



Safety Practices Required of Welding Technicians for Effective Field Job Performance in Construction Industries in Nigeria

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ABSTRACT

One of the key determinants of effective welding operations is safety practices. This study therefore, investigated the Safety Practices Required of Welding Technicians for Effective Field Job Performance in Benue State. The study used descriptive survey research design. A sample of 36 students and 37 welders in production industries was selected using Yamane (1967) formula, making a total sample size of 73 respondents. A self-structured questionnaire was used and consisted five sections. Section A, contains demographic information, section B, addresses safety practices on electric shock; section C, addresses safety practices on ultraviolet radiation, section D, addresses safety practices on fumes and oxides, and finally, section E, addresses safety practices on heat/fire outbreak. The instrument was validated by three experts. In order to establish the reliability of the instrument a pilot study was conducted on 30 respondents in Enugu State. The Cronbach's Alpha reliability coefficient was computed along with the various inter-item correlations. The results yielded a reliability coefficient of $\alpha = 0.78$ and was considered reliable. It then means that SPRWTEJPQ instrument was reliable for the study. The data collected was analyzed using descriptive statistics of mean and standard deviation to answer the research questions while t-test was used to test the hypotheses at 0.05 level of significance. Mean responses up to and above 2.50 was considered accepted and mean responses of 2.49 and below was rejected.

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INTRODUCTION

Welding practitioners are regarded as one of the most important occupational group in the field of work, especially in developing countries like Nigeria regarding its rapid development and contributions in construction industries and beyond. According to Singh and Anand (2013), the process of welding is being used extensively for the last several decades as one of the most commonly used joining techniques for various metallic structures including among others house roofing, ship building, airplanes, automobile bodies,

bridges, pressure vessels and sports facilities. From performance point of view, it provides better performance in comparison to other joining techniques in terms of joint efficiency, mechanical properties, and applications. The welding occupation is potentially safety and health risk threatening if sufficient safety measures are not put in place to protect the welding performers they will run in to trouble (Ganesh & Dharanipriya, 2015).

There are more than 80 different types of welding and associated processes used all over the world. Some of the most common conventional types of welding



that are frequently used include among others: arc welding, which includes “stick” or shielded metal arc welding (SMAW), the gas-shielded methods of metal inert gas (MIG) and tungsten inert gas (TIG), plasma arc welding (PAW), and submerged arc welding (SAW) (Singh & Anand, 2013). The major welding activities involved in these joining processes are cutting, soldering and brazing and sometime painting which are hazardous to mankind. Welding operations present several hazards to both those undertaking the activity and others in the vicinity. Therefore, it’s imperative that you are aware of the risks and hazards welding poses, and understand what precautions you can take to protect yourself (Martinelli, 2018). Welding hazards include electric shock, burns, fire and explosions, radiation, heat, noise, fumes and gases. The Occupational Safety and Health Administration (OSHA, 2015) found that welding fumes can cause serious health problems for workers if inhaled, according to Short-term exposure can result in nausea, dizziness, or eye, nose and throat irritation. Prolonged exposure to welding fumes can lead to cancer of the lung, larynx and urinary tract, as well as nervous system and kidney damage. Certain gases, such as helium, carbon dioxide and argon, displace oxygen and can pose suffocation risks, particularly in enclosed work areas. According to Oduntan (2008), all of the conventional welding processes produce intensive visible light as well as high levels of infrared and ultraviolet radiations posing a unique combination of both safety and health risk for welders. Therefore, exposure to any or all of these can cause harm that may result to injury or even death if not minimized by using effective combination of control measures such as wearing eye goggles, face masks, gloves, ear plug, apron, and air filter (Ganesh & Dharanipriya (2015).

The potential group of welders who are likely to be exposed to this safety

and health risk are the welding technicians students practicing welding in various science and technical colleges workshops. Since these workshops are set up to teach students who may not have prior knowledge of welding operations, the tendency for them exposing to this hazard becomes inevitable (Okwelle & Normakoh, 2019). Students’ exposure to these harmful effects may lead to loss of confidence in the job profession thereby discouraging their learning and performance ability (Amenger, 2013). Thus it is therefore, necessary for technology teachers teaching students fabrication and welding in science and technical colleges to ensure that they observe safety practices while performing welding operations. Okwelle and Normakoh (2019) define safety as the state of being certain that adverse effect will not be caused by some agents under defined condition. While Safety practices are processes or techniques put forward by a work man in a working environment to safe guard and protect his or her safe from possible injury Ganesh and Dharanipriya (2015) in (Ganest, 2014). Some of the safety practices as identified by (Martinelli, 2018), include among the following;

- a. Use of welding helmets with side-shields-Welding helmets protect you from ultraviolet (UV) is electromagnetic radiation with wavelength from 10 nm to 400 nm, shorter than that of visible light but longer than X-rays, particles, debris, hot slag and chemical burns.
- b. Avoid touching part of the welding or electrode circuit at the same time as touching the metal you are welding to protect you from electric shock.
- c. Use of respirators to protect you from fumes and oxides that the welding process creates. Your respirator must be suitable for the work you are carrying out.



- d. Use of fire resistant clothing to protect you from heat, fire and radiation created in the welding process and shields you from burns.
- e. Use of ear protection to protect you from noise hazards. It's important you wear ear protection that is appropriate for the noise created in your workplace, and use fire resistant ear muffs if there is a risk of sparks or splatter entering the ear.
- f. Use of boots and gloves that are insulated, flame resistant gloves and rubber-soled, steel toe-capped safety shoes shield you from electric shocks, heat, fire, burns and falling objects. To ensure full protection from your, personal protective equipment (PPE), you must not:
- g. Roll up sleeves or trousers doing that will leave you susceptible to molten metal or sparks getting caught in the folds, which could potentially lead to severe burns. You should also never tuck your trousers into your work boots.
- h. Remove your helmet while welding by doing that will expose you to the intensity of the radiation produced.

It is believed that when the students or any one practicing welding is made to adhere to these safety practices, will minimize their chances of exposure to risks and hazards and increase their performance in production industries. Performance is the art to complete the task within the defined boundaries (Saeed, Mussawar, Lodhi, Iqbal, Nayab & Yaseen, 2014). Effective job performance is a situation where organizational environment, job demands, and an individual's competencies, are consistent or fit (Vathanophas & Thai-ngam, 2017). It is acknowledged that safety practices are deeply needed by all welders no matter the levels of their proficiency to work

effectively in the construction industries (OSHA, 2015). Construction is the process that sets up a portable plant, brings material to the site, and on completion of the work moves the plant away, leaving its output standing (Hyris, 2006). While construction industries is a sector of economic activity which erect, alter, repair, and demolish a building, civil engineering works, and other similar structures (Hazard, 2012).

Evidence from related works and personal observations in both school shops and construction sites has revealed that different kinds of accidents are recorded in relation to welding practices resulting to injury or damage to health hazards. Some of the frequently encountered hazards as experienced by welders and other related workers include mainly among others the electricity, radiation, heat, flames, fire, explosion, noise, welding fumes, fuel gases, inert gases, gas mixtures solvents. This is a worrisome situation that deserves serious attention to ensure safe working conditions in school shops and production environments. It is believed that when the students or any one practicing welding is exposed to risks and hazards due to ignorance or negligence, it lead to loss of confidence in the job profession thereby, discouraging his or her learning and performance ability. In spite of this, few studies have been conducted to investigate safety practices required of welding technicians for effective field job performance in Nigeria. Studies of such nature will provide useful information in developing appropriate prevention methods and safety practices in welding. Therefore, there is strong need to investigate the safety practices required of welding technicians for effective field job performance in construction industries in Nigeria.

Purpose of the Study

The main purpose of the study was to determine safety practices required of welding technicians for



effective field job performance in Benue State. Specifically, the study will sought to;

1. Find out safety practices required to protect welders from electric shocks;
2. Examine safety practices required to protect welders from ultraviolet radiation (UV);
3. Investigate safety practices required to protect welders from fumes and oxides; and
4. Determine safety practices required to protect welders from heat/fire.

Research Questions

1. What are the safety practices required to protect welders from electric shocks?
2. What are the safety practices required to protect welders from ultraviolet radiation (UV)?
3. What are the safety practices required to protect welders from fumes and oxides?
4. What are the safety practices required to protect welders from heat/fire?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance;

1. There is no significant difference between mean response scores of students and production welders on electric shock safety practices.
2. There is no significant difference between mean response scores of students and production welders on ultraviolet radiation safety practices.
3. There is no significant difference between the mean scores responses of students and production welders on ultraviolet radiation safety practices.
4. There is no significant difference between the mean scores responses of students and production welders on heat/fire safety practices.

METHODS

This study used descriptive survey research design. The area of study is Benue state of Nigeria. The population of the study was 760 respondents, consisting 320 fabrications and welding students in Government Science and Technical colleges and 440 welders in production industries in Benue state. A sample of 36 students and 37 welders in production industries was selected using Yamane (1967) formula, making a total sample size of 73 respondents. The instrument that used for data collection was a self- structured questionnaire titled "Safety Practices Required of Welding Technicians for Effective Field Job Performance Questionnaire (SPRWTEJPQ)" instrument. The instrument is structured on a 4-point rating scale of Highly Required (HR) = 4, Required (R) = 3, Not Required (NR) = 2 and Highly Not Required (HNR) = 1. The instrument was validated by three experts. One of the validators was a specialist in measurement and evaluation in Benue State University Makurdi, another, a specialist in Benue State University Science and Technical College Makurdi, and the last but not the least was a specialist in the Department of Curriculum and Teaching, Benue State University Makurdi. The observations of the experts were useful as they ensured the correctness and conciseness of the instrument that answered the research questions. In order to establish the reliability of the instrument a pilot study was conducted on 30 respondents in Enugu State who were not part of the study but had similar characteristics to the study population. The scores were subjected to reliability analysis using the test of internal consistency. The Cronbach Alpha reliability coefficient was computed along with the various inter-item correlations. The results yielded a reliability coefficient of $\alpha = 0.78$ and was considered reliable. It is then means that SPRWTEJPQ instrument is reliable for the study (Pallant, 2007). The data collected



was analyzed using descriptive statistics of mean and standard deviation to answer the research questions while t-test was used to test the hypotheses at 0.05 level of significance. Mean responses up to and above 2.50 was considered accepted and mean responses of 2.49 and below was rejected.

RESULTS OF DATA ANALYSIS AND INTERPRETATION

Research Question One: What are the safety practices required to protect welders from electric shocks?

Table 1: Mean and Standard Deviation of how students in science and technical colleges and production welders on safety practices to reduce electric shock in welding operations, N1 = 36 and N2 = 37

S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
1	Read all instructions, labels, before operating, or servicing the equipment.	3.667	0.478	3.757	0.434	3.735	HR
2	Welders should observe safe electrical work practices.	3.666	0.477	3.649	0.484	3.658	HR
3	Always ascertain if equipment are properly installed.	2.806	0.467	3.595	0.599	3.201	R
4	Avoid touching live electrical parts.	3.389	0.728	3.946	0.229	3.668	HR
5	Examine and inspect power switches, equipment, terminals and current carrying capacity.	3.167	0.560	3.541	0.505	3.354	R
6	Avoid working alone where there are electrically hazardous conditions.	3.389	0.494	3.432	0.502	3.411	R
7	Wear dry, hole-free, insulating gloves in good condition and protective clothing.	3.167	0.507	3.432	0.502	3.299	R
8	Avoid touching the electrode with a bare hand.	3.278	0.614	3.648	0.483	3.463	R
9	Insulate yourself from the work piece and ground using dry insulating mat.	3.611	0.494	3.081	0.493	3.346	R
10	Use covers big enough to prevent	3.639	0.487	2.892	0.516	3.266	R

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S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
11	any physical contact with the work or ground. Wear properly designed and approved rubber-soled boots in good condition.	3.306	0.467	3.540	0.505	3.423	R
12	Avoid touching an energized electrode while you are in contact with the work circuit.	3.750	0.439	3.513	0.506	3.635	HR
13	Examine the working area to check for potentially live structures or components and wet areas.	3.611	0.494	3.513	0.506	3.562	HR
14	Avoid wrapping cables carrying electric current around any part of your body.	3.972	0.166	3.378	0.492	3.649	HR
	Cluster Mean	3.458	0.491	3.494	0.483	3.476	R

The result presented in Table1, shows cluster mean of 3.458 and 3.494, indicating that students of science and technical colleges and welders in production industries had agreed that all the safety practices are required to reduce electric shock in welding operations in Benue State. The item by item analysis displayed that items 1, 2, 4, 12, 13 and 14 with Grand Mean ratings of 3.735, 3.658, 3.668, 3.635, 3.562 and 3.649 are safety practices rated highly

required, while items 3, 5, 6, 7, 8, 9, 10, and 11 with Grand Mean response scores ranging from 3.201, 3.354, 3.411, 3.299, 3.463, 3.346, 3.262 and 3.423 are safety practices rated required. The standard deviation shows that there is homogeneity among responses indicating a greater unanimity of opinions.

Research Question Two: What are the safety practices required to protect welders from ultraviolet radiation (UV)?

Table 2: Mean and Standard Deviation of how students in science and technical colleges and production welders on safety practices to protect fumes and oxide in welding operations, N1 = 36 and N2 = 37

S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
15	Keep your head out of the fumes.	3.417	0.554	3.703	0.617	3.560	HR
16	Do not breathe the fumes.	3.307	0.624	3.973	0.164	3.640	HR



S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
17	Use enough ventilation or exhaust at the arc, or both, to keep fumes and gases from your breathing zone and general area.	3.972	0.167	3.675	0.476	3.824	HR
18	Where ventilation is questionable, use air sampling to determine the need for corrective measures.	3.444	0.504	3.568	0.502	3.406	R
19	Use mechanical ventilation to improve air quality.	3.833	0.377	3.892	0.315	3.863	HR
20	Be sure of the breathing mask.	3.417	0.500	3.270	0.608	3.343	R
21	Avoid welding in locations near degreasing; cleaning or spraying is taking place.	3.639	0.487	3.162	0.727	3.400	R
22	Be sure the breathing place is safe.	3.806	0.401	3.324	.6260	3.565	HR
23	Always have a trained watchperson nearby.	3.833	0.378	3.378	0.497	3.606	HR
24	Wear approved safety glasses with side shielded under your helmet.	3.917	0.280	3.378	0.492	3.648	HR
	Cluster Mean	3.659	0.427	3.532	0.502	3.596	HR

The result presented in Table2, shows cluster mean of 3.659 and 3.532, indicating that students of science and technical colleges and welders in production industries had agreed that all the safety practices are highly required to protect fumes and oxide in welding operations in Benue State. The item by item analysis displayed that items 15, 16, 17, 19, 22, 23, and 24 with Grand Mean ratings of 3.560, 3.640, 3.824, 3.863, 3.565, 3.648 and 3.606 are safety

practices rated highly required, while items 18, 20, and 21 with Grand Mean response scores ranging from 3.406, 3.343, and 3.400 are safety practices rated required. The standard deviation shows that there is homogeneity among responses indicating a greater unanimity of opinion.

Research Question Three: What are the safety practices required to protect welders from fumes and oxides?



Table 3: Mean and Standard Deviation of how students in science and technical colleges and production welders on safety practices to protect ultraviolet radiation in welding operations, N1 = 36 and N2 = 37

S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
25	Avoid having direct eye contact with ultraviolet radiation.	3.667	0.478	3.676	0.475	3.672	HR
26	Use welding helmet to protect you from ultraviolet radiation.	3.222	0.422	3.243	0.435	3.233	R
27	Adjust the lens filter to have good visibility that does not irritate your eyes.	3.250	0.692	2.892	0.567	3.071	R
28	Stay 40 meters away from ultraviolet radiation.	3.333	0.633	3.838	0.553	3.586	HR
29	Use a fire-resistant hood under your helmet to protect the back of your head.	3.167	0.561	3.162	0.553	3.165	R
	Cluster Mean	3.328	0.537	3.362	0.517	3.345	R

The result presented in Table3, shows cluster mean of 3.328 and 3.362, indicating that students of science and technical colleges and welders in production industries had agreed that all the safety practices are required to protect ultraviolet radiation in welding operations in Benue State. The item by item analysis displayed that items 25 and 28 with Grand Mean ratings of 3.672 and 3.586 are safety practices rated highly

required, while items 26, 27, and 29 with Grand Mean response scores ranging from 3.233, 3.071, and 3.165 are safety practices rated required. The standard deviation shows that there is homogeneity among responses indicating a greater unanimity of opinion.

Research Question Four: What are the safety practices required to protect welders from heat/fire?

Table 4: Mean and Standard Deviation of how students in science and technical colleges and production welders on safety practices to protect heat/fire in welding operations, N1 = 36 and N2 = 37

S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
30	Avoid touching hot parts bare handed.	3.833	0.378	3.405	0.498	3.619	HR
31	Allow cooling period before working on equipment.	3.500	0.507	3.162	0.501	3.331	R



S/N	Item	\bar{X}_1	Std. 1	\bar{X}_2	Std. 2	\bar{X}_G	Remark
32	To handle hot parts, use proper tools and/or wear heavy, insulated welding gloves and clothing to prevent burns.	3.778	0.425	3.297	0.617	3.538	HR
33	Use suitable class ABC fire extinguisher.	3.611	0.494	3.595	0.498	3.603	HR
34	Keep the work area clean.	3.807	0.401	3.623	0.492	3.715	HR
35	Keep all flammable substances away from the work area.	3.667	0.478	3.432	0.502	3.549	HR
	Cluster Mean	3.699	0.448	3.419	0.518	3.544	HR

The result presented in Table4, shows cluster mean of 3.699 and 3.419, indicating that students of science and technical colleges and welders in production industries had agreed that all the safety practices are required to protect heat/fire in welding operations in Benue State. The item by item analysis displayed that items 30, 32, 33, 34, and 35 with Grand Mean ratings of 3.619, 3.538, 3.603, 3.715 and 3.549 are safety practices rated highly required, while

items 31 with Grand Mean response scores ranging 3.331 are safety practices rated required. The standard deviation shows that there is homogeneity among responses indicating a greater unanimity of opinion.

Test of Hypotheses

Hypothesis One: There is no significant difference between mean response scores of students and production welders on electric shock safety practices.

Table 5: t-test analysis of mean response of students and production welders about safety practices on electric shock in welding operations

Respondent	N	\bar{X}	Std.	t	df	Sig. (2tailed)	Decision
Students	36	3.458	0.127	-1.154	71	0.252	Insignificant
Production welders	37	3.494	0.138				

Result presented in Table 5 shows that no significant difference between the mean response scores of students and production welders (t= -1.154, p= 0.252). Therefore, the null hypothesis which states that there is no statistical significant difference between the mean responses of students and

production welders about safety practices on electric shock in welding operations is upheld.

Hypothesis Two: There is no significant difference between mean response scores of students and production

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welders on ultraviolet radiation safety practices.

Table 6: t-test analysis of mean response of students and production welders about safety practices on fumes and oxide in welding operations

Respondent	N	\bar{X}	Std.	t	df	Sig. (2tailed)	Decision
Students	36	3.658	0.161	3.077	71	0.003	Significant
Production welders	37	3.532	0.187				

Result presented in Table 6 shows there is significant difference between the mean response scores of students and production welders ($t=3.077$, $p=0.003$). Therefore, the null hypothesis which states that there is no statistical significant difference between the mean responses of students and production welders about safety practices

on fumes and oxide in welding operations is rejected.

Hypothesis Three: There is no significant difference between the mean scores responses of students and production welders on ultraviolet radiation safety practices.

Table 7: t-test analysis of mean response of students and production welders about safety practices on ultraviolet radiation in welding operations

Respondent	N	\bar{X}	Std.	t	df	Sig. (2tailed)	Decision
Students	36	3.328	0.314	-0.495	71	0.662	Insignificant
Production welders	37	3.362	0.278				

Result presented in Table 7 shows that there is significant difference between the mean response scores of students and production welders ($t=-0.495$, $p=0.662$). Therefore, the null hypothesis which states that there is no statistical significant difference between the mean responses of students and

production welders about safety practices on ultraviolet radiation in welding operations is upheld.

Hypothesis Four: There is no significant difference between the mean scores responses of students and production welders on heat/fire safety practices.

Table 8: t-test analysis of mean response of students and production welders about safety practices on heat/fire in welding operations

Respondent	N	\bar{X}	Std.	t	df	Sig. (2tailed)	Decision
Students	36	3.472	0.199	-2.430	71	0.321	Insignificant
Production welders	37	3.419	0.082				

Result presented in Table 7 shows that there is significant difference between the mean response scores of students and production welders ($t=-2.430$, $p=0.321$). Therefore, the null hypothesis which states that there is no statistical significant difference between

the mean responses of students and production welders about safety practices on heat/fire in welding operations is upheld.

DISCUSSIONS OF FINDINGS

The findings of this study with respect to research question 1, 2, 3, 4 and

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hypotheses 5, 6, 7, and 8 revealed that both students and production welders accepted the safety practices as being required in welding operations and no statistical difference exist in their mean responses. The results is in agreement with Oduntan (2008) who discovered that a large proportion of welders in Nigeria did not take adequate precautions to protect their selves from hazards associated with welding. Also Ganesh and Dharanipriya (2014) found that flying sparks, particles of hot metal, ultraviolet radiation, and metal fumes may seriously threaten the arc welders' health, and therefore safety measures are a matter of concern in welding operations. The study agreed with Afeez (2016) who declared that welding occupation is potentially safety and health risk threatening if sufficient safety measures are not put in place to protect the welding performers they will run in to trouble. The study is also in consonance with Okwelle and Normakoh (2019) who interested that teachers and supervisors need knowledge and skills necessary to be safety conscious and educate their students and workers on safety procedures while performing welding operations.

CONCLUSION

The researchers discovered that safety practices are deeply needed by all welders no matter the levels of their proficiency to work effectively in the construction industries. This is because both students and production welders agree with all the items about safety practices on electric shock, fumes and oxide, ultraviolet radiation and heat and fires in welding operations in schools and production industries. It was also discovered that welders perform their duty effectively well when they consider safety practices. On the whole, the results showed no statistical difference between the respondents on all the items.

RECOMMENDATIONS

Based on the findings of this study, the recommendations were made as follow:

1. Beginners and those already on the job in welding operation should be made by the instructors and supervisors to understand that safety practices are very essential in welding and should be seriously observed while carrying out the welding process to protect them from electric shock that can lead to electrocution.
2. Fumes and oxide are health risk threatening if inhaled continuously will cause contraction and subsequently result to cancer as well as affect the eyes, therefore, those in charge of welding workshops should always provide approved protective devices to welders to be worn during welding operations for protection.
3. Managers of welding shops should make a deliberate policy to educate welders through the use of multimedia and pictures on the dangers posed to specifically, the eyes by ultraviolet radiation emitted during welding operations and also provide the necessary shielding devices for their uses for eye and body protection.
4. School authorities and mangers of production industries should provide heat/fire resistance clothing to be worn by welders and always insure that fire extinguishers are provided and welders are thought on how to use for firefighting.

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