass Weave

#### DESTRUCTIVE EXAMINATION

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**Video Demonstration**
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**Video Demonstration**