



Split-Air Conditioner Maintenance Competencies Required for Effective Training of Secondary School Leavers at Skill Acquisition Centers in Enugu State

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Abstract

The study was carried out to determine split-air conditioner maintenance competencies required for effective training of secondary school leavers at skill acquisition centres in Enugu State. To achieve the purpose of the study, six research questions were developed and answered by the study while six null hypotheses formulated were tested at 0.05 level of significance. The study employed a descriptive survey research design. The population for the study was 80 subjects comprising of 20 instructors in two skill acquisition centres, 40 installers and 20 split air conditioner technicians. There was no sampling because of the manageable size of the population. The instrument used for data collection was structured questionnaire comprised 68 item statements to answer the six research questions. Three experts validated the instrument used for the study. The reliability of the research instruments was established using Cronbach Alpha reliability method and a reliability coefficient of 0.93 was obtained which indicated that the instrument was reliable for the study. Data collected were analyzed using mean and standard deviation to answer the research questions while analysis of variance was used to test the null hypotheses. The findings of the study showed that eleven competencies are required for installation of wall mounted indoor and outdoor units of split air conditioner, eight competencies are required for installation of refrigerator tubing in Split air conditioner, six competencies are required for gas charging in split air conditioner, twelve competencies are required for servicing split air conditioner, fifteen competencies are required for repairing Split air conditioner and fifteen safety competencies are required for effective maintenance of split air conditioners, and there were no significant difference in the mean responses of respondents on the maintenance competences determined. It was recommended that all the determined competencies should be used for training secondary school leavers at various skills acquisition centers.

Keywords: Split-Air Conditioner, Maintenance, Competencies, Secondary school leavers, Training, Skill acquisition centers

Introduction

Maintenance is the actions undertaken to mend, improve and reconstruct damaged or faulty system. Maintenance according to Iloma, (2013) is the combination of actions carried out to service, repair or replace a device or system so that it will continue to operate satisfactorily for a specified period. Olaitan in Ihediwah (2007) defined maintenance as a set of measure or steps taken to ensure that a given piece of equipment or infrastructure is kept in good operational order until it attains its maximum possible life span. One of such equipment that needs regular maintenance is split air conditioner (SAC). The systematic approach to improve the maintenance of split air conditioner is to ensure that it functions optimally to satisfy the users need as well as to elongate their lifespan. In other words, any activity aimed at keeping or restoring a SAC to its

satisfactory operating status can be considered as maintenance. The split air conditioner is one of the most widely used types of the air conditioners. Earlier, window air conditioner was used most widely, but the split air conditioner is now common among people because of its flexibility, accuracy, low power consumption, efficiency among others. Legutko and Taylor (2000) stated that a split system is an air-conditioning or heat pump system that uses refrigerant as the heat exchange fluid and has an evaporator, compressor, and condenser as separate components. There are two main parts of the split air conditioner: the indoor unit and the outdoor unit. The indoor unit of the split AC is installed inside the room that is to be air conditioned or cooled while the outdoor unit is installed outside the room in open space where the unit can be installed and maintained easily. Apart from these two major parts there is copper tubing connecting the indoor and the outdoor units. To maintain these units or the SAC as a whole efficiently requires a competent technician

Competence is the ability to do something successfully or efficiently. UNICEF (2019) defined competencies as sets of behaviors that are instrumental in the delivery of desired results. Rankin (2002) also stated that competency is a collection of behaviors and skills which people are expected to show in their organization.

Skills are learned, while competencies are inherent qualities an individual possesses; which is the combination of skills, knowledge and ability. For the purpose of clarity, Onoh (2011) defined skill as the ability to perform expertly well, facility in performance with dexterity and tact through what one has learnt and practiced in training. Skill is the ability to make a purposeful movement that is necessary to complete or master a particular task in a given job (Mbah & Umurhurhu, 2016). Skill therefore is the ability and capability acquired through deliberate, systematic, and constant effort to smoothly and adaptively carryout multifaceted activities or job functions involving the maintenance of split air-conditioner. Competency therefore is the combination of skills, knowledge and attitudes possessed by secondary school leavers for effective maintenance of split air conditioner either through training or experience.

A secondary school leaver is the young person who has just left secondary school. A secondary school leaver can be trained to acquired skills, knowledge and attitudes for effective maintenance of SAC. Training is the activity of learning skills, the basic skill needed to perform a certain job. Nick (2011) described training as the acquisition of knowledge, skills, and competencies as a result of the teaching of vocational or practical skills and knowledge that relate to specific useful competencies. Uko (2010) also described training as a process of transferring basic knowledge, skills and attitudes to learners to enable them improve their performance. Maintenance of SAC also involves employing good operational inspection, fault model analysis skills, practical and safety skills but secondary school leavers do not acquire these skills; this is because the curriculum they went through while in schools does not contain element of these quality/skills. It is therefore worthwhile to determine these skills or competencies required for maintenance of split air conditioners in order to prepare secondary school leavers to take career in SAC maintenance.



Statement of the Problem

Effective maintenance of split air-conditioning is vital for national development in industrial air-conditioning, home air-conditioning, office air-conditioning and other uses in industries in Enugu State, Nigeria. Skills for installation of wall mounted indoor and outdoor units, installation of refrigerator tubing, gas charging in Split air conditioner, servicing and repairing of Split air conditioner are required. Lack of these skills gives rise to various forms of problems for consumers of split-AC. Most of the consumers could not easily locate trained and competent technicians who can repair or service their defective split-AC thereby making users whose split-AC are defective to be subjected to maintenance monopoly, high cost of maintenance and increased dependency on the few numbers of craftsmen who carry out these maintenance activities even in an ineffective way, some also abandon the faulty AC for the purchase of new ones. Lack of training of people for maintenance of split-AC indirectly amounts to continuous spending of money and electronic wastage which can cause health problems such as cancer to people especially where they are disposed haphazardly. Besides, skill centers that are to produce skilled technicians and technologists to maintain and repair all kinds of electronics such as Split-AC still lack contents of split-AC maintenance activities. Also, with this lack of maintenance skills by secondary school leavers, there will be unemployment as not all secondary school leavers can get admission into higher institutions. Lack of unemployment among these leavers in turn can lead to increase in crime rate that can disturb the peace of the entire society. There is need for effective training of secondary school leavers with split air conditioner maintenance competencies as this will enable them to acquire relevant skills, knowledge and attitudes to embark on repair and maintenance of split air conditioners.

Purpose of the Study

The general purpose of the study was to determine split air conditioner maintenance competencies for effective training of secondary school leavers at skill acquisition centres in Enugu State. Specifically, the study identified:

1. competencies required for installation of wall mounted indoor and outdoor units of split air conditioner.
2. competencies required for installation of refrigerator tubing in split air conditioner.
3. competencies required for gas charging in split air conditioner.
4. competencies required for servicing split air conditioner.
5. competencies required for repairing split air conditioner.
6. safety practice competencies required for effective maintenance of split air conditioners.

Research Questions

The following research questions guided the study:

1. What are the competencies required for installation of wall mounted indoor and outdoor units of Split air conditioner?
2. What are the competencies required for installation of refrigerator tubing in Split air conditioner?
3. What are the competencies required for gas charging in Split air conditioner?
4. What are the competencies required for servicing Split air conditioner?
5. What are the competencies required for repairing Split air conditioner?

6. What are the safety practice competencies required for effective maintenance of split air conditioners?

Hypotheses

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

1. There is no significant difference in the mean responses of split air conditioner installers, instructors and road side technicians on the competencies required for installation of wall mounted indoor and outdoor units of Split air conditioner
2. There is no significant difference in the mean responses of split air conditioner installers, instructors and road side technicians on the competencies required for installation of refrigerator tubing in Split air conditioner
3. There is no significant difference in the mean responses of split air conditioner installers, instructors and road side technicians on the competencies required for gas charging in Split air conditioner
4. There is no significant difference in the mean responses of split air conditioner installers, instructors and road side technicians on the competencies required for servicing Split air conditioner
5. There is no significant difference in the mean responses of split air conditioner installers, instructors and road side technicians on the competencies required for repairing Split air conditioner
6. There is no significant difference in the mean response of split air conditioner installers, instructors and road side technicians on the safety competencies required for effective maintenance of split air conditioners.

Method

A descriptive survey research design was employed for this study which by its nature is aimed at gathering data and describing in a systemic manner, the facts and features or characteristics about a given population. Descriptive research design according to McCombes (2019) is aims to accurately and systematically describe a population, situation or phenomenon. This design can answer what, when, where and how questions, but not why questions and this makes it suitable for this study. Through this study, a questionnaire was used to obtain information on the maintenance competencies required for the maintenance of split AC.

The study was carried out in Enugu State of Nigeria. Enugu State is one of the 36 States located in South-Eastern Nigeria. This state has schools and skill acquisition centers such as; Nazareth Vocational Skill Centre, Coal Camp, Enugu, Calvary Foundation Institute of Technology, (CAFITECH), Enugu, Enugu State and Institute of Administration and Construction Engineering, Awgu, Enugu State. Enugu is a State that works towards empowering the youths for skill acquisition, evident in the free skill acquisition support programme, UNN Enterprise Skill acquisition school among others. Enugu State was chosen for this study because of aforementioned reasons and the presence of skill acquisition Centers with personnel who can respond to questionnaire items adequately.



The population for the study was 80 which comprised 10 instructors of Electrical Installation and Repair in Calvary Foundation Institute of Technology (CAFITECH), Enugu, Enugu State, 10 instructors of Electrical Installation and Repair in Institute of Administration and Construction Engineering, Awgu, Enugu State and 40 split AC technicians and 20 installers in Enugu State. The instructors were selected for the study to respond to all sections of the questionnaire in order to determine competencies required for the maintenance of split AC. Split AC technicians and installers were selected as part of the population as they are those that practice the installation and have encountered some problems at the cause of installation and maintenance. The entire population was used in the study as their size is manageable.

The instrument used in gathering data for this study was a structured questionnaire titled maintenance competencies for installation of split-AC Questionnaire (MCISAQ). The MCISAQ was structured questionnaire used to elicit information from the respondents on the maintenance competencies required for installation of split AC. MCISAQ has two parts; part one solicited general information of the respondents and part two made up of six sections consisting of 68 items in all, A to F. Section A was made up of 11 items soliciting information on the competencies required for installation of wall mounted indoor and outdoor units of split air conditioner, section B had 8 items on the competencies required for installation of refrigerator tubing in split air conditioner, section C consisted 7 items on the competencies required for gas charging in split air conditioner, section D consisted 12 competencies required for servicing split air conditioner, section E had 15 competencies required for repairing split air conditioners while section F consisted 15 items on safety competencies required for effective maintenance of split air conditioners. The response options of five-point scale of 5, 4, 3, 2 and 1 representing Highly Required, Required, Undecided, Not required and Highly Not Required was adopted for the instrument for data collection.

The instrument was face validated by experts in the Industrial Technical Education Department, University of Nigeria, Nsukka. The researchers requested these experts to examine and objectively criticize and scrutinize the research instrument for validity and relevance. This was to ensure that no aspect of the instrument is faulty for collecting relevant data and to ensure the sound quality of the instrument and invariably the reliability of the research findings. The title, the purpose of the study, the statement of the problem, research questions and hypotheses were attached to the instrument to guide the validation. The experts made insightful and corrective suggestions to the submitted instrument. The researchers later adjusted the research instrument in line with the experts' corrections.

The instrument (MCISAQ) was trial tested on 20 respondents (technicians, installers and instructors) at Nsukka other than the ones sampled for the study. This area possesses similar characteristics with the study area as it is still within the state. Cronbach alpha reliability method was used in determining the internal consistency of questionnaire items. Their responses were analyzed using Statistical Package for the Social Science (SPSS) version 20. The Cronbach Alpha Coefficient values obtained through this trial testing are 0.89 for competencies required for installation of wall mounted indoor and outdoor units of Split air conditioner, 0.87 for competencies required for installation of refrigerator tubing in Split air conditioner, 0.92 for competencies required for gas charging in Split air conditioner, 0.96 for competencies required for servicing Split air conditioner, 0.96 for competencies required for repairing Split air conditioner, 0.98 for safety competencies required for effective maintenance of split air conditioners. The

overall reliability coefficient of 0.93 was obtained for the instrument, indicating that the instrument is reliable.

The researchers administered copies of MCISAQ on the respondents with the help of three research assistants. The researchers personally visited the road side technicians and installers in their various workshops. The presence of the researchers to the road side technicians and installers enables him provide adequate explanation or clarification to the respondents if the need arises. By this, a 100% return of the questionnaires was ensured.

Data collected was analyzed using Mean and standard deviation in answering the research questions, while Analysis of Variance (ANOVA) was used to test null hypotheses one to six at 0.05 level of significance. A cut-off points of 3.50 was used for decision making. Any item whose Mean value is greater than or equal to 3.50 was accepted, while any item whose Mean value is less than 3.50 was unaccepted. In taking decision on the hypotheses tested, the hypothesis of no significant difference was rejected in favour of the alternative hypothesis, when the p value is less than 5% ($p < 0.05$) and this indicated that there is a significant difference in the mean responses of the respondents on that item. But retained when the p value is greater than 5% ($p > 0.05$) which indicated that there is no significant difference in the mean responses of the respondents on that item.

Results

The results are presented in Table(s) below in line with the research questions and null hypotheses that guided the study.

Table 1
Mean and Standard Deviation of Responses on the Competencies Required for Installation of Wall Mounted Indoor and Outdoor Units of Split Air Conditioner

S/N	ITEMS	\bar{X}	SD	Remarks
A	Setting up the indoor unit			
1	Select an unobstructed location on the interior wall to mount the indoor unit	4.54	0.50	R
2	Secure the mounting plate to the interior wall	4.33	0.61	R
3	Make a hole in the wall or partition	4.49	0.50	R
4	Mount the indoor unit	4.18	0.69	R
5	Tilt the indoor unit	4.74	0.44	R
B	Installing the Outdoor Condenser			
6	Position the outdoor unit away from any heavily trafficked, dusty, or hot areas	3.86	0.47	R
7	Lay a concrete pad on the ground	4.29	0.46	R
8	Secure the outdoor unit on top of the concrete pad	4.25	0.44	R
9	Install the outdoor unit on a non-tilted surface	4.66	0.50	R
10	Secure the outdoor unit against any water collector environment	4.49	0.50	R
11	Use burglary to secure the outdoor unit from intruders	4.16	0.43	R
	Grand mean	4.36		R

\bar{X} = Mean, SD = Standard Deviation, R = Required, NR = Not Required



Table I shows that all the items have their Mean values higher than the cutoff point of 3.50 on 5-point Likert scale. This indicated that the entire items were required competencies for installation of wall mounted indoor and outdoor units of Split air conditioner. In general, the grand Mean of 4.36 indicates that the item statements are required competencies for installation of indoor and outdoor unit of the Split air conditioner. The items have standard deviation ranging from 0.43 – 0.69 which is less than 1.96 that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Table 2:

Mean and Standard Deviation of Responses on the Competencies Required for Installation of Refrigerator Tubing in Split Air Conditioner

S/N	Item Statements	\bar{X}	SD	Remarks
12	Cut two copper tubing of the distance between the indoor and outdoor unit	4.59	0.50	R
13	Make the two tubing have flaring connections at one end.	4.40	0.49	R
14	Pass the two-copper tubing from the indoor unit of the split AC to emerge through the hole made in the wall	4.45	0.57	R
15	Connect the flaring end of the tubing into the flare nut already available on the tubing emerging from the indoor unit	4.34	0.47	R
16	Cover the refrigerant tubing with the insulation material, which is usually the foam tube	4.83	0.38	R
17	Connect the refrigerant tubing to the outdoor unit	4.11	0.32	R
18	Connect the nuts of each of the tubing to the connector provided outside the outdoor unit	4.35	0.48	R
19	Tighten the connection of the tubing to the outdoor and indoor unit	4.31	0.47	R
	Grand mean	4.42		R

Table 2 show 8 competencies required for installation of refrigerator tubing in Split air conditioner. The Means of the competencies ranged from 4.11 to 4.59. Each mean was above the cutoff of 3.50 indicating that all the items are the competencies required for installation of refrigerator tubing in Split air conditioner. The value of the grand mean 4.42 also confirmed that all the items are the competencies required for installation of refrigerator tubing. The items have standard deviation ranging from 0.32 – 0.57 which is less than 1.96 that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Table 3

Mean and Standard Deviation of Responses on the Competencies Required for Gas Charging in Split Air Conditioner

S/N	Item Statements	\bar{X}	SD	Decision
20	Install the new split air conditioners without charging as it is always prefilled with gas	2.86	1.00	NR
21	Charge the gas externally if the distance between the indoor and the outdoor units is large.	3.55	0.50	R
22	Refill the outdoor unit with the refrigerant or the gas from the factory	4.45	0.57	R
23	Check right at the installation of the system to ensure that there are no leakages of the gas	3.69	0.47	R
24	Apply soap solution to the joints to check for leakage of the gas.	4.83	0.38	R
25	Frequently check the gas to know when it is due for refill	4.23	0.50	R
26	Keep track of the refill interval to know when next to refill the gas	4.35	0.48	R
	Grand mean	3.99		R

Table 3 reveal 7 item statements representing competencies required for gas charging in Split air conditioner. The Means for the competencies ranged from 3.55to 4.83, except for item 20 which is 2.86. Each Mean was above the cutoff of 3.50 except for item 20, indicating that all the items are the required competencies for gas charging in split air conditioner except for item 20 which is indicated not to be a competency for gas charging. The items have standard deviation ranging from 0.38 – 1.00 which is less than 1.96 that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Table 4

Mean and Standard Deviation of Responses on the Competencies Required for Servicing Split Air Conditioners

S/N	Item Statements	\bar{X}	SD	Decision
27	Identify wrong connection	4.38	0.60	R
28	Recharge refrigerant if necessary	4.28	0.59	R
29	Fix blocked capillary tube	4.39	0.67	R
30	Change faulty parts when identified	4.21	0.71	R
31	Make use of parts appropriately	4.61	0.49	R
32	Make use of a multi-meter in taking measurement	3.81	0.39	R
33	Make use of appropriate tools	3.91	0.40	R
34	Clean the outdoor unit of split AC regularly	4.33	0.47	R
35	Clear simple or minor faults	4.56	0.50	R
36	Clean dirt in the condenser to enable easy transfer of heat	4.35	0.48	R
37	Clean the evaporator coil when there is a warm air or no air from the split AC register	4.31	0.47	R
38	Check for leaking or dirty duct if the air are not evenly distributed	4.13	0.33	R
	Grand mean	4.27		R



Table 4 reveal 12 item statements representing competencies required for servicing Split air conditioner. The Means for the competencies ranged from 3.81 to 4.61 for all the items. Each Mean was above the cutoff of 3.50 indicating that all the items are the required competencies for servicing Split air conditioner. The items have standard deviation ranging from 0.33 – 0.71 which is less than 1.96 that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Table 5: mean and standard deviation of responses on the competencies required for repairing Split air conditioner

S/N	Item Statements	\bar{X}	SD	Decision
39	Identify faulty parts	4.38	0.60	R
40	Check if the split air conditioner turns on	4.28	0.59	R
41	Check for blown fuse or tripped circuit breaker if AC refuse to turn on	4.39	0.67	R
42	Check broken or loose wiring if the fuse and circuit breaker are in place	4.21	0.71	R
43	Set the thermostat to the lowest temperature setting if it does not tell the air conditioner to turn on	4.61	0.49	R
44	Check for leakage if there is low refrigerant leading to no cooling	3.81	0.39	R
45	Fix the leakage path if it is just one	3.91	0.40	R
46	Replace the unit if there are multiple leakages	4.32	0.47	R
47	check the condenser coil if the air conditioner heats up easily	4.56	0.50	R
48	Fix power faults if any	4.35	0.48	R
49	Fix panel board when faulty	4.31	0.47	R
50	Shut down the AC by turning off your thermostat if it suddenly trips due to storm	4.13	0.33	R
51	Locate the electrical panel and find the circuit breaker that your AC connects to	4.55	0.53	R
52	Leave the thermostat off for at least half an hour for the AC to reset its internal circuit breaker	4.40	0.67	R
53	Investigate further AC electrical damage after waiting if the air does not come back on with the thermostat.	4.29	0.58	R
	Grand mean	4.30		R

Table 5 reveal 15 item statements representing competencies required for repairing Split air conditioner. The Means for the competencies ranged from 3.81 to 4.61 for all the items. Each Mean was above the cutoff of 3.50 indicating that all the items are the required competencies for repairing Split air conditioner. The items have standard deviation ranging from 0.33 – 0.71 which is less than 1.96, that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Table 6

mean and standard deviation of responses on the safety competencies required for effective maintenance of split air conditioners

S/N	Item Statements	\bar{X}	SD	Decision
54	Disconnect power supply prior to repair	4.53	0.66	R
55	Keep children away from unit while on repair	4.26	0.59	R
56	Ensure not to use extension card in powering the AC	4.41	0.50	R
57	Make sure installation conditions are satisfactory for safety	4.43	0.50	R
58	Connect properly and not tap into power cord	4.35	0.48	R
59	Always use soapy water to check for leakage.	4.09	0.28	R
60	Keep the parts away from rainfall	4.21	0.47	R
61	Use specified refrigerant	4.33	0.52	R
62	Keep the rotating fan away from reach	4.48	0.50	R
63	Use suitable soldering method in joining pipe	4.46	0.65	R
64	Be very careful in making wire connection	4.29	0.48	R
65	Gently dismantle the system to avoid damage	4.33	0.47	R
66	clean air filter properly	4.16	0.46	R
67	Be careful in opening the A/C front grill	4.58	0.69	R
68	Use appropriate tools for what they are meant for during maintenance	4.68	0.50	R
Grand mean		4.37		R

Table 6 reveal 15 item statements representing safety practice competencies required for effective maintenance of split air conditioners. The Means for the safety competencies ranged from 4.09 to 4.68 for all the items. Each Mean was above the cutoff of 3.50 indicating that all the items are the required safety practice competencies for effective maintenance of split air conditioners. The items have standard deviation ranging from 0.28 – 0.69 which is less than 1.96 that is 95% confidence limit. This indicated that the respondents were not too far from the mean and were close to one another in their responses. This added some values to the reliability of the mean.

Testing of Hypotheses

Table 7

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Competencies Required for Installation of Wall Mounted Indoor and Outdoor Units of Split Air Conditioners

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.078	2	0.039	2.008	3.96	0.141	0.05
Within Groups	1.492	77	0.019				
Total	1.570	79					

Data in Table 7 show the P-value of 0.141 is greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis is therefore accepted at 0.05 level of significance. This implies that there is no significant difference in the mean responses of respondents on the competencies required for installation of wall mounted indoor and outdoor units of Split air conditioners. Therefore, the null hypothesis of no significant difference was accepted for the



competencies required for installation of wall mounted indoor and outdoor units of Split air conditioner.

Table 8

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Competencies Required for Installation of Refrigerator Tubing in Split Air Conditioner

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.059	2	0.029	0.931	3.96	0.398	0.05
Within Groups	2.422	77	0.031				
Total	2.480	79					

Data in Table 8 show the P-value of 0.398 is greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis is therefore accepted at 0.05 level of significance. This implies that there is no significant difference in the mean response of respondents on the competencies required for installation of refrigerator tubing in Split air conditioners. Therefore, the null hypothesis of no significant difference was accepted for the competencies required for installation of refrigerator tubing in Split air conditioner.

Table 9

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Competencies Required for Gas Charging in Split Air Conditioner

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.090	2	0.045	1.335	3.96	0.269	0.05
Within Groups	2.600	77	0.034				
Total	2.690	79					

Data in Table 9 show the P-value of 0.269 greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis is therefore accepted at 0.05 level of significance. This implies that there is no significant difference in the mean response of respondents on the competencies required for gas charging in Split air conditioners. Therefore, the null hypothesis of no significant difference was accepted for the competencies required for gas charging in Split air conditioner.

Table 10

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Competencies Required for Servicing Split Air Conditioner

Sources of Variance	Sum of Squares	df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.053	2	0.026	1.181	3.96	0.312	0.05
Within Groups	1.721	77	0.022				
Total	1.774	79					

Data in Table 10 show the P-value of 0.312 greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis is therefore accepted at 0.05 level of significance. This

implies that there is no significant difference in the mean response of respondents on the competencies required for gas charging in Split air conditioner. Therefore, the null hypothesis of no significant difference was accepted for the competencies required for gas charging in Split air conditioner.

Table 11

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Competencies Required for Repairing Split Air Conditioner

Sources of Variance	Sum of Squares	df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.104	2	0.052	1.853	3.96	0.164	0.05
Within Groups	2.163	77	0.028				
Total	2.267	79					

Data in Table 11 show the P-value of 0.164 greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis is therefore accepted at 0.05 level of significance. This implies that there is no significant difference in the mean response of respondents on the competencies required for repairing Split air conditioner. Therefore, the null hypothesis of no significant difference was accepted for the competencies required for repairing Split air conditioner.

Table 12

Analysis of Variance (ANOVA) of the Mean Responses of Instructors, Technicians and Installers on the Safety Practice Competencies required for Effective Maintenance of Split Air Conditioners

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	F-Tab	P-Value	Level of Sig.
Between Groups	0.042	2	0.021	0.868	3.96	0.424	0.05
Within Groups	1.876	77	0.024				
Total	1.919	79					

Data in Table 12 show the P-value of 0.424 greater than 0.05 at degree of freedom between and within of 2 and 77. The null hypothesis was therefore accepted at 0.05 level of significance. This implies that there is no significant difference in the mean response of respondents on the safety practice competencies required for effective maintenance of split air conditioners. Therefore, the null hypothesis of no significant difference was accepted for the safety practice competencies required for effective maintenance of split air conditioners.

Discussion of findings

The study found out eleven competencies required for installation of wall mounted indoor and outdoor units of split air conditioners, eight competencies required for installation of refrigerator tubing in Split air conditioner, six competencies for gas charging in split air conditioners, twelve competencies required for servicing split air conditioners, fifteen major competencies required for repairing split air conditioner and fifteen safety competencies required for effective maintenance of Split air conditioner. These findings are in line with the findings of Oluka & Onyebuanyi (2017) who worked on the electric motors maintenance practice training needs of electrical installation



and maintenance works students for self-employment in Nigeria and found that installation competencies are required for maintenance of electric motors. The findings of the study also agreed with the findings of Kanishk (2017) that gas charging competencies are important and that during gas charging. Proper display of gas charging competencies during maintenance allows refrigerant to get distributed in the whole air conditioning system including the indoor unit, the outdoor unit and the refrigerant tubing. The findings of the study also agreed with the opinion of Onyebuenyi & Mbah, (2018) that servicing of split AC is a very important competency required by an AC installers, technicians and instructors. The authors also stated that practical skills like ability to draw and interpret designed drawings, ability to carry out repairs, fault detection, troubleshooting and likes are highly required for sustainable self-employment of electrical/electronic technology education graduates in Enugu urban. The findings of the study also agreed with the findings of the study conducted by Nwachukwu, Bakare & Jika (2009) who found out that all the safety and installation skills are required by electrical/electronic students for effective functioning in the workshop/laboratory.

Conclusion

Split air conditioner is an electric device capable of removing heat and moisture from the interior of an occupied space to increase the comfort of occupants in their various places such as industries, homes, offices and other places. This device is very useful but the users found it very difficult to locate trained and competent technicians who can repair or service it. It was on this note that this study was carried out to determine the SAC maintenance competencies in order to train secondary school leavers for effective maintenance of SAC and also to solve the problems of Split AC users

Recommendations

The following recommendations were made in view of the findings of the study:

1. The determined SAC maintenance competencies should be integrated to secondary school curriculum for preparation of students in SAC maintenance.
2. Relevant facilities should be supplied to provide adequate training to secondary school leavers at various skill acquisition centers

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