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Preparedness of Welders with Formal and Informal Training to Handle Structural Construction Jobs in Nigeria

Benedict Iorzer Labe &Terzungwe Alaghde
Department of Vocational and Technical Education
Benue State University, Makurdi, Benue State-Nigeria
Email: blabe@bsum.edu.ng
Corresponding Author: Benedict Iorzer Labe

ABSTRACT

This study investigated the level of preparedness of welders with formal and informal training to handle structural construction jobs in Benue State, Nigeria. To achieve the objective, six research questions were developed and answered while four null hypotheses were tested at 0.05 level of significance. The study used cross-sectional survey research design that made use of a 39 item structured questionnaire. The population for the study consisted of 286 structural welders drawn from six major towns in Benue State, Nigeria. The structured questionnaire was face and content validated by three experts. The scale reliability of items in the questionnaire was found to have a Cronbach Alfa α = .759. The questionnaire was administered on a sample of 286 respondents. Data was analyzed using percentage, mean and standard deviation while t-test was used to test the hypotheses. The findings of the study revealed that both skilled and unskilled structural welders are involved in the construction works. The conclusion was that majority of the structural welders handling structural works in Benue State had not undergone the minimum duration of practical training. They had low educational qualification, low mathematical skills to work out measurements, could hard read or interpret technical/engineering drawing. They also lacked the relevant theoretical knowledge in welding. Based on the findings of this study, some recommendations were made which include legislation requiring structural welders to be certified after undergoing a certain minimum period of formal training before they could be allowed to practice.

INTRODUCTION

Welding construction jobs completed by structural welders in Nigeria are failing to serve the users. Especially in Benue State, overhead tanks, residential and commercial entrance gates, building roofs, sports facilities (floor lights,

goal posts, basketball post, and stadium structures) and other public structures such as bill boards, canopies are examples of numerous welding jobs that collapsed or failed to serve the users. Generally, it is expected that welders will have acceptable level of proficiency before they are engaged on high stakes jobs like structural welding. However, the level at which metal products and structures constructed by structural welders fail or collapse in Nigeria gives room for suspicion that unskilled persons who are not having basic training and formal education are involved in the construction and fabrication of these metal products. Although there is no set path, some employers prefer to hire welders who have received formal technical training (Bureau of Labor Statistics, U.S. Department of Labor, 2017).In order to be eminently qualified in the design and construction of metal product through welding and fabrication as crafts person, technician, technologist or artisan, the person should undertake a formal education technical training either in a technical college programme or other forms of training programmes. Stone, Watts, and Zhon (2011) found that structural welders trained formally with integrated programmes had superior training out comes than those structural welders trained in informal education. According to Manca (2013), as cited in Byrd (2014) when individuals are trained with virtual formal education they increase their memory retention and reduce human error; this is because the trainees can perfect their skills and gain a deeper understanding of the work environment before actually put it into real-life situation. In Nigeria, individuals willing to have formal education training in welding and fabrication can seek for admission in to technical training schools and colleges. The Federal Government of Nigeria (FGN, 2013) in its National Policy on Education (2013) defines technical education as that aspect of education, which leads to the acquisition of practical and applied skills as well as basic scientific knowledge. Ogundele (2010) also defines technical education as "the aspect of knowledge, which involves special manipulative skills, creative minds, and attitudes required to practice a profession (occupation) for the benefit of that individual and the society''.

Technical knowledge and skills in welding and fabrication can also be acquired in informal education training. Knudsen (2015) described informal training as the kind training that lie outside of the training acquired in a formal school setting. It is a purposive but voluntary learning that takes place in a diverse range of environments and situations for which teaching/training and learning is not necessary their sole or main activity. According to the author, the activities are planned but are hardly ever structured by conventional pattern or curriculum subjects. They usually address specific target groups, but rarely documents or assess learning outcomes or achievements in conventional visible ways.

The two forms of training; either formal or informal ensures adequate knowledge and skills for the individuals to perform their respective tasks proficiently. However, the high rate of metal structural failures in Benue state could be that the welders may be short of domain knowledge and relevant skills to perform their jobs. Considering the facts, there would be need to carry out individual performance assessment/needs analysis in order to determine what training needs exist so that training can be developed to help the individuals accomplish their construction objectives. Brown (2002) asserts that's any gap between performance and job requirements indicates a need for task analysis. A good task analysis identifies skills and knowledge that requires performing job and where and how these skills are best acquired.

Wiss (2006) viewed structural failure as unacceptable difference between expected and performance level of a structure. Structural failure is attributed to some factors such as overstress, large deflections, and fatigue cracking. Wiss (2006) also sees structural collapse as being gross movement of major members of a significant portion or a whole structural system that renders it incapable of supporting the intended load. Wiss however, stressed that structural failure does not imply collapse but collapse is viewed as a structural failure. Similarly, Ede (2011) maintained that structure is assumed to have failed when it can no longer serve the purpose for which it was made. Anyimola and Olalusi (2004) discussed the causes and possible

solutions to building structure failures in Nigeria. In summary, they found that the presence of unqualified professionals was the principal cause of structure failure and collapse. Similarly, Ramachandra, Raghuram, Krishnaun & Bhaumik (2005) observed that there are four reasons for material failure; the material is subjected to an environment beyond its design envelop; inappropriate choice for the design and operating conditions; defectiveness of material or wrong design. Ede (2011) viewed that the cause of failures in structures with in Nigeria can be traced to be abnormal factors not obtainable in most nations. Worldwide, the generally known causes of structural failure or collapse are design faults, ageing, material fatigue, extreme operational hazards. But in Nigeria, the principal causes of collapse are non-adherence to the code of conduct, use of unskilled persons, conflicts among professional and corruption. Olagunji and Akande (2012) have also stated that failure of building structures in Nigeria can be attributed to the causes such as design faults fifty percent, faults on construction forty percent, and product failure ten percent.

Common products that fail and collapse in Nigeria in which the failure and collapse are traced to be weld faults mostly from structural welders include: doors, windows, sign post, overhead tanks, building roofs, chairs, residential gates, canopies, mast, vehicle bodies, furniture and sports facilities are everyday examples of these failures, some of which are: The overhead tank of a mini-water project in Ukana Iba, Essien Udim, Local Government Area, Akwa-Ibom State, on Thursday June 30, 2013. Collapsed and killed one person and injured another. One of the major causes was poor welding (Abagoro, 2013). Another similar incident took place in Ika south Local Government Area, Delta State where six primary school pupils were killed and 10 other sustained various degrees of injuries in their classroom, when an overhead tank along with its metal collapsed and fell on a block of classrooms. The cause of the incident was also attributed to poor welding joints and low quality materials selected for the project (Francisco, 2010). Similarly, the Reigners Bible Church made of metal materials on the 6th December 2016 collapse in Akwa Ibom killing 26 persons and several others sustaining varying

degree of injuries. The panel constituted by the Akwa Ibom State Government revealed that the collapsed of the church was due to poor construction work and use of sub-standard materials (Epiong, 2016). Another overhead water tank collapsed in Benue Cement Company Plc now Dangote Cement, Gboko Plant in Amua Housing Estate and killed seven goats and damaged a power house that was close to it. The cause of collapse was later traced to be poor welding and use of sub- standard materials (Akya, 2006). All these disasters occurred from failed metal structures.

The researchers also observed several products made of metal by Nigerian technicians, artisans, technologists and craftsperson that suddenly fail or collapse. These products include a backboard/basket of the basketball court in Benue State University Makurdi, part of Benue State University 1st and 2nd gate, a collapsed welded mast along university of agriculture road, Makurdi, a billboard belonging to Dangote Cement along Gyado villa, in Makurdi, some metal seats in lecture halls of the Benue state University and University of Agriculture Makurdi, entrance gates of some private houses in Benue state and other metal furniture in some offices in Benue State University, College of Education Katsina-Ala and a collapsed overhead tank in Amua Community in Gboko Benue State, to mention but a few of these disasters.

The researcher equally observed that most of the structures mentioned in this study are either assembled by welding, riveting, or use of nuts and bolts. This means that the structures are constructed by metal workers who specialized in welding and fabrication. Nevertheless, the major causes of these collapses were attributed to inability of the structural welders to use the right materials and the desired welding method. Kurmi and Gupta (2012) define welding as a process of joining two similar or dissimilar metals by fusion, with or without the application of pressure and without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be obtained from blacksmith's fire, electric arc, electrical resistance or by chemical reaction.

Evidence from national dailies like; The Will Nigeria News Paper and The Nation News Paper as well as personal observations has shown that there is mass failure of metal structures constructed by welders in Nigeria. Most of the structures constructed of metal by these welders such as overhead tanks, bill boards, residential/commercial gates, sports facilities and automobile parts fail, collapse, deform or disintegrate. These failure incidences are seemed to be construction faults from the structural welders. Whenever such failures occur it would lead to damage, waste of time, and waste of resources, injuries and sometimes loss of lives. This is a worrisome situation to the researcher, metal product users and other members of the society who are affected in one way or the other. If the situation is allowed to continue more wastage, injuries and loss of lives would be recorded as a consequence of products deformation, disintegration, collapse or failure. Therefore, there is strong need for the researcher to investigate the level of preparedness of structural welders with formal and informal raining to handle structural construction jobs. It is also the aim of this study to ascertain to what extent the welders have passed through the minimum duration of practical training, their educational qualification, mathematical skills to work out measurement, ability to read and interpret technical/engineering drawing, ability to solve technical related problems and their level of theoretical knowledge in welding.

Purpose of the Study

The purpose of this study was to investigate level of preparedness of welders with formal and informal training to handle structural construction jobs in Benue State.

Specifically, the study sought out to investigate the level structural welders has:

i. passed through the recommended minimum duration of training for proficient structural welding;
ii. the modal qualification required to perform proficiently in structural welding;
iii. the mathematical skills to work out measurement in structural welding;
iv. the ability to read or interpret technical/engineering drawing in structural welding;

v. the ability to solve technical problems related to structural welding work;
vi. Sufficient theoretical knowledge in structural welding.

Research Questions

The following research questions guided the study:

i. To what extent have the structural welders gone through the minimum duration of practical training in Benue State?
ii. What is the educational qualification of structural welders in Benue State?
iii. To what extent do the structural welders have the mathematical skills to work out measurement in structural welding in Benue State?
iv. To what extent do the structural welders have the ability to read or interpret technical/engineering drawing in structural welding in Benue State?
v. To what extent do the structural welders have the ability to solve technical problems related to welding structural work in Benue State?
vi. Do the structural welders have sufficient theoretical knowledge to handle structural welding in Benue State?

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 significant levels.

Ho_1: There is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal training on carrying out mathematical measurement in structural welding;

Ho_2: There is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal training on the ability to understand technical/engineering drawing;

Ho_3: There is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal training on the ability to

solve technical problems related to structural welding work;

Ho4: There is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal training on having sufficient theoretical knowledge in structural welding;

METHODOLOGY

A cross-sectional survey research design was used for the study. A cross-sectional survey research design allows researchers to compere many different variables at the same time. It is also used to examine one variable in different groups that are similar (Emaikwu, 2015). The cross-sectional survey design was chosen for this study because the variables are going to be examining in two groups and the information collected from respondents will be their self-report of the attributes under investigation. Additionally, the information was collected from the respondent at a single period but not at given intervals. The study was carried out in Benue State, Nigeria. The population for the study consisted of 1003 welders in Benue state. The Welders Association Register (WAR) records in various towns were as follows: 98 welders in Zaki-Biam,45welders in Katsina-Ala, 282 welders in Gboko, 326 welders in Makurdi, 202 welders in Otukpo and 50 welders in Otukpa (WAR, 2016). Among the welders 27 were Master Craftsmen, fifty-three (53) were Journey-Men. One hundred and forty-two (142) were Senior Apprentice and sixty-four (64) were Apprentice. On their mode of training, eighty (80) of them received formal training and two hundred and six (206) received informal training. The sample of 286 welders in the various major towns of Benue state was drawn using Yamane (1967) formula for calculating sample size. (See appendix A). Multi-stage sampling technique was adopted. This is because units (welders) were selected at various stages (Emaikwu, 2015). Firstly, cluster sampling technique was used to divide registered welders into six clusters and a random sample of these clusters are selected namely Zaki-Biam, Katsina-Ala, Gboko, Makurdi, Otukpo, and Otukpa which the researcher considered to be places where structural construction jobs is done. Secondly, Proportionate Stratified Random

Sampling technique was adopted. Proportionately, the sample of welders who were either Master Craftsman, Journey-Man, Senior Apprentice, and Apprentice was drawn using Anaekwe (2007) formula for calculating proportionate stratified random sampling. Copies of the PWHSCJ questionnaire were distributed to registered structural welders carrying out construction jobs in Zaki-Biam, Katsina-Ala, Gboko, Makurdi, Otukpo and Otukpa in Benue State by the researcher, with the aid of two research assistants. The research assistants as instructed collected all the 286 questionnaires distributed to respondents without any one missing. The assistants and the researcher collected them timely and in person to avoid multiple filling and delay associated with mailing.A descriptive statistics was used to analyze the data collected using validated and reliable instrument. Particularly, percentage, mean and standard deviation were used to answer the research questions and independent t-test was used for testing the hypotheses formulated at 0.05 significant level. A mean score of 2.50 and above will be considered as accepted, while any mean score less than 2.50 will be considered not accepted. The Statistical Package for Social Sciences (SPSS) version 21 was used to analyze the data (Pallant, 2007). To analyze and interpret the data, the status of the respondents and their Mode of training were answered using percentage; mean and standard deviation were used to answer research questions. The four hypotheses formulated for this study were tested at 0.05 significant levels. Decisions were taken based on values of associated probabilities denoted by **p**. When the **p** values are observed to be equal or less than **0.05**, the noted difference is statistically significant therefore, the null hypothesis is rejected. But if the **p** value is greater than **0.05**, the noted difference is statistically insignificant therefore, the null hypothesis is upheld.

Research Question One

To what extent have the structural welders gone through the minimum duration of practical training in Benue State?

Table 1. Minimum Duration of Training of Structural Welders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 Year	10	3.5	3.5	3.5
	1 Year to less than 2 years	34	11.9	11.9	15.4
	2Years to less than 3 Years	157	54.9	54.9	70.3
	3Years to less than 4 Years	57	19.9	19.9	90.2
	5 Years and above	28	9.8	9.8	100.0
	Total	286	100.0	100.0	

From Table 1, it can be seen that 10 of the welders representing 3.5% received less than one year of training, 34 representing 11.9% received between one and less than two years. One hundred and fifty-seven (157) representing 54.5% received between two years and less than three years of training, 57 representing 19.9% were trained between three years and less than four years and 28 representing 9.8% were trained between five years and above. This has shown that the higher percentage of structural welders practicing welding construction works in Benue State are those trained between 2 and less than 3 years. This duration of training is below the recommended minimum duration of training of 3 to 6 years for welders.

Research Question Two

What is the modal qualification of structural welders in Benue State?

Table 2. Educational Qualification of Structural Welders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Attended primary school but dropped out	32	11.2	11.2	11.2
	Have FSLC	46	16.1	16.1	27.3
	Have JSSCE	98	34.3	34.3	61.5
	Attended junior secondary school but dropped out	16	5.6	5.6	67.1
	Attended school up to SSS III but dropped out	14	4.9	4.9	72.0
	Have FCC and LTTC	38	13.3	13.3	85.3

Have ND	17	5.9	5.9	91.3
Have NCE	9	3.1	3.1	94.4
Have HND	4	1.4	1.4	95.8
Have B.Sc. (Ed) Technology	7	2.4	2.4	98.3
If any other certificate(s)	5	1.7	1.7	100.0
Total	286	100.0	100.0	

Table 2 shows that the modal qualification for welders handling construction jobs in Benue State is Junior Secondary School Certificate (JSSC). While 32 representing 11.2% were those who attended primary school but dropped out. Forty-six (46) representing 16.1% had First School Living certificate (FSLC). Sixteen (16) representing 5.6% were those who attended junior secondary school but dropped out, while 98 representing 34.3% had Junior Secondary School Certificate (JSSC). Fourteen (14) representing 4.9% were those who attended Senior Secondary School (SSS) up to SSS111 but dropped out, fourteen (38) representing 13.3% had Federal Craft Certificate (FCC) and Labour Trade Test Certificate (LTTC). Seventeen (17) representing 5.9% had National Diploma (ND), nine (9) representing 3.1% had National Certificate in Education (NCE). Four (4) representing 1.4% had Higher National Diploma (HND), seven (7) representing 2.4% had Bachelor of Science (Education) Technology (B.Sc. Ed. Technology). While 5 welders representing 1.7% had other certificates related to welding construction.

Research Question Three

To what extent do the structural welders have the mathematical skills to work out measurement in structural welding?

Table 3: Mathematical Skill Required to Work out Measurements

	Mode of Training	N	Mean	Std. Deviation
Mathematical Skills to Work out Measurement	Trained in School	80	2.850	.547
	Trained Outside School	206	2.378	.688

Key: N= Population, M= Mean and SD= Standard deviation

Table 3 reveals that welders who received formal training can easily carry out mathematical measurements on construction jobs

(N=80, M=2.85, SD=.547), while those who received informal training can somehow easily carry out mathematical measurements on construction jobs (N= 206, M=2.850 SD=.547).

Research Question Four

To what extent do the structural welders have the ability to read or interpret technical/engineering drawing in structural welding in Benue State?

Table 4: Structural welders Ability to Read and Interpret Technical/Engineering Drawing

	Mode of Training	N	Mean	Std. Deviation
Ability to Read and Interpret Technical/ Engineering Drawing	Trained in School	80	3.150	.563
	Trained Outside School	206	2.081	.825

Table 4 shows that welders who are formally trained had very high ability to read and interpret technical/engineering drawing in structural welding jobs (N=80, Mean=3.150, SD=.563). Those who received informal training had low ability to read and interpret technical/engineering drawing in structural welding jobs (N=206, M=2.08, SD=.825).

Research Question Five

To what extent do the structural welders have the ability to solve technical problems related to welding structural work in Benue State?

Table 5: Welders Ability to Solve Technical Problems Related to Welding Structural Work

	Mode of Training	N	Mean	Std. Deviation
Ability to Solve Technical Problems Related to Structural Welding	Trained in School	80	2.892	.548
	Trained Outside School	206	2.458	.950

Table 5 reveals that welders who received formal training had high ability to solve technical problems related to construction jobs (N=80, M=2.892, SD=.548). While welders who received informal training had

low ability to solve technical problems related to construction jobs (N=206, M=2.458, SD=.445).

Research Question Six

Do the structural welders have sufficient theoretical knowledge to handle structural welding in Benue State?

Table 6: Structural Welders Sufficient Theoretical Knowledge

	Mode of Training	N	Mean	Std. Deviation
Sufficient Theoretical Knowledge in Welding	Trained in School	80	3.163	.539
	Trained Outside School	206	1.920	.780

Table 6 shows that welders who received formal training had sufficient theoretical knowledge in welding construction jobs (N=80, M=3.163, SD=.539). While welders who received informal training had insufficient theoretical knowledge in welding construction jobs (N=206, M=1.920, SD=.780).

Hypothesis One

There is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal training on carrying out mathematical measurement in structural welding.

Table 7: T-test for Difference Between Formally and Informally Trained Welders on Mathematics Skills to Worked out Measurements in Structural Welding

	Mode of Training	N	Mean	Std. Deviation	T	df	Sig. (2tailed)
Mathematical Skills to Work out Measurement	Trained in School	80	2.850	.547	5.504	284	.000
	Trained Outside School	206	2.378	.688			

Data presented in Table 7 shows that significant difference exist in the mean response scores of structural welders trained in formal education and those who underwent informal training in carrying out mathematical measurement in structural welding (t=5.504, p=.000). Therefore, the null hypothesis which states that there is no significant difference in the mean response scores between structural welders trained in formal education and those who underwent informal

training on carrying out mathematical measurements in structural welding is not accepted.

Hypothesis Two

There is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to read and interpret technical/engineering drawing in structural welding.

Table 8: T-test for Difference between Formally and Informally Trained Welders on Ability Read and Interpret Technical/Engineering Drawing

	Mode of Training	N	Mean	Std. Deviation	t	df	Sig.(2tailed)
Structural Welders' Ability to Read and Interpret Technical Engineering Drawing	Trained in School	80	3.150	.563	10.649	284	.000
	and Trained Outside School	206	2.081	.825			

Data presented in Table 8 shows that significant difference exist in the mean response scores of welders who received formal training and those who underwent informal training on ability to read and interpret technical/engineering in welding construction jobs (t=10.649, p=.000). Therefore, the null hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to read and interpret technical/engineering drawing in structural welding is not accepted.

Hypothesis Three

There is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to solve technical problems related to structural welding works.

Table 9: T-test for Difference between Formally and Informally Trained Welders on Ability Solve Technical Problems Related Structural Welding

	Mode of Training	N	Mean	Std. Deviation	t	df	Sig.(2tailed)
Structural Welders' Ability to Solve Technical Problems Related to Structural Welding	Trained in School	80	2.892	.548	3.843	284	.000
	Trained Outside School	206	2.458	.950			

Data presented in Table 9 shows that significant difference exist in the mean response scores of welders who received formal training and those who underwent informal training on ability to solve technical problems related to welding construction jobs (t=3.848, p=.000). Therefore, the null hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to solve technical problems related to structural welding works is not accepted.

Hypothesis Four

There is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on having sufficient theoretical knowledge in structural welding.

Table 10: T-test for Difference between Formally and Informally Trained Welders on the Required Theoretical Knowledge to Perform Proficiently in Structural Welding

	Mode of Training	N	Mean	Std. Deviation	T	df	Sig.(2tailed)
Structural Welders' Sufficient Theoretical Knowledge in Welding	Trained in School	80	3.162	.539	13.080	284	.000
	Trained Outside School	206	1.920	.780			

Data presented in Table 10 shows that significant difference exist in the mean response scores of structural welders trained in formal education and those who underwent informal training on

having sufficient theoretical knowledge in structural welding(t=13.080, p=.000). Therefore, the null hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on having sufficient theoretical knowledge in structural welding is not accepted.

DISCUSSION OF FINDINGS

The findings of this study with respect to research question one revealed that the higher percentage of welders handling construction jobs in Benue States are those trained between 2 to less than 3 years. This disagrees with Onyenekenwa (2010) who is of the view that the minimum duration of training for apprenticeships in welding should be 3 to 6 years. Similarly, this finding confirmed Heyes's, (2005) ten (10) years' experience necessary for an individual to acquire a skill in a domain.

The findings of this study with respect to research question two on educational qualification of structural welders has shown that Junior Secondary School Certificate (JSSC) is the modal qualification of the welders. This is an indication that majority of the structural welders handling construction jobs in Benue State have JSSC. This does not agree with McCarthy (2001) who found that the general educational requirement for the welders handling structural jobs includes High School graduation and two years of Post High school training. The acquisition of an educational qualification therefore implies the successful completion of a course of study or training programme. Similarly, the United Bureau of Labor Statistics (BSLS, 2013) recommended high school diploma and degree certificate in welding from a technical school, vocational school or college.

The findings on carrying out mathematical measurements in structural welding works in respect to research question three and hypothesis one on Tables 3 and 7 revealed that welders who received formal training can easily carry out mathematical measurements in structural jobs, while those who received informal training can somehow easily carry out the mathematical measurements. The hypothesis which states that there is no significant difference in the mean

response scores between structural welders trained in formal education and those who underwent informal training on carrying out mathematical measurement in structural welding is of no significance and is rejected. Mathematical skills having been important skills for carrying out measurement in welding, the structural welders need the skills to enable them to perform their job well. The findings agree with Yusup (2013) who said that welders need to have a good general knowledge of fractions, and decimals to carry measurements, read and understand blueprints. It is true because several basic principles of geometry, like the measurement and calculation of angles, area and volume are also indispensable in a field like welding full of triangles and spaces that need to be filled with just the right amount of material. The findings were also in consonance with Irwin (2015) who found that a good welder needs to have a general knowledge in mathematics to perform proficiently. It could be that, short of mathematics knowledge by welders who received informal training is one of the factors responsible for structural failure in Benue State.

Data presented in respect to research question four and hypothesis two on Tables 4 and 8 regarding the ability of welders to read and interpret technical /engineering drawing in structural welding revealed that majority of the welders handling structural construction works in Benue State lack the ability to read and interpret technical/engineering. The hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to read and interpret technical/engineering drawing in structural welding is of no significance and is rejected. It is therefore, very essential that technical /engineering drawing is required by structural welders in Benue State to perform proficiently in welding construction works. This agrees with Vladis (2005) whore commends that welders need engineering drawing which serves as an important means of communication between Engineers, Technicians, Technologists, Craft persons, and professionals involved in design and production. It is also in consonance with Regello (2012) who averred that like other aspects

of drafting, there is a set of symbols for welding to simplify the communication between designers and the welder. Hence welders who are trained informally are the predominant of the welders in the labour market in Benue State following this statistic, there is a possibility that the work constructed by them will fail.

The analysis of the data presented with respect to research question five and hypothesis three on Tables 5 and 9 regarding ability of structural welders to solve technical problems related to welding work revealed that welders who received formal training had high ability to solve technical problems related to welding and those who received informal training had low ability to solve technical problems. The hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on the ability to solve technical problems related to structural welding works is of no significance and is rejected.

So far as the number of those trained in school were far less in number than those trained outside school, it is a clear indication that works constructed by them will fail to serve the users. For that reason, welders in Benue State need very high ability to solve technical problems related to welding work. This agrees with Barns (2009) who acknowledged that the development of problem solving ability is a key factor in creating an independent work man. It is also in line with McCade (2001) who remarked that problem solving is an important ability in industrial arts because it allows those on the job training to overcome stumbling blocks that are inevitable in producing a well-crafted product.

The findings in respect to research question six and hypothesis four on Tables 6 and 10 regarding welder's sufficient theoretical knowledge in welding show that welders who receive formal training had sufficient knowledge, while those who received informal training had very low theoretical knowledge in welding construction jobs. The hypothesis which states that there is no significant difference in the mean responses between structural welders trained in formal education and those who underwent informal training on having sufficient theoretical knowledge in structural

welding is of no significance and is rejected. The welders need very sufficient theoretical knowledge to perform better in their construction jobs. This is in consonance with Chasan (2006) who is of the view that theoretical knowledge provides information to a welder about a variety of welding terminology and its application to the practical knowledge. It is also in agreement with Braddley (2012),who emphasized that theoretical knowledge helps one to understand why one technique works where another fail. It shows you the whole forest, builds the context, and helps one set strategy. Where self-education is concerned theory prepares you to set a direction for your future education. Theory teaches you through the experience of others. Theoretical knowledge can often lead to a deeper understanding of a concept through seeing it in context of a greater whole and understanding.

CONCLUSION

It is concluded that structural welders handling construction works as of the time of this report need to improve seriously on both practical and theoretical knowledge in fabrication and welding. This implies that metal structural failure cannot be addressed unless the relevant regulatory bodies will check and compel welders handling structural works to go on retraining courses and equipped themselves with the required skills that will qualify them to handle construction jobs.

RECOMMENDATIONS

Considering the findings of the study, the researcher therefore, recommended that:

(a) Structural welders should make deliberate effort to improve on their jobs and ensure to pass through the minimum duration of training of at least 3 to 6 years of practical training as also recommended.

(b) Since majority of the welders carrying out constructions in Benue State do not have the required certificate, this study therefore, recommends that Government of Benue State should device a method for checking the unqualified welders who do not have the required certificate to operate on their own and advise them to go for formal welding retraining programme to acquire the needed certificates to qualify them operate on their own.

(c) Structural welders practicing in Benue State need to have a good general knowledge of fractions, and decimals so as to carry out measurements, read and understand blueprints. The records of this study show that predominant of the welders handling construction jobs do not have the required mathematical skills to carry out measurements in welding construction jobs. The researcher recommends that they should look for ways to improve their knowledge on mathematical measurement.

(d) Since drawing or sketching is a universal language used to convey all necessary information to the individual who will fabricate or assemble any object. Structural welders need to have a good knowledge of technical/engineering drawing hence the majority of those handling the construction works in Benue State had low ability to read or interpret technical/engineering drawing.

(e) Since majority of the Structural welders practicing in Benue State had insufficient theoretical knowledge to perform their duties proficiently, the researcher therefore recommends that the welders need the knowledge so that it will provide them with required information about a variety of welding terminology and its application to the practical knowledge.

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