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Metal Forming Skills Needed by Artisan Welders in the Production of Standard Doors and Gates for Households in Nigeria

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Abstract

This study was conducted to determine the metal forming skills needed by artisan welders in the production of standard doors and gates for households in Nigeria. Three research questions and three null hypotheses were formulated to guide the study. A descriptive survey research design was employed for the study. A total of 65 respondents comprising of 40 Welders (Master Craftsmen) and 25 Industrial Welders were used as population for the study. Forty items questionnaire was used to collect data from respondents. Mean, standard deviation and z-test were used to answer the research questions and test the null hypotheses. The findings revealed that various skills are needed in the handling of metal forming tools and equipment by artisan welders and skills are needed in grooving and forming of metals by artisan welders in the production of standard doors and gates for households in Nigeria using Ilorin metropolis. It was recommended that standard workshops and training should be provided in order to equip the artisan welders with necessary metal forming skills.

Keywords: Metal forming, artisan welder, doors, gates, skills, households.

Introduction

Metals are elastic and plastic and therefore, have the ability to be formed and shaped into various sizes. This enables articles, tools and parts to be fabricated using different forming processes. Forming is the metalworking process of fashioning and shaping metal parts and objects through mechanical and or thermal deformation; the piece of metal is then reshaped through recrystallization or fusion without adding or removing any part of the material, and its mass remaining unchanged. Metal forming operates on the materials science principle of plastic and elastic deformation, where the physical shape of a material is permanently deformed by forming them. Metal forming is a manufacturing process in which physical forces are applied on metals such that stresses induced in the material are greater than yield stress and less than ultimate stress of the material. The material experiences plastic deformation to change the shape of the component and converted to the desired shape of the component.

Metal forming remains a strong global industry with significant growth in emerging economies. It is a general term for a large group of production methods that includes a wide variety of technical manufacturing processes. Metal forming processes are characteristic in that the metal being processed is plastically deformed to shape it into a desired geometry (Lange, 1985). In order to plastically deform a metal, a force must be applied that will exceed the yield strength of the material. When low

amounts of stress are applied to a metal it will change its geometry slightly, in correspondence to the force that is exerted. Artisans achieve this without having knowledge of the science involved in forming metals. An artisan is a skilled craft worker who creates or forms things by hand from an informally acquired skill and training. Artisans practice a craft and may through experience and aptitude reach the expressive levels of an artist (Hoodwin, 2004). It's in the nature of artisans to express themselves through the invention, creation, manufacture, repair, and manipulation of things. These can be artistic masterpieces or mechanical devices. Artisans that are involved in joining metals together are called welders.

Welding is a craft in which pieces of material are joined together to produce crafts. Welding is a process of permanently joining two or more materials (usually metals) through localized coalescence resulting from a suitable combination of temperature, pressure and metallurgical conditions. According to Mannir (2013), the term welding is used to describe variety of joining two or more materials (metals and metals, metals and nonmetals or nonmetals and nonmetals) together by applying heat or pressure or both to form a localized union through fusion or recrystallization across the interface of the parent metals. Welding is an ancient occupation. People have been working with metals or creating parts and items for thousands of years, and metalworking is an important part of human life that archaeologists even use the working of various

metals to describe eras in human history like the Bronze, Iron and Steel Ages. Classically, metal welding has been accomplished with the use of heat to melt the metals before fusing them together to form a joint; modern welding includes an assortment of various other techniques for joining materials, including electricity as source of heat in arc welding and chemical energy as source of heat in oxy-fuel welding. Skills are needed in order to have efficiency and proficiency in welding.

Skill can be defined as learned ability to carry out a task with predetermined result often within a given amount of time and energy. It is the ability and capacity that needed knowledge through desperate, systematic and sustained efforts to smoothly and adaptively carryout complex activities or job function involving ideas (cognitive skills), things (technical skills), and people (interpersonal skills). It is also to do something well having enough ability, experience and knowledge to be able to do things in a better way. It is the proficiency displayed by someone in the performance of a given task. In the context of this study, skill is the ability that an individual has acquired that enables him perform a task efficiently such as using some additional practical skill needed to improve his/herself.

Practical skills mean skills performed by hand or with human interaction using equipment, tools or technology requiring guidance, force or movement (Ojo, 2000). Practical skill can be defined as "doing skills" for example, ability to perform a task like repairs, computer skills, metalworking among others. Practical skills primarily needs physical dexterity, although an understanding of principles, processes, and sequences is also essential, especially for more complex practical skill. In many learning environment, the word "competency" has replaced the term "practical skill". The terms are not entirely interchangeable as competencies can also include the application of knowledge and theory not associated with practical skill. But in general, the demonstration of a practical skill can also be described as demonstration of competence.

Artisan welders are sometimes referred to as roadside welders in Nigeria. Welding offers good employment and source of livelihood for various individuals in Ilorin, Nigeria. These artisan welders always set-up workshops around mechanic workshops, motor spare-parts markets and along major highways where they run their privately owned small-scale workshops with about three to five welders or apprentices per workshop. They are known to generally produce various household articles including doors and gates. This research

study is aimed at examining the metal forming skills needed by artisan welders in the production of standard doors and gates for households in Ilorin metropolis.

Statement of the Problem

A number of industrial accidents are caused by improper use and handling of tools and equipment. These accidents are caused by using the wrong tool for a job, using the right tool incorrectly, failing to wear personal protective equipment while working, or failing to follow safety guidelines. Tool handling is a very important aspect of production in metalwork. The way tools and equipments are handled goes a long way to tell on the product produced. Most artisans lack the skills needed in handling metal forming tools and equipment while producing articles. Skills needed in proper handling forming tools and equipment is important for the production of gates and doors by artisan welders. Some artisan welders find it hard to manipulate tools and equipment. Some of them don't use the right tool for the right job, thereby, leading to the early damage of these tools and equipment as well as the inability of getting the exact formed shape that is needed. This is a major challenge common amongst artisan welders.

The safety, reliability, efficiency and effectiveness of a product depend on the skills of the craftsmen that are producing the metal products. Welding is a special production process which requires special skills in order to achieve the needed quality in metal forming of products. The ability to weld to required standard is a very important skill a good artisan welder should possess. The problem of this study is therefore put as "what are the metal forming skills needed by artisan welders in the production of standard doors and gates for households in Nigeria?" The purpose of this study is therefore to determine:

1. The skills needed in handling metal forming tools and equipment
2. The skills needed in the grooving and forming of metals
3. The welding skills needed in the welding of doors and gates

Research Questions

The following research questions guided the study:

1. What are the skills needed in handling metal forming tools and equipment?
2. What are the skills needed in the grooving and forming of metals?
3. What are the welding skills needed in the welding of doors and gates?

Hypotheses

The following null hypotheses were formulated to guide the study at .05 level of significance.

- H0₁:** There is no significant difference between the mean ratings of master artisan welders and industrial welders on the skills needed in handling metal forming tools and equipment in the production of standard doors and gates for households in Ilorin metropolis
- H0₂:** There is no significant difference between the mean ratings of master artisan welders and industrial welders on the skills needed in grooving and forming metal plates in the production of standard doors and gates for households in Ilorin metropolis
- H0₃:** There is no significant difference between the mean ratings of master artisan welders and industrial welders on welding skills needed in the production of standard doors and gates for households in Ilorin metropolis.

Methodology

The study adopted a descriptive survey research design. Descriptive survey research design is a scientific method of observing and describing the behaviour of a subject without influencing it in any way (Shuttleworth, 2018). This study solicited information from master artisan welders and industrial welders on metal forming skills needed by artisan welders in the production of standard doors and gates for households in Nigeria. The study was conducted in Ilorin metropolis of Kwara state.

The targeted population for the study was 65 subjects' comprising of 40 master artisan welders and 25 industrial welders. A structure questionnaire was the main instrument used by the researcher for data collection. Four point rating scale response option of Highly Needed (HN) = 4 Points, Needed

(N) = 3 Points, Moderately Needed (MN) = 2 Points, Not Needed (NN) = 1 Point was used for the three sections of the questionnaire. The instrument was subjected to face validation by three (3) experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna, Niger State. The rationale used for choosing the validators was that they have been involved in teaching for many years and are familiar with different welding operations. Their Observations, suggestions, and comments were used to draft the final copy of the instrument. The validated instrument was pilot tested and reliability coefficient of 0.75 was obtained. The instrument was therefore adopted for the study.

The questionnaire was administered by the researchers' personally by visiting the welding shops in seven (7) key areas and six (6) industrial Organizations in the area of study. The questionnaires were collected immediately where possible and in some areas a minimum of one week was given to the respondents before retrieval. The percentage return rate of the instrument was 85 percent.

Mean and Standard Deviation (SD) were used to answer the research questions, while z-test was used to analyze the hypotheses postulated for the study. A real limit of number was used to reflect the four point rating scale adopted for the study and to answer the research questions. As a basis for decision, the null hypothesis were accepted where the p-values (Sig. 2-tails) were greater than significance criterion ($p > .05$) and rejected where they were less than significance criterion ($p < .05$).

Results

Research Question 1

What are the skills needed in handling metal forming tools and equipment?

Data answering this research question is presented in Table 1.

Table 1:
Mean Responses of the Respondents on the Skills Needed in Handling Metal Forming Tools and Equipment

S/N	ITEM	\bar{X}_1 $n_1=40$	SD_1	\bar{X}_2 $n_2=25$	SD_2	\bar{X}_t $N_t=65$	REMARK
1	Application of workshop safety rules and regulations in the use of tools in the welding workshop	3.48	0.71	3.50	1.14	3.49	N
2	Careful handling of metal forming tools and equipment used in production of doors and gates	2.28	1.17	2.36	1.52	2.32	NN
3	Ability to use measuring tool is to determine specific length of plates and sheet metals to be formed	3.08	0.86	3.36	1.42	3.22	N

4	Ability to use marking out tools for producing development patterns for forming operations.	3.13	0.71	3.48	0.65	3.31	N
5	Ability to use cutting tools for cutting of metals to be formed.	2.64	0.81	3.50	0.69	3.07	N
6	Ability to use striking tools to beat out shapes on metals for forming operations	2.80	0.78	2.76	0.50	2.78	N
7	Ability to apply forging tools for cold and hot forging operations in metal forming process	2.50	1.11	3.20	0.51	2.85	N
8	Ability to apply driving tools in metal forming process	3.40	0.87	3.38	1.13	3.39	N
9	Ability to apply appropriate workshop processes, techniques and tools to mark out, and form projects in sheet metals and plates.	2.56	1.04	2.50	0.70	2.53	N
10	Ability to drawing, develop and produce templates for the production of door patterns, panels and frames	2.92	1.26	3.38	1.11	3.15	N
11	Ability to operate metal presses	3.48	1.19	2.50	1.28	2.99	N
12	Ability to choose appropriate dies for press working operations	3.04	0.88	3.38	1.32	3.21	N

Key: n_1 = Number of master artisan welders, n_2 = Number of industrial welders

X_1 = Mean Responses of master artisan welders, X_2 = Means Responses of the industrial welders

X = Average Mean of both master artisan welders and industrial welders

$S.D_1$ = standard deviation of master artisans,

$S.D_2$ = standard deviation of industrial welders

N = Needed, NN = Not Needed

Table 1 revealed that item 2 was rated not needed with the mean score 2.32. All other items were rated by both industrial welders and master artisan welders as skills needed in handling metal forming tools and equipment.

Research Question 2

What are the skills needed in the grooving and forming of metal plates?

Data answering the research question is presented in Table 2

Table 2: Mean Responses of the Respondents on the Skills Needed in the Grooving and Forming of Metal Plates

S/N	ITEM	X_1 $n_1=40$	SD_1	X_2 $n_2=25$	SD_2	X $N_1=65$	REMARK
1	Application of workshop safety rules and regulations in the use of grooving tools in the welding workshop	3.43	1.12	3.24	0.07	3.35	N
2	Ability to select appropriate grooving tools to carry out grooving operations	2.88	0.83	3.80	0.99	3.34	N
3	Ability to calculate bending allowance for plates and sheet metals	3.20	0.86	3.33	1.06	3.36	N
4	Ability to measure out dimensions for grooving operations	3.68	0.71	2.38	0.65	3.06	N
5	Ability to mark out dimensions for grooving operations	3.00	0.88	3.13	0.56	3.07	N
6	Ability to produce grooves at correct given dimensions	2.92	0.82	3.32	1.24	3.12	N
7	Ability to operate bending and grooving machines for accurate production of grooves for doors and gates	3.12	0.64	3.13	0.77	3.13	N

8	Ability to select appropriate grooving methods for grooving of plates	3.36	0.93	2.87	0.69	3.12	N
9	Ability to select appropriate metal thicknesses for grooving operations	3.48	1.28	3.370	0.48	3.43	N

Table 2 revealed that respondents agreed that all the skills listed were needed by artisan welders in the grooving and forming of metal plates.

Research Question 3

What are the welding skills needed in the welding of doors and gates?

Table 3

Mean Responses of Respondents on Welding skills needed in the Welding of Doors and Gates.

S/N	ITEM	\bar{X}_1 $n_1=40$	SD_1	\bar{X}_2 $n_2=23$	SD_2	\bar{X} $N=63$	REMARK
SHIELDED METAL ARC WELDING							
1	Application of safety precautions related to metal arc welding	2.87	0.51	2.73	1.24	2.80	N
2	Understanding the construction, features and working principles of arc welding machines and accessories	3.35	0.89	3.20	0.51	3.28	N
3	Making different types of welded joints in all positions	3.30	0.99	3.05	0.38	3.18	N
4	Selection of the correct electrode and electrode size	3.40	1.14	3.36	0.70	3.38	N
5	Selection of correct welding current for the arc	2.80	1.09	3.28	0.18	3.04	N
6	Selection of correct arc length	2.80	0.76	3.20	0.72	3.00	N
7	Selection of correct angle of electrode to work	3.15	0.97	3.84	0.64	3.50	N
8	Selection of correct travel speed of arc	2.88	0.61	3.42	1.13	3.15	N
9	Selection of correct preparation of base metal to be welded	2.96	0.79	3.68	0.81	3.32	N
10	Selection of the correct position for carrying out arc welding operations	3.16	0.68	2.32	1.13	2.74	N
11	Carrying out smooth welds with appropriate penetration and strength	2.98	0.99	2.53	0.84	2.76	N
OXY-ACETYLENE WELDING							
12	Application of the various safety precautions related to oxy-acetylene welding	2.72	0.92	2.92	0.72	2.82	N
13	Understanding the construction, features and working principles of oxy-acetylene cylinders and accessories	2.78	1.05	2.40	0.86	2.59	N
14	Skills in lighting the torch in oxy-acetylene welding	3.20	1.04	2.95	1.13	3.08	N
15	Skills in the selection of oxy-acetylene flames for welding	2.96	1.13	2.80	0.94	2.88	N
16	Selection of correct angle of the torch to the work	2.40	0.90	2.80	0.87	2.60	N
17	Selection of correct angle of the filler metal to the work	2.90	1.39	2.64	0.94	2.77	N
18	Selection of correct travel speed of the torch	3.48	0.62	2.78	0.70	3.13	N
19	Selection of correct preparation of base metal to be welded	2.88	0.48	3.37	0.90	3.13	N

Table 3 revealed that respondents agreed that all the skills listed were needed by artisan welders in welding of doors and gates.

Hypothesis 1

There is no significant difference between the mean response of master artisan welders and the industrial welders on the skills needed in handling metal forming tools and equipment.

Table 4: t-test Analysis of the Respondents on the Skills Needed in Handling Metal Forming Tools and Equipment

S/N	Respondent	N	SD	Mean	df	t-cal	Sig. (2-tailed)	Alpha level	Decision
1.	Master artisan welders	40	0.30	0.96	63	60.73	2.00	0.05	Accepted
2.	Industrial welders	25	1.32	1.60					

The result shown in Table 4 indicates the comparison between the master artisan welders and industrial welders. The analysis revealed that all the items have a calculated t-value less than t-critical value (> 1.60), hence the null hypothesis for these items were upheld at 0.05 level of significance. Hence the null hypotheses were accepted for these items.

Hypothesis 2

There is no significant difference between the response of master artisan welders and the industrial welders on the skills needed in the grooving and forming of metal plates.

Table 5: t-test Analysis of the Respondents on the Skills needed in the Grooving and Forming of Metal Plates

S/N	Respondent	N	SD	Mean	df	t-cal	Sig. (2-tailed)	Alpha level	Decision
1.	Master artisan welders	40	0.30	0.71	63	115.39	2.00	0.05	Accepted
2.	Industrial welders	25	0.29	1.14					

The result shown in Table 5 indicates the comparison between the master artisan welders and the industrial welder. The analysis revealed that all the items have a calculated t-value less than t-critical value (> 2.00), hence the null hypothesis for these items were upheld at 0.05 level of significance. Hence the null hypotheses were accepted for these items.

Hypothesis 3

There is no significant difference between the response of the master artisan welders and industrial welders on the skills needed in welding doors and gates.

Table 6: t-test Analysis of the Respondents on Welding skills needed in the Welding of Doors and Gates

S/N	Respondent	N	SD	Mean	df	t-cal	Sig. (2-tailed)	Alpha Level	Decision
1.	Master artisan welders	40	0.42	1.42	63	78.13	2.00	0.05	Accepted
2.	Industrial welders	25	0.64	1.29					

The result shown in Table 6 indicates the comparison between the master artisan welders and the industrial welders. The analysis revealed that calculated t-value less than t-critical value (> 2.00), hence the null hypothesis were upheld at 0.05 level of significance. Hence the null hypothesis was accepted.

Discussion of findings

Findings on skills needed in handling metal forming tools and equipment indicated that one set of skillset needed in handling metal forming tools and equipment involves using great pressure and force to shape metal to retain a particular form. This is in line with findings of Fairchild (2012) which are

that metal forming skills and operations include the following: Blanking, this involves the cutting a large section of sheet metal stock into smaller pieces for another operation, such as drawing. Shearing is a form of metal separation accomplished partially by the slicing action of a dropping blade, followed by a clean fracture along the cut. In line with above assertion Boljanovic (2014) maintained that stamping which is a technique for transforming sheet metal into a three-dimensional object in a large machine press, also includes Drawing (deep and shallow) in which a blank of sheet metal is restrained at the edges and the middle section is forced by a punch into a die to stretch the metal into a shape and extrusion in which a long straight metal part can be produced or reduced in size by passing through successive dies. Another findings on skills needed in handling metal forming tools and equipment shows that they need ability to apply forging tools for cold and hot forging operations in metal forming process This is in line with observation by Kent (2009) that wire production is an excellent example of extrusion process of metal forming which requires the skills in applying forging tools.

A relevant skills needed in handling metal forming tools and equipment is ability to operate metal presses, because hardness of metals cannot be worked on using bare hands. Tools and equipment (Presses) are then used to work with these metals in order to produce items and wares. Tools according to Olaitan (2000) are the instruments or devices that can be handled easily while carrying out special operations in the workshop. Tools are used in workshops or in the field for carrying out operations. In this situation, presses are used for the production of door patterns, panels and frames as identified by the findings.

Ability to apply appropriate workshop processes, techniques and tools to mark out and form projects in sheet metals and plates was one of the findings needed in handling metal forming tools, this is in consonant with Olaitan (2000) who claims that tools can be categorized in Metalwork into: Measuring tools, marking out tools, cutting tools, driving tools, forging/casting tools, holding devices and protective devices. The hypothesis revealed a non-significant difference between the mean responses of master artisan welders and the industrial welders on the skills needed in handling metal forming tools and equipment.

The findings of the study on skills needed in the grooving and forming of metal plates revealed that Artisan welders needs skills on ability to calculate

bending allowance for plates and sheet metals, ability to select appropriate grooving tools to carry out grooving operations, ability to apply the use of grooving tools in welding shop, ability to select appropriate metal thickness for grooving operations among others. This findings agreed with Shield and Praschl (2011) who maintained that presses are relevant in the production of grooving operations. Also Ede and Ariyo (2014) emphasized that the knowledge of calculation of bending allowance for sheet and plate metals is a relevant skill that should be possessed by metalwork specialist. The hypothesis however revealed that there is no significant difference in the mean responses of master artisan welders and the industrial welders on the skills needed in the grooving and forming of metal plates.

The findings of the study on welding skills needed in welding doors and gates showed that artisan welders needed skills in making different types of welded joints in all positions, selection of the correct electrode and electrode size, selection of correct welding current, skills in lighting the torch in oxy-acetylene welding, selection of correct travel speed of the torch, selection of correct preparation of base metal among others. According to World of Welding (2004), good welding techniques will guide a welder in the Selection of the correct electrode and electrode size, selection of correct welding current, selection of correct arc length, selection of correct angle of electrode to work, selection of correct travel speed, and selection of correct preparation of work to be welded. In the same vain, Khan (2007) emphasized that skills in welding in all position by welders is vital in order to have a perfect welded joints that will stand the taste of time. The hypothesis however revealed that there is no significant difference in the mean responses of master artisan welders and the industrial welders on the welding skills needed in welding doors and gates.

Conclusion

Based on the findings of the study, it can be concluded that artisan welders needed various metal forming skills in the production of standard doors and gates for households in Ilorin metropolis which by extension is a reflection of what is happening in Nigeria. This is because many of the skills are needed in the production of standard doors and gates by artisan welders as revealed in the study.

Recommendations

Based on the findings of the study, it was recommended that:

1. Seminars and workshops should be organized for Artisan welders by master welders in order to acquire relevant metal forming skills in the production of standard doors and gates
2. Artisan welders should be enlightened by master welders on the use of appropriate tools such as measuring, cutting, striking and forging tools for the production of standard doors and gates for household in Nigeria.
3. There should be training on how to select and use appropriate grooving tools for grooving operations for Artisan welders by relevant stakeholders in order to produce standard doors and gates for household use.
4. Training of artisan welders on arc and gas welding skills should be provided through collaboration with industrial welder and master artisan welders in order to produce standard doors and gates for households in Nigeria.
5. There should be application of workshop safety rules and regulations in the use of metal forming tools by artisan welders in order to produce standard doors and gates for households in Nigeria.

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