



Refrigeration and Air-condition Skills Required for Industrial Development of Mechanical Craft Final Year Students in Technical Colleges in Rivers State

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ABSTRACT

The study assess Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. Two purpose, research questions and hypotheses guided the study. This study adopted a survey research design. The study was carried out in South-south States which includes the following Rivers, Akwa Ibom, Cross-River, Delta, Bayelsa and Edo states. The targeted population of the study was 278 respondents, comprising 89 mechanical teachers and 186 mechanical students in technical colleges in south-south States. Purposive sampling technique was used to select only mechanical teachers and students. This gave a total sample size of 278 respondents. A structured questionnaire instrument was used to collect data for this study titled 'Refrigeration and air condition skills required for industrial development of mechanical craft Questionnaire (RASRIDMCQ)'. The instrument was face-validated by three experts, one from Department of Technical education, Ignatius Ajuru University of Education Rivers State and the other two experts are from the department of industrial technical education, Rivers State University. Cronbach Alpha reliability coefficient formula was used to determine the reliability of the instrument which yielded a reliability coefficient of 0.75. Findings of the study revealed that the skills listed are the Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. It was recommended that (1) The government should supply refrigeration and air condition equipment, materials and tools to the Colleges in large numbers to cater to the ever-growing population of students. (2) The government should train mechanical teachers to enable to properly use the equipment in the Technical Colleges.

Keywords: Refrigeration, Air condition, skills, industrial development, mechanical craft, and technical colleges.

INTRODUCTION

Technical and Vocational education is the foundation of nation's wealth and development. It is a type of education that is meant to produce skilled and technical manpower necessary to restore, revitalize, energize, operate and sustain the national economy and substantially reduce unemployment. Skills and knowledge are the engines of economic growth and social development of any nation (Goel, 2010), and Technical Vocational Education and Training (TVET) holds the key to training the skilled and entrepreneurial workforce needed for the changing technological workforce (Afeti, 2010). Technical Vocational Education and Training (TVET) is used as a comprehensive term referring to those aspects of the educational process involving in addition to general education, the study of technologies and related sciences, and the acquisition of practical skill, attitudes, understanding and knowledge relating to

occupations in various sectors of economic and social life (UNESCO, 2002). According to Mclean and David (2009) TVET is concerned with the acquisition of knowledge and skills for the world of work to increase opportunities for productive empowerment and socio-economic development in knowledge economics and rapidly changing work environment. TVET thus equips people not only with technical and vocational skills, but with a broad range of knowledge, skills and attitudes that are now recognized as indispensable for meaningful participation in work and life. TVET has numerous goals which vary from countries to countries. In Nigeria, TVET is part of the formal education system incorporated in the three levels of education (primary, secondary and tertiary) with a view to meeting the nation's need for skilled manpower and support the economic state of individual and the nation in general. As qualitative TVET is increasingly recognized as the bedrock of every development, quality assurance therefore is an indispensable process for achieving the national goals in TVET which will in turn lead to the production of qualitative human capital for sustainable national development.

Technical Vocational Education and Training is the provision of skills, knowledge, attitude and values needed for a specific occupation. Osuala, (2006) explained that technical Vocational Education and Training is meant to prepare learners for careers based on manual and practical activities, understanding of laws of science and technology as applied to modern design and production which leads to the acquisition of skills. Skill, according to Osuala (2006) is the ability to perform expertly, facilitate performance during employment. It is also the ability to do something well. Skill is observable competence to perform a learned behaviour regarding the relationship between mental activity and body movements (Miller and Rosenbaum, 2007). This implies that to possess a skill is to demonstrate that habit of acting, thinking and behaving in a specific activity in such a way that the process becomes natural to the individual through repetition or practice. Safety practice skill as obtained in sawmill is a regular practice of safety skills in sawmill. According Hornby (2010), practice is referred to as doing an activity or training regularly so that one can improve one's skills. A skilled person in a job is an individual who has undergone some extensive training in such job and has thus mastered the activities that lead to successful performance in the job. Okorie (2001) stated that skill is manual dexterity through repetitive performance of an operation. Skill can be acquired through experience and training.

However, Technical colleges are established by the Federal Government of Nigeria to prepare individuals to acquire practical skills, basic and scientific knowledge and attitude required by craft men and technicians at sub-professional level in order to achieve the goals of technical education, which shall be to:

- 1) Provide trained manpower in the applied sciences, technology and business particularly at craft, advance craft and technical levels.
- 2) Provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development.
- 3) Give training and impart the necessary skills to individual who shall be self-reliant economically. In pursuance of the above goals:
 - (a) The main features of the curriculum activities for technical college shall be structured in foundation and trade modules.
 - (b) The components are general education, theory and related courses; workshop practice and Industrial training/production work (Federal Republic of Nigeria, 2013).

According to Digbori-Besmart (2004) the venue for acquiring practical skills by technical college students is the workshop. Technical college provide technical training in a number of courses including Automobile mechanics, Welding and Fabrication, Plumbing, Electrical/Electronics, Mechanics work, Auto-electrical work, Auto-mechanics works, Auto-body building, Auto parts merchandising, Metal Technology, Mechanical Engineering craft practice, Welding and Fabrication engineering craft practice, Foundry craft practice, Instruments mechanics work and Refrigeration and air-conditioning.

The technology of heat engine and refrigeration system has made living in a system habitual as a result of air conditioner system innovation. Air conditioner is an electro-mechanical device that moderates the temperature humidity and ventilation of a given system (room, car, shop, office, e.t.c) by the use of refrigerants or other coolants. Air conditioner (often referred to as AC) is an apparatus or machine that is

used to control the temperature and humidity in an enclosed space (yourdictionary.com, 2017). The process of controlling the temperature and humidity is often regarded as air conditioning. McDowall (2006) opined that air conditioning is the process of removing heat from a confined space, thus cooling the air, and removing humidity. Basically, the function of air conditioner is to provide comfortable temperature, filtering and circulation the air in to the room. Air conditioning can be used in both domestic and commercial environments. This process is used to achieve a more comfortable interior environment, typically for humans or animals; however, air conditioning is also used to cool/dehumidify rooms filled with heat-producing electronic devices, such as computer servers, power amplifiers, and even to display and store artwork.

According to Nagengast (2009) air conditioners (AC) often use a fan to distribute the conditioned air to an occupied space such as a building or a car to improve thermal comfort and indoor air quality. AC units range from small units that can cool a small bedroom, which can be carried by a single adult, to massive units installed on the roof of office towers that can cool an entire building. The cooling is typically achieved through a refrigeration cycle, but sometimes evaporation or free cooling is used. Air conditioning systems can also be made based on desiccants (chemicals which remove moisture from the air) and subterranean pipes that can distribute the heated refrigerant to the ground for cooling (daviddarling.info/encyclopedia, 2017). Air conditioner may be of split or window type. The main components of window AC are packed in one box which is usually mounted on the window. The split air conditioner was invented due to the compressor noise which has annoying effects on the users of window air conditioner. The main components of window AC are split into two in this new design. These air conditioners are widely in use in both domestic and industrial sectors of the economy of Rivers State. These air conditioners utilized in dehumidifying the temperature of a given system usually demands maintenance for proper functionality. The need for the maintenance of AC has become pertinent because of the growing demand to achieve comfortable environmental conditions for human being.

Statement of Problem

Technical college has been seen as an education for equipment of individuals with manual dexterity for life long career employment (self employed or paid employed) through the utilization of trending technological devices. This programme in Rivers State has been seen unsatisfactory in the production of workforce in the maintenance of technological devices, as most students find maintenance practices in devices like the air conditioner system complex to comprehend and as well abscond from it which invariably results in ill training and unsaleable skill acquisition. These has created a skill gap and affected the development of both the industrial and domestic sectors of the economy of the State as most people do not find qualify personnel that can maintain the AC unit in room, office, cars, shops etc for conducive living. Nevertheless, this scenario has brought about a maintenance monopoly, high cost of maintenance and increased dependency on the few numbers of craftsmen who carry out these maintenance activities, thereby increasing the rate of technical college graduates unemployment in the State.

However, the skills in refrigeration and air condition required for industrial development in technical colleges in Rivers State is lacking. According to Obed and Amadi (2016) who explained that majority of mechanical craft students have been completing their program with very poor academic performance and inadequate skills which is incapable of earning them a living. They further stated that in this regard, the employers of labour responded by non-demand of the graduates of technical colleges. This decline in acquisition of appropriate refrigeration and aircondition skills by mechanical students gave rise to the topic under investigation. Hence the problem of the study is what are the Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State?

Purpose of the Study

General purpose of the study is assess Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. Specifically, the study explored the followings:

1. Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

2. Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Research Questions

Two research questions guided the study

1. What are the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.
2. What are the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Hypotheses

Two hypotheses were formulated to guide the study and were tested at 0.05% level of significance.

1. There is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.
2. There is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

MATERIALS AND METHODS

Design of the Study

This study adopted a survey research design. According to Bryman and Bell (2007), this research design allows researchers to easily describe and provide an understanding of a phenomenon using simple descriptive statistics. The design was found suitable because it permitted the researchers to obtain data from the respondents at a relatively low cost. Furthermore, the study elicits data/information Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Area of the Study

The study was carried out in South-south States which includes the following Rivers, Akwa Ibom, Cross-River, Delta, Bayelsa and Edo states. These states have companies and industries that needs the graduates of Refrigeration and air condition. More also, the areas has technical institutions that offer Refrigeration and air condition. These mechanical teachers, and final year students were suitable to form the population of the study.

Population of Study

The targeted population of the study was 278 respondents, comprising 89 mechanical teachers and 186 mechanical students in technical colleges in south-south States.

Sample and Sampling Techniques

Purposive sampling technique was used to select only mechanical teachers and students. This gave a total sample size of 278 respondents, comprising 89 mechanical teachers and 186 mechanical students in technical colleges in south-south States.

Instrument for Data Collection

A structured questionnaire instrument was used to collect data for this study titled 'Refrigeration and air condition skills required for industrial development of mechanical craft Questionnaire (RASRIDMCQ)'. According to Walen and Fraenkel (2001), cited in Incoom (2012), questionnaires are designed to collect data for decision in research. To them it is considered as the best for researchers who wish to acquire original data for describing a large population. The instrument was developed after the review of relevant literature on Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in south-south States. The instrument contains two sections A-D. Section A elicited information on personal data of the respondents. Section B elicited data on the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. Section C elicited data on the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Validation of the Instrument

The instrument was face-validated by three experts, one from Department of Technical education, Ignatius Ajuru University of Education Rivers State and the other two experts are from the department of industrial technical education, Rivers State University. The experts were requested to read through the questionnaire items in terms of clarity and appropriateness based on the research questions under investigation. The experts' comment and suggestions were utilized to structure the new questionnaire instrument used for the study.

Reliability of the Instrument

To establish the reliability of the instrument, 30 copies of the questionnaires was trial-tested among technical institutions in Imo state, hence this did not form the part of the main population of the project. On the return of the instrument the Cronbach Alpha reliability coefficient formula was used to determine the reliability of the instrument which yielded a reliability coefficient of 0.75. This indicated that the instrument was reliable. The Cronbach alpha reliability coefficient method was used because it gives a generalized formula which deals with multiple scores items.

Method of Data Collection

The researchers administered the questionnaire personally together with the help of five research assistants. The researchers informed the research assistance on the procedures required in administering the questionnaire instruments. The completed copies of the questionnaire were also retrieved by the researchers and the five research assistants within a week to help maximize the return rate of the questionnaire for data analysis.

Method of Data Analysis

Data collected from the respondents was analyzed on four point scale using mean and standard deviation to answer the three research questions. 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 will be rejected. On the other hand if the calculated value is less than the table value, the null hypothesis will not be rejected.

RESULTS

Research Question 1: *What are the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State?*

Table 1: *Mean ratings and standard Deviation of teachers and students on Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.*

S/N	ITEMS	Mechanical Teachers			Mechanical Students		
		X	SD	RM K	X	SD	RMK
	Ability to:						
1.	Retrieve, inspect compressor valves	3.37	0.83	A	3.02	0.92	A
2.	Reassemble and adjust service valves for correct functioning	3.89	0.75	SA	3.12	1.28	A
3.	Adjust compressor service valves and know their application in refrigeration or air-conditioning system.	3.07	1.29	A	3.43	0.75	A
4.	Observe and assess the pumping and suction action of the compressor.	3.22	1.31	A	3.89	0.84	SA
5.	Oil and grease the appropriate parts of refrigeration and air-conditioning systems	2.89	1.29	A	3.06	1.21	A
6.	Locate and repair the point of leakage if any, by using electronic leak detector halve torch, soap solution	3.63	1.41	SA	2.62	1.60	A
7.	Reclaim refrigerant from a dead system and evacuate dry and recharge the system	3.43	0.96	A	3.24	1.69	A
8.	Perform efficiency test of a refrigeration unit	3.70	0.87	SA	3.92	1.36	SA
9.	Design simple condenser and evaporator and Select materials used for constructing condenser/evaporators, copper, pipes, fins,	3.89	1.30	SA	3.01	0.85	A
10.	Locate the controls within the System	3.79	0.75	SA	3.34	0.63	A
11.	Install different controls in any System	2.98	1.25	A	3.02	0.77	A
12.	Detect faults in refrigerant controls, service, repair and test them	3.54	0.80	SA	3.24	1.48	A
13.	Diagnose fault in refrigerant controls: thermostatic expansion valve, low side float valve, high side float valve and effect repairs.	3.19	0.66	A	2.92	1.58	A
	Ground Mean	3.43	1.03	SA	3.21	1.15	SA

Data in table 1 revealed that the respondents had a ground mean of 3.43, 3.21 and standard deviation of 1.03, 1.15. Further-more, the items mean ranges between 2.89-3.89, and 2.61-3.92 with standard deviation of 0.66-1.41 and 0.63-1.69. the homogeneity of the standard deviation showed that the respondents were no too far in their ratings. Therefore the respondents agreed that the items are Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Research Question 2: *What are the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State?*

Table 2: *Mean ratings and standard Deviation of teachers and students on Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.*

S/N	ITEMS	Mechanical Teachers			Mechanical Students		
		X	SD	RMK	X	SD	RMK
	Ability to:						
1.	Connect components up with line compressor, condenser and Evaporator	3.17	0.93	A	3.00	0.82	A
2.	Wire the system components in accordance with manufacturer's wiring diagrams: gear switch starter, time switch, solenoid, valves, thermostats and pressure cut-outs.	3.89	0.65	SA	3.10	1.08	A
3.	Diagnose faults within electrical circuits e.g. electrical panel and effect repairs to faults e.g. faulty compressor motor, open circuit, short circuit, single phasing (ii) adjust time switch thermostat, time delay relay and starter.	3.07	1.09	A	3.44	0.65	A
4.	Diagnose faults within refrigerant circuit and effect repairs,; topping up until there is no bubbles on sight glass at correct temperature: complete charging of the system so that system cuts in and out at correct temperatures and avoid erratic refrigeration so that TEV do not defrost and frost at intervals.	3.42	1.11	A	3.88	0.94	SA
5.	to use correct instruction like psychrometer and psychrometric dart to determine relative humidity, dew point, humidity ratio, enthalpy, per unit mass of air etc	2.99	1.19	A	3.05	1.11	A
6.	Diagnose any fault in an automobile Air- Conditioning system and rectifying same	3.53	1.11	SA	2.61	1.40	A
7.	Installing and testing a new air condition system in a car and carry out a routine service	3.23	0.86	A	3.23	1.19	A
8.	Diagnose faults such as: shortage of gas, blockage of air-filter, faulty evaporator/condenser fans, faulty compressor and leakage of gas hose/tube, etc.	3.50	0.67	SA	3.90	1.16	SA
9.	Rectify faults such as: shortage of gas (topping up or complete charge), clearing the filter, replacing the compressor and replacement of leaking hose	3.79	1.10	SA	3.00	0.85	A
10.	Install the components. Connect the components together (compressor, condenser, receiver, and evaporator)	3.59	0.85	SA	3.33	0.93	A
11.	Explain the importance of routine service to air conditioning and refrigeration systems.	2.88	1.35	A	3.03	0.97	A
12.	Design a routine service chart for use in the service of air-conditioning and refrigeration system	3.64	0.60	SA	3.22	1.08	A
13.	Service the various component of the system: cleaning of condenser, filters, evaporator,; checking of joints for leaks, check oil evaporation fan motor, check and clear water drain pipe, and check the operation of the system	3.49	0.86	A	2.90	1.48	A
	Ground Mean	3.12	0.38	SA	3.20	1.02	SA

Data in table 2 revealed that the respondents had a ground mean of 3.12, 3.20 and standard deviation of 0.38, 1.02. Further-more, the items mean ranges between 2.88-3.89, and 2.61-3.90 with standard deviation of 0.60-1.19 and 0.65-1.40. the homogeneity of the standard deviation showed that the respondents were no too far in their ratings. Therefore the respondents agreed that the items are Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Hypotheses

H₀₁ There is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Table 3: t-test analysis on the difference between teachers and students on Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Respondents	N	X	SD	P-value	DF	t-Cal	t-Crit	RMK
Teachers	89	3.58	0.78	0.05	101	-.63	1.96	No Sig
Students	186	3.77	0.96					

Result in table 3 revealed that t-cal (-.63) 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 final year students on the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

H₀₂ There is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Table 4: t-test analysis on the difference between teachers and students on Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

Respondents	N	X	SD	P-value	DF	t-Cal	t-Crit	RMK
Teachers	89	3.66	0.46	0.05	101	-.72	1.96	No Sig
Students	186	3.58	0.53					

Result in table 3 revealed that t-cal (-.72) 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 final year students on the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State.

DISCUSSION OF FINDINGS

The study revealed that there is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Refrigeration skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. Furthermore, all the Refrigeration skills outlined are required for industrial development of mechanical craft final year students in technical colleges in Rivers State. This is in line with This is in line with Okorie in Chiorlu, Ogundu, and Obed (2016) who explained that the school environment should expose students to the use of the refrigeration equipment in a way that will lead students to acquire relevant knowledge and skills. Furthermore, Ukoha (2007) encouraged teachers to teach through practice as experience shows that students learn best by practice, especially with regard to psychomotor activities, which in turn become more advanced.

Furthermore, the study showed that there is no significant difference in the mean ratings of mechanical craft teachers and final year students on the Air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. More also, all the Air condition skills listed are required for industrial development of mechanical craft final year students in technical colleges in Rivers State. This finding is in line with Okorie (2000) who postulated that the workshops, laboratories and the overall vocational education environment must be adequately equipped so as to reflect the actual working environment beyond the classroom.

CONCLUSION

The study focused on assessing Refrigeration and air condition skills required for industrial development of mechanical craft final year students in technical colleges in Rivers State. School workshop, laboratories and the environment where vocational and technical education is given must be adequately equipped to reflect the actual working environment. It is recognized globally that technical college workshop, etc should be well equipped with instructional facilities. In short the school workshops should look like the workshop where the students will work after the training. It is only through this way that the students' effectiveness and efficiency in the world of work can be ensured after training. These skills cannot be acquired in a vacuum but rather in a well- established and functional workshop with the right tools, equipment and machines for effective implementation of TVE program. However, the desire to produce competent graduates of refrigeration and air condition can be achieved when the facilities in the workshops are relevant and adequate for the programs as demanded by the curriculum of the programs.

RECOMMENDATION

- (1) The government should supply refrigeration and air condition equipment, materials and tools to the Colleges in large numbers to cater to the ever-growing population of students.
- (2) The government should train mechanical teachers to enable to properly use the equipment in the Technical Colleges.
- (3) The refrigeration and air condition equipment, materials and tools supplied to the Technical Colleges should be installed and adequate power supply from the Power Holding Company of Nigeria (PHCN) must be made available.
- (4) Refrigeration and air condition courses require the services of a well trained and qualified refrigeration and air condition teacher to utilize and handle the complex and sophisticated tools and equipment and to teach the theoretical and practical aspect of the subject.

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