



## **Application Of Safety Measures In Machine-Shop Practice In Technical Colleges In Rivers State**

<sup>1</sup>Prof. G.I. Ken Akaninwor, <sup>2</sup>Obed.O.O and <sup>3</sup>Enyiche, C. E.

<sup>1 & 2</sup>Department of Vocational and Technology Education, Faculty of Technical and Science, Rivers State University, Port-Harcourt Rivers State, Nigeria

<sup>3</sup>Department of Industrial Technical Education, Faculty of Vocational Technical Education, Ignatius Ajuru University of Education, Port-Harcourt Rivers State, Nigeria

### **ABSTRACT**

The study focused on application of safety measures in machine-shop practice by students in technical colleges in Rivers State. Three purposes, research questions and hypotheses guided the study. This study adopted a descriptive survey research design and was carried out in Rivers State. The population for the study was 175 respondents, comprising 25 mechanical Teachers, and 150 mechanical craft Students from the four technical colleges in Rivers State. The study adopted structured questionnaire instrument which was used to collect data for this study titled ‘Safety Measures in Machine-shop Practice Questionnaire (SMMPQ)’. The instrument was face-validated by three experts. Reliability of the instrument was carried out using test retest method and was determined using Cronbach Alpha reliability coefficient which yielded 0.76 reliability. Mean and standard deviation were used to answer the research questions, while t-test was used to test the null hypotheses at 0.05 probability level of significance. The findings of the study revealed that to a high extent are the application of safety measures in welding operations by students in technical colleges in Rivers State. The study also revealed that to a low extent are the application of safety measures in sheet metal operations by students in technical colleges in Rivers State. The study finally recommended that health education session should be organized for welders on the health effects of their workplace hazards. School administrators should adopt a policy that will make it compulsory for welders and machinist to use appropriate personal protective equipment during welding and other mechanical operation and personal protective equipment should be made available and emphasis should be placed on it the application of safety measures in Sheet Metal Operations in the workshop.

**Keywords:** Safety measures, Machine shop Practice and Technical College

### **INTRODUCTION**

Technical colleges in Nigeria have been training people to become craftsmen and technicians. Training qualifies them for jobs in both public and private sectors of the economy. Both sectors, according to Okorieocha and Duru (2014), require well-trained and competent technicians who can operate and maintain the available technical facilities. Therefore, there is a need for qualitative training in technical colleges in Rivers State for education and training to produce graduates that can perform competently in their chosen vocation without a need for pre-employment training. The major goal of vocational institutions is to prepare students for successful employment in the labor market (Ekpenyong & Edokpolor, 2015). This condition can be met through a curriculum that is relevant and comprehensive and a well-equipped workshop with relevant training facilities.

School workshops offer opportunities for practical training of students in skill acquisition in their technical trade areas for future development of the key sectors of the economy. Student’s practical projects are an important part of the curriculum in technical colleges, but a supportive school environment

is a fundamental requirement for the successful implementation of such a curriculum (Yakubu, 2014). This aspect of the curriculum can only be implemented where facilities in the workshop are adequate and relevant. Availability of appropriate facilities enhances students' learning by allowing them to be involved in demonstrations and practice which will continue to build their skills. However most of the technical colleges in Nigeria have been performing below standard due to purported non availability, poor management or utter neglect of the required facilities in the workshops for effective training in machine-shop practice.

Machine-shop practice is a sub-professional subject offered in mechanical trades in technical colleges. Machinshop is a room, building, or company where machining is done. In a machine shop, machinists use machine tools and cutting tools to make parts, usually of metal or plastic (but sometimes of other materials such as glass or wood). It is one of the vocational education courses which according to James (2005), a form of education whose primary purpose is to prepare students for employment. Machine-shop practice according to Rex and Mark (2004), provides the skills, knowledge and attitude necessary for effective employment in specific occupations.

The machine-shop practice programme in Nigerian technical colleges is designed to produce competent craftsmen in various machine-shop trades. According to National Board for Technical Education (NBTE) (2001), a graduate of machine-shop practice is expected to operate machines and perform other metalwork skills like welding, foundry, casting, metal forming and fabrication effectively for production purposes in private practices or in the industries. These graduates may proceed to tertiary institutions for further studies in technical education. Unified National curriculum is adopted in all the technical colleges accredited by NBTE. The programmes in technical colleges are offered at levels leading to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) for craftsmen and master craftsmen respectively (Federal Government of Nigeria, 2013). The Federal Government of Nigeria (FRN) (2013) pointed out that the main feature of the curricular activities for Technical Colleges shall be structured in foundation and trade modules, the curriculum for each trade shall consist of general education, theory and related courses, workshop practice industrial training components and small business management and entrepreneurial training. The trade theory and workshop practice involve the study of welding, fabrication, machine operation. The curriculum of metalwork if adequately implemented is expected to produce competent craftsmen for industrial and technological development in Nigeria. The Craftsmen can be employable or be self-reliant if adequate skills are possessed in machine-shop practice. Acquisition of these skills can be effective if the students are trained in an accident free workshop (Azodo & Adejuyigbe, 2013). This is because accident occurrence poses threat to the working environment which will ultimately affect the training of the students, hence safety measures need to be applied for an effective machine-shop practice in technical colleges in Rivers State. However, the increase in accident rate in the machine-shop practice during the various operations call for more advanced instruction on accidents prevention that requires increase emphasis on safety. Osang, Obi, and Ewona, (2013) stated that emphasis should be placed on safety education because of sophisticated machines and equipment which are becoming increasingly complicated and digitalized. They further added that the need for industrial safety was realized because of millions of industrial accidents occurring yearly which results in injuries, permanent or temporary disablement and sometimes in death. Tuuli (2010) defined safety as the art and science of identifying, evaluation and controlling work place hazards. They further stated that safety is the state of being certain that adverse effect will not be caused by some agents under defined condition. Safety according to US Department of Labor (2002) is an art of inculcating the necessity of taking precautions for the avoidance of personal injuries or reducing accidents in order to protect people and property. Washington State Department of Labor and Industries (2009) stated that safety means safeguarding against damage to machine tools and materials as well as preventing personal injuries. The authors agreed that every step toward skills acquisition must first address the subject matter of industrial accident and safety. Prosser in Calhoun and Finch (2017) provided vocational educational theory which supports that effective skill acquisition in vocational education can only be secured when the teacher has successful experience in the application of skills and knowledge of safety

practice to the operations. Therefore, safety is any method, technique or process which students can apply to minimize or prevent accident in industries and workshops of technical colleges.

Accident according to Ward (2009) is a mishap in an industrial establishment causing bodily injuries to a person which make him unfit to resume his duties in the next 48 hours. An accident is explained by Work Cover Corporation (2004) as a specific, unpredictable, unusual and unintended external action which occurs in a particular time and place, with no apparent and deliberate cause but with marked effects. It implies a generally negative outcome which may have been avoided or prevented had circumstances leading up to the accident been recognized, and acted upon, prior to its occurrence. Occupational Safety Health Administration, OSHA, (2003) further postulated that accident is an unwanted, unexpected event which cannot be anticipated in advance. Improper dressing, ignorance, over confidence, carelessness, non-provision of required safety guards to revolving parts of machines, filthiness, insensitivity, distraction, influence of alcohol and abuse of tools are the sources of accident in mechanical workshops. These call for Metalwork students at the Technical Colleges who are trained for industry to be conversant with safety practice skills right from the school. Acquisition of safety practice skills by metalwork students before graduation may likely reduce high rate of accidents in metal workshop as well as industries.

Safety practices according to Ofonmbuk and Ekereobong (2012), are those activities that seek either to minimize or to eliminate hazardous conditions that can cause bodily injuries. Safety practice is the effort directed at preventing or eliminating accidents in the workshop by the teachers, students and school administrators. There are two categories of teachers in technical colleges that can instruct students on safety practices. They are experienced and less experienced metal work teachers. Experienced metalwork teachers are individuals who have been trained pedagogically and technically in the metal work technology and have been in teaching for ten years and above. Less experienced metalwork Teachers are those with pedagogical and technical skills that have teaching experience between 1 – 9 years (Okon, 2011). Both are trained to impart knowledge, skills and attitudes to students under their control. Workshop supervisors are individuals trained to supervise all the technical or practical activities carried out by others in the workshop. Also Safety practices are activities which require that everyone in the workshop should think and act responsibly at all times and in every activity. The metal work teacher who is a link between the students and the curriculum should have the skills of manipulating tools and machines safely without fear of being involved in accident.

Skills in the opinion of Olagbegi, Kwasi, and Ugbi, (2013), is the ability to perform activity expertly. They further explained that skill is a well established habit of doing things and involves acquisition of performance capabilities through repetition of an operation. Nichols (2005) also defined skill as expertness or dexterity or practice or ability of facilitating or doing something. Skill is the demonstration of dexterity or the ability of manipulating step by step processes of metalwork operation such as cutting, drilling, forging, fitting, welding and assembling in Technical Colleges' metal workshop with little or no wastage of necessary resources.

Technical college according to Bauer (2006), is the principal vocational institution intended to prepare students for various occupations with saleable skills. Technical Colleges are those institutions that are responsible for the training of men and women to the level of National Business and Technical Examination Board (NABTEB) Certificate.

There have been numerous complaints about the competency and the qualities of graduates produced in technical colleges in Nigeria today. Groover (2007) observed that these graduates do not possess adequate safety practice skills necessary for employment in industries for effective operations in metalwork workshops. Nichols (2005) stated that there is wider scale of accidents that take place in technical colleges' workshops due to carelessness or lack of safety practice skills by students and teachers. The study is therefore designed to assess the application of safety measures in machine-shop practice by students in technical colleges in Rivers State.

### **Statement of the Problem**

Teachers and students in machine-shop practice, in technical colleges are prone to accidents as a result of the nature of operations involved. The operations include welding, fabrication, casting, foundry, forging, machining and fitting. These operations also involve working with hot metals, sharp objects, working with infrared light, combustible gases and substances, hazardous tools, materials and equipment (National Institute for Occupational Safety and Health, 2009). For these operations to be carried out effectively, machine-shop practice teachers and students must possess safety practice skills in order to prevent or totally eliminate occurrences of accidents which could result in human and material resource wastage.

Teachers often fail to inculcate safety practice skills into the students due to the fact that safety instructional aids such as posters, bulletin boards and films are not provided by the authority concerned neither are they improvised. Where they are available the teachers may lack the knowledge and skills to apply and administer the safety tools and equipment. Also, some activities or operations (gas welding, cutting, drilling) in the machine-shop practice sometimes inflict serious injuries to students such as deep cut, arc burns, electric shock and even serious explosion during gas welding. These cause serious damage to the workshop building, oxy-acetylene equipment and amputation of the students' hand. If safety practice skills are identified and included in the training of students, there are possibilities of reducing accident that may cause damage to tools, machines and wastage of materials in machine-shop practice in Technical Colleges in Rivers State. The above gave rise to assessing the application of safety measures in machine-shop practice by students and teachers in technical colleges in Rivers State.

### **Purpose of the Study**

The purpose of the study is to assess the application of safety measures in machine-shop practice by students in technical colleges in Rivers State. Specifically, the study determined the following:

1. Application of safety measures in Welding Operations by students and teachers in technical colleges in Rivers State.
2. Application of safety measures in Sheet Metal Operations by students and teachers in technical colleges in Rivers State.
3. Application of safety measures in Machine Tools operation by students and teachers in technical colleges in Rivers State.

### **Research Questions**

Three research questions were formulated to guide the study:

1. What is the extent of application of safety measures in Welding Operations by students and teachers in technical colleges in Rivers State?
2. What is the extent of application of safety measures in Sheet Metal Operations by students and teachers in technical colleges in Rivers State?
3. What is the extent of application of safety measures in Machine Tools operation by students and teachers in technical colleges in Rivers State?

### **Hypotheses**

Three hypotheses were formulated to guide the study:

**HO<sub>1</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Welding Operations by students and teachers in technical colleges in Rivers State.

**HO<sub>2</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Sheet Metal Operations by students and teachers in technical colleges in Rivers State.

**HO<sub>3</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Machine Tools operation by students and teachers in technical colleges in Rivers State.

## METHODS

This study adopted a descriptive survey research design. According to Gall, Gall and Borg (2007), a survey research is a method of data collection in which questionnaires or interview is utilized in collecting data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized. The study was carried out in Rivers State. Rivers State has companies and industries that need the graduates from technical colleges. More also, the area has technical institutions. These Teachers and Students were suitable to form the population of the study.

The population of the study was 175 respondents, comprising 25 mechanical Teachers, and 150 mechanical craft Students from the four technical colleges in Rivers State. The entire population was used since the entire population is of manageable size. Thus there was no sampling. A structured questionnaire instrument was used to collect data for the study titled 'Safety Measures in Machine-shop Practice Questionnaire (SMMPQ)'. The instrument was developed after the review of relevant literature on application of safety measures in machine-shop practice by students in technical colleges. The instrument contains five sections A-D. Section A elicited information on personal data of the respondents. Section B elicited data on application of safety measures in Welding Operations by students in technical colleges in Rivers State. Section C elicited data on application of safety measures in Sheet Metal Operations by students in technical colleges in Rivers State. Section D elicited data on application of safety measures in Machine Tools operation by students in technical colleges in Rivers State.

The instrument was face-validated by three experts. One from the Department of Technical education, Ignatius Ajuru University of Education Rivers State and two from vocational and technology education, Rivers State university. The validators were requested to read through the questionnaire items in terms of clarity and appropriateness based on the research questions for the study under investigation. The experts' comment and suggestions were utilized to structure the new questionnaire instrument. To establish the reliability of the instrument, 30 copies of the questionnaires were trial-tested by machine-shop practice teacher and Students in technical institutions in Bayelsa State. On the return of the instrument the Cronbach Alpha reliability coefficient formula was used to determine the reliability of the instrument which yielded 0.76 reliability.

The researcher administered the questionnaire personally together with the help of two research assistants. The researcher informed the research assistants on the procedures required in administering the questionnaire instruments. The completed copies of the questionnaire were also retrieved by the researcher and the two research assistants to help maximize the return rate of the questionnaire for data analysis. Data collected from the respondents were analyzed on 4- point scale using mean and standard deviation to answer the three research questions. Decision rule: accept any item with mean greater or equal to 2.50. On the other hand reject item if mean is less than 2.50. t-test statistics was used to test the null hypotheses at 0.05 probability level of significance. Decision was taken as follows: if the calculated value is greater or equal to the table value, the null hypothesis was rejected. On the other hand if the calculated value is less than the table value, the null hypothesis was accepted.

**RESULTS**

**Research Question 1:** *What is the extent of application of safety measures in welding operations by students and teachers in technical colleges in Rivers State?*

**Table 1: mean and standard deviation on the application of safety measures in welding operations**

S/N O	Extent of application of safety measures in Welding Operations	Mechanical Craft Teachers			Mechanical Craft Students		
		X	SD	RMK	X	SD	RMK
1	Make sure that your arc welding equipment is properly installed and grounded and in working condition.	2.98	.93	A	3.03	.90	A
2	Always wear eye protection during welding, spraying, cutting or grinding.	3.09	.92	A	3.00	1.05	A
3	Do not weld in a confined space without special precautions.	3.30	.86	A	2.89	.99	A
4	Make sure that no flammable volatile or explosive materials are in or near the work area.	2.83	.95	A	3.21	.87	A
5	Do not weld on sealed containers or compartments without providing vents and taking special precautions.	2.91	1.06	A	3.08	.92	A
6	Use mechanical exhaust at the point of working when welding lead, cadmium, chromium, Manganese, brass, bronze, zinc or galvanized steel and when welding in a confined space	1.75	1.12	D	1.15	.82	D
7	When it is necessary to weld in a damp or wet area, wear rubber boots and stand on a dry insulated platform.	2.91	1.01	A	3.35	.74	A
<b>Ground Mean</b>		<b>2.82</b>	<b>0.98</b>	A	<b>2.81</b>	<b>0.90</b>	A

**Source :** researcher’s field work, 2018. A=agreed, D=disagreed, X= mean, SD= standard deviation .

Data in table 1 revealed that mechanical Teachers had a mean range of 1.75-3.30 and a standard deviation range of 0.86-1.12. While the mechanical Students had a mean range of 1.15-3.35 and a standard deviation range of 0.74-1.05. Both respondents disagreed with item 6.

**Research Question 2:** *What is the extent of application of safety measures in sheet metal operations by students and teachers in technical colleges in Rivers State?*

**Table 2: mean and standard deviation on the application of safety measures in sheet metal operations**

S/N O	Extent of application of safety measures in Sheet Metal Operations	Mechanical Craft Teachers			Mechanical Craft Students		
		X	SD	RMK	X	SD	RMK
1	Always keep tools in good working condition by sharpening, cleaning, and oiling them	3.10	.93	A	3.12	.95	A
2	Always return all tools to their respective positions after use	2.98	.90	A	2.99	.96	A
3	Secure your work in a vice whenever possible; Never hold small work piece in your hand when using a screw driver	1.03	1.03	D	1.87	.88	D
4	Chisels, screw driver or other pointed tools should never be carried in clothing pockets	1.08	.82	D	1.29	.83	D
5	Hammer should have heads ground properly, should not have broken claws or handles. Check for loose handle. Always use proper size and weight for the job	1.09	.89	D	1.74	1.04	D
6	Make sure that cutting tools are sharp and in good working condition before using them.	3.19	.93	A	3.18	.88	A
7	Always ensuring that all small works and short works are secured with a vice or clamp	3.21	.85	A	3.26	.82	A
<b>Ground Mean</b>		<b>2.24</b>	<b>0.91</b>	<b>D</b>	<b>2.49</b>	<b>0.91</b>	<b>D</b>

Data in table 2 revealed that mechanical Teachers had a mean range of 1.09-3.21, while the mechanical Students had a mean range of 1.29-3.26. The closeness of the standard deviation shows the homogeneity of the respondents. Both respondents disagreed with item 3, 4, and 5.

**Research Question 3:** What is the extent of application of safety measures in machine tools operation by students and teachers in technical colleges in Rivers State?

**Table 3: mean and standard deviation on the application of safety measures in machine tools operation**

S/N O	Extent of application of safety measures in Machine Tools operation	Mechanical Craft Teachers			Mechanical Craft Students		
		X	SD	RMK	X	SD	RMK
1	Do not operate any machine if you cannot stop it	3.15	.93	A	3.08	.96	A
2	Always wear hand gloves to protect the hands from cuttings	3.18	.88	A	3.17	.89	A
3	During machining operation always wear appropriate respiratory equipment in compliance with local regulations	3.26	.85	A	3.24	.95	A
4	During machining operation, use tightly fitted safety goggles or face shield	3.03	.90	A	3.23	.93	A
5	During machining operation use ear protection and safety shoes.	3.27	.90	A	3.17	.89	A
6	Those who are highly sensitive should take precautions, due to possible eye, nose, or throat irritation from solid surface dust and foams	3.01	.93	A	3.17	.94	A
7	Keep a clear, safe and oil free working area around your machine tools	2.92	.97	A	2.98	.94	A
	<b>Ground Mean</b>	<b>3.11</b>	<b>0.91</b>	<b>A</b>	<b>3.14</b>	<b>0.93</b>	<b>A</b>

Data in table 3 revealed that mechanical Teachers had a mean range of 2.92-3.27. While the mechanical Students had a mean range of 2.98-3.24. The closeness of the standard deviation shows the homogeneity of the respondents.

**Hypotheses**

**HO<sub>1</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Welding Operations in technical colleges in Rivers State.

**Table 4: The t-test analysis on the extent of application of safety measures in Welding Operations**

Respondents	N	X	SD	P	DF	t-Cal	t-Crit	Remark
Teachers	25	2.82	0.98					
0.05	76	3.97	1.96	Sig				
Students	150	2.81	0.90					

Result in table 4 revealed that t-cal (3.97) is greater than t-crit (1.96) which indicates that the hypothesis stated is rejected. Therefore there is a significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Welding Operations in technical colleges in Rivers State.

**HO<sub>2</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Sheet Metal Operations in technical colleges in Rivers State.



**Table 5: The t-test analysis on the extent of application of safety measures in sheet metal operations**

Respondents	N	X	SD	P	DF	t-Cal	t-Crit	Remark
Teachers	25	2.24	0.91					
0.05	76	1.23	1.96	No Sig				
Students	150	2.49	0.91					

Result in table 5 revealed that t-cal (1.23) is less than t-crit (1.96) which indicates that the hypothesis stated is accepted. Therefore there is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Sheet Metal Operations in technical colleges in Rivers State.

**HO<sub>3</sub>** There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Machine Tools operation in technical colleges in Rivers State.

**Table 6: The t-test analysis on the extent of application of safety measures in sheet metal operations**

Respondents	N	$\bar{X}$	SD	P	DF	t-Cal	t-Crit	RMK
Teachers	25	3.11	0.91					
0.05	76	2.76	1.96	No Sig				
Students	150	3.14	0.93					

Result in table 6 revealed that t-cal (2.76) is greater than t-crit (1.96) which indicates that the hypothesis stated is rejected. Therefore there is a significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Machine Tools operation in technical colleges in Rivers State.

### DISCUSSION OF FINDINGS

The findings of the study revealed that to a high extent are the application of safety measures in Welding Operations by students and teachers in technical colleges in Rivers State. There is a significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Welding Operations in technical colleges in Rivers State. This finding is line with Lar (2013) who carried out a study in Northern Europe and found that occupational exposure to welding fumes and smoking are associated with increased risk of chronic bronchitis. Another study also reported an increasing lung cancer risk for longer duration of exposure to welding fumes (Andrea, Paul, David, Neonila, Peter & Jolanta, 2012).

The study revealed that to a low extent is the application of safety measures in sheet metal operations by students and teachers in technical colleges in Rivers State. There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Sheet Metal Operations in technical colleges in Rivers State. This finding is line with Andrea, Paul, David, Neonila, Peter and Jolanta, (2012) who stated that a study done in Nigeria reported average of 35.9% of machinist used personal protective equipment when carrying out sheet metal operation.

The study finally revealed that to a high extent is the application of safety measures in machine tools operation by students and teachers in technical colleges in Rivers State. There is no significant difference in the mean ratings of mechanical craft Teachers and Students on the extent of application of safety measures in Machine Tools operation in technical colleges in Rivers State. This finding is in line with Nicholas, Wendy, Benjamin, Leslie, David and Murray, (2010) who explained that there is a general believed that machinist and other workers in similar occupation particularly in developing countries lack knowledge of occupational health hazards and were unlikely to take protective measures against the hazards.

## CONCLUSION

The study focused on application of safety measures in machine-shop practice by students and teachers in technical colleges in Rivers State. The findings of the study revealed that to a high extent are the application of safety measures in Welding Operations and safety measures in machine tools operation by students and teachers in technical colleges in Rivers State but further find out that to a low extent is the application of safety measures in sheet metal operations by students and teachers in technical colleges in Rivers State. This implies that safety measure should be taught to the study and more emphasis should be laid on safety measures in the application of machines and equipment in the mechanical workshop.

## RECOMMENDATIONS

The following recommendations were drone based on the findings of the study:

1. There is need to have a health education session for this welders on the health effects of their workplace hazards.
2. School administrators should adopt a policy that will make it compulsory for welders and machinist to use appropriate personal protective equipment during welding and other mechanical operation.
3. Personal protective equipment should be made available and emphasis should be placed on it the application of safety measures in Sheet Metal Operations in the workshop.
4. Appropriate safety gauds and wears should be provided and the students should be sensitized on the need to utilize the safety measures in Machine Tools operation in the workshop

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