ENVIRONMENTAL HEALTH EDUCATION AND E-WASTE MANAGEMENT AMONG ELECTRONIC TECHNICIANS IN IBADAN METROPOLIS, NIGERIA

BY

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CERTIFICATION

I certify that this research was carried out under my supervision by Nwankaego Eunice OMEBOH with Matriculation No. 105743 in the Department of Human Kinetics and Health Education, Faculty of Education, University of Ibadan, Ibadan, Nigeria.

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DEDICATION

To my parents; Mr. Edward Thomas Omeboh and late Mrs. Grace Nduka Omeboh

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ABSTRACT

The management of electronic waste, which is increasingly becoming an intractable environmental problem in most urban cities, has become a topical health concern. The indiscriminate manner in which e-wastes are disposed has posed serious hazardous to humans and animals health. Previous studies focused largely on the management of solid waste with little emphasis on knowledge, attitude and practice of e-waste management through the instrumentality of an educational intervention targeted at attitudinal changes. This study, therefore, was designed to determine the effect of Environmental Health Education (EHE) on knowledge, attitude and practice of E-waste Management (EM) among electronic technicians in Ibadan metropolis, Nigeria. The moderating effects of work experience and educational background were also examined.

Sustainable e-waste Supply Chain model provided the framework, while the pretest-posttest control group quasi experimental design using 2x3x3 factorial matrix was adopted. Two Local Government Areas (LGAs) (Ibadan North and Ibadan South West) with high density of electronics technicians (ETs) were purposively selected out of the five LGAs in Ibadan metropolis. Fifty male ETs with high-stocked used electronics and who are duly registered with the trade association were purposively selected from each LGA as participants. Participants were randomly arranged to EHE (Ibadan North - 50) and control (Ibadan South West - 50) groups. Treatment lasted for eight weeks. Instrument used were instructional guides EM Knowledge (r=0.70), EM Attitude (r=0.72) and EM Practice (r=0.81) scales. Data were analysed using descriptive statistics and Analysis of covariance at 0.05 level of significance.

The participants were males with mean age of 40.6±6.8years. There was a significant main effect of treatment on EM knowledge ($F_{(1,84)}$=19.58, partial η^2=0.19). Participants in the EHE obtained higher mean score (22.06) than their counterparts in the control (16.10) group. Treatment had a significant main effect on attitude to EM ($F_{(1,84)}$=4.90, partial η^2=0.06). The participants exposed to EHE had a higher mean score (28.71) than their counterparts in the control (22.06) group. There was a significant main effect of treatment on practice of EM ($F_{(1,84)}$=5.64, partial η^2=0.06). Participants in the EHE had a higher mean score (23.56) than control (17.86) group. There were no significant main effects of work experience and educational background on knowledge, attitude and practice of EM. The two-way interaction effects were not significant. The three-way interaction effect was significant on knowledge EHE ($F_{(2,84)}$=3.74, partial η^2=0.08) in favour of participants in EHE with Ordinary National Diploma of 6-10 years work experience. Three-way interaction effect was significant on practice of EM ($F_{(2,84)}$= 3.82, partial η^2=0.08) in favour of participants in EHE with Primary School Leaving Certificate and over 11 years of work experience, but not on attitude.

Environmental health education improved knowledge, attitude to and practice of e-waste management among electronic technicians in Ibadan metropolis regardless of their work experience and educational background. Environmental health educational intervention should be used regularly to promote the management of e-waste.

Keywords: Environmental health education, E-waste management, Electronic technicians.
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CHAPTER ONE

INTRODUCTION

Background to the Study

The advent of electronic equipment (EE) has continued to make life bearable for humanity. This is evident in the use of EEs for washing, cleaning, cooling and heating; while some electronic gadgets like radio and television are being used for information dissemination, education and entertainment. This perhaps explains the reason for high demand for the goods. The exorbitant prices of newly manufactured articles in Nigeria are however,perceived to be limiting their affordability by many Nigerians.

Consequently, large quantities of used EEs are imported into Nigeria; with their attendant public health consequences, particularly in the management of wastes.

Dumping of e-waste indiscriminately has become a source of worry particularly in developing nations. Kelly, Schindler, Hodson, Short, Radmanovich and Nielsen (2010), noted that e-waste is growing at an exponential rate due to the introduction of low priced electrical devices. It is of note that e-wastes are dumped in developing countries and often illegally. Kelly et al. (2010) revealed that e-waste is expected to grow by 33% in the next four years in developing countries; as such, the nations will be deficient in their ability to safely manage and dispose of used electronics. Inadequate awareness of hazardous effects of e-waste seems to be contributing to the problem of poor e-waste management in Nigeria.

In Nigeria, the challenges of waste production and the manner of managing it in majority of cities have become one of the intractable environmental problems. Human population and rural-urban migration have increased, however, the waste management operation carried out was not enough to control the level of wastes produced in developed areas (Ibrahim, Adie, Giwa, Abdullahi and Okuofu, 2013). This had negative impact on the environment. Cui and Forssberg (2003) stated that the manner in which waste is being produced is almost higher than the rate of its disposal.

Basel Action Network [BAN] (2002) defined electronic waste (e-waste) or Waste Electrical and Electronic Equipment (WEEE) as uunwanted electronic equipment that are obsolete, and have reached the end of their lives or that have been discarded by their original users. This e-waste broadly covers waste from all electronic and electrical appliances and comprises items such as computers, mobile phones, digital music recorders/players, refrigerators, washing machines, televisions and many other household consumer items that are perceived to be no longer useful. In the same vein, Appelbaum (2002) described e-waste as electrical or electronic equipment waste that includes all components, subassemblies and consumables which are part of the products at the time of discarding.

E-waste management (EM) is a designed arrangement of successful handling of collection, transportation, processing and disposal of e-waste in sanitary manner. It is concerned with handling, treating, utilizing or controlling of e-waste in an approved way. Usually, waste resources are gathered, conveyed, discarded and recycled with the aim of bringing down the negative effect on human health and environment (Audu, 2013).

Most developing countries do not have both the necessary infrastructures and effective legislation to avert the hazards that could emerge from poor e-waste management. Rather, the prominent methods of e-waste handling in developing countries involve low-end treatment methods such as backyard recycling, open dump disposal, disposal in water bodies and open burning (Furter, 2004). E-waste is highly complex to handle due to its composition. It is made up of multiple components, some of which contain toxic substances that have adverse impact on human health and the environment if not handled properly. Often, these problems arise from improper recycling and disposal methods. This underlines the need for appropriate technology for handling and disposal of these harmful chemicals (Agnihotri, 2011).

E-waste management has become an issue of interest based on the way e-wastes presently penetrate into underdeveloped nations, where dumping in the landfills are not properly controlled. Improper management of e-waste is progressively causing distress everywhere throughout the world because of its dangerous consequences on people, livestock and the ecology (Adediran and Abdulkarim, 2012). In having successful e-waste management, it is essential to measure and illustrate waste stream, detect waste

generators and assess the dangers involved. Additionally, systematic, safe and ecologically solid management, including policies and technologies are needed for improvement and execution of e-waste management. This requires expertise segregation, collection, conveyance, treatment and transfer (United Nations Environment Programme [UNEP], 2007).

Chemical components of e-waste like lead, mercury, copper, cadmium and chromium are hazardous. Therefore exposure to e-waste and its processing methods have physiological susceptibility. The degree at which contamination from e-waste influence serious health effect is yet to be ascertained. However, it is considered to be significant when casual recycling operation takes place inside or close to communities. Human contact with lead from electronic items is more harmful due to little or no control on unlawful recycling in cottage industries, most especially in developing countries. The exposure to lead can cause danger to the central nervous systems, kidney and reproductive system in people. The substance like lead with neurotoxin destroys cells of the heart. It has likewise been connected with learning deficiency, attention deficit disorder and hyperactivity syndromes among children. In the same vein, mercury effects can cause damage to different organs like heart and kidney (Onwughara, Nnorom, Kanno and Chukwuma, 2010; Grant et al, 2013).

Electronic equipment that has become obsolete is based on incessant improvement of modern models. Rapid technological turnover can lead to high rate of e-waste; which is estimated about 20 to 50 million metric tonnes produced globally every year. Some of these are incinerated materials, which could bring about environmental pollution from fumes. Moreover, a large percentage of the out-dated equipment penetrated into poor developing countries of Africa and Asia, where they are continually being used. As a result of poor awareness, some equipment are carelessly handled which in turn, pose severe danger to the health of people (BAN, 2002). Nigeria is one of the leading countries where poisonous chemicals and e-wastes from advanced nations are dumped. BAN (2005) revealed that, about 500 shipping containers with a load equal in volume to 400,000 computer monitors were dropped in Lagos lagoon each month. About 75% of the shipments were classified as e-wastes. The poor e-waste management procedures employed pose health threats to Nigerians.

Indiscriminate dismantling of used EEE is observed to be common among the repairers and technicians of the equipment. Such artisans are usually influenced by their peers or society through the way they manage their e-waste. Bakare, Adeyemi, Adeyemi, Alabi and Osinbajo (2012) reported that due to inappropriate recycling process, many tonnes of electrical and e-waste materials and repair residues end up in open fields, river banks, workshops, yards, road sides, irrigation canals and ponds. In addition, UNEP (2009) revealed that conventional solid waste disposal approach has failed to provide the needed sanity and sustainability desired in the market environment. E-waste management is specifically posing health challenges to various people, particularly in developing countries. Nnorom and Osibanjo (2009) as well as Robinson (2009) posited that e-waste is increasingly growing globally due to illegal dumping which results in hazardous constituents through trans-boundary movement.

E-waste typically, is rapidly growing across the globe and estimated at 40 million tonnes annually, whereas, its production is evaluated three times than municipal solid waste. Robinson (2009) further established that e-waste is a typical tropical ecological subject of concern in recent times. There are factors that influence mismanagement of waste, particularly e-waste. Kahhat, Kim, Xu, Allenby, Williams and Zhang (2008) revealed that location of e-waste disposal equipment or facilities is regarded as a factor that influences management of e-waste. Similarly, the inability to locate or distribute equipment and facilities appropriately can result to improper or indiscriminate disposal of e-wastes. Also, poor sanitary inspection is also considered as a factor that influences improper management of e-waste (Padilah, Brustolin, Azevedo and de Mattos Fagundes, 2015).

Substantial number of e-wastes are being handled in developing nations using wrong methods; including open dumps, open burning and the use of crude extraction techniques in recovering precious metals without environmental safeguards and protection of human health. Consequently, there is a great concern about human health hazard due to potential contact with the hazardous substances in e-waste, based on the crude management methods in use in developing countries (Bakare, Adeyemi, Adeyemi, Alabi and Osinbajo, 2012). The health effects comprised central nervous system, skin disorder and cancer prevalence diseases. This may be caused by constituents of electrical

and electronic equipment like lead, mercury and beryllium (Tsydenova and Bengtsson, 2011). Poor management of e-wastes might be attributed to factors like illiteracy, social influence, economic status and non-provision of e-waste disposal equipment and facilities. The location of such equipment and facilities as well as inability of government agencies to inspect how the wastes are being disposed also pose challenge.

The BAN (2005) revealed that about 500 (40-foot) containers of second hand computers with each comprising nearly 800 monitors of Central Processing Units, which is equivalent to about 400,000 scrap components enter the port of Lagos every month. This is imported primarily from developed countries. This amounts to an annual importation estimated at about 5m scrap units or 60,000 metric tons of scrap comprising about 18,000 tons of plastic substances. This is estimated to an importation of 15,000-45,000 tons of poisonous waste comprising about 1000-3600 tons of lead which is harmful to human and environmental health. Ibadan as a city is not exempted from e-waste management problem. This can be attributed to some factors like proximity to Lagos port, urbanization, economic status and population. Komolafe (2012) revealed that the high rate of illiteracy, poverty, indecent culture of waste littering and violation of town planning regulations are factors responsible for disposal of e-waste in Ibadan in last five decades. Similarly, Adekunle, Adekunle, Akintokun, Akintokun and Arowolo (2010) established that few traders in Ibadan were neither aware of the recycling plant nor the importance of having it.

The personal exploration carried out by the researcher also revealed that electronic technicians in Ibadan lacked adequate knowledge of the management of e-waste. This might affect their attitude towards same. In order to promote proper management of waste, particularly e-waste among electronic technicians, health knowledge is essential. Famuyiwa (2006) asserted that, health knowledge is very important because a person who is well informed about health will likely engage in activities that will promote personal health or seek urgent advice when such person's health is likely to be in jeopardy. Also, Adio-Moses (2007) established that certain set of activities that involve health education significantly enhanced traders' attitude and practices in relation to management of waste that are solid in nature.

A typical aspect of health education that could promote effective improvement in knowledge and attitude of individuals towards e-waste is environmental health education. United Nations-HABITAT (2004) affirmed that environmental health education is directed at increasing the acquisition of peoples' consciousness and understanding of environmental health matters, contributing to responsible individual and group actions. It is aimed at improving environmental health literacy and skills through teacher's health instruction to technicians and people in general.

Health knowledge, good attitude and practice usually have significant impact on healthful living of individuals, families and the communities in general. Adequate knowledge of proper e-waste management has the tendency of improving healthful living of individuals; while inadequate knowledge might pose dangers to individuals and the environment. Audu (2013) revealed that poor knowledge was associated with predisposition of the inhabitants of Jos South Metropolis' environment to air and water borne diseases.

Attitude involves a tendency to respond either positively or negatively towards objects or persons in an environment. Positive attitude towards environment is therefore required in order for individuals and the environment to be free from hazards. On the other hand, poor attitude towards e-waste management might pose threat to individuals and the environment. Audu (2013) opined that apart from knowledge, interest and attitude, individuals' behaviour about the environment is important. Attitudes are improved feelings, knowledge, thoughts of individual as well as social benefits and conviction. The manner of practicing e-waste management also has strong influence on health, environment and people. A society with good management practices of wastes has tendency to be free from danger, while those societies that do not, are likely to be faced with risks. Years of work experience and age have tendency to influence adequate handling of e-waste.

Regarding the problem of e-waste management as well as its effect on the health of the people; previous studies of Adekunle, Adekunle, Akintokun, Akintokun and Arowolo (2010); Adediran and Abdulkarim (2004) focused on contamination of environment and its effects on human health, with little emphasis on knowledge, attitude and practice of e-waste management. Similarly, other related studies like Adio-Moses

(2007) as well as Bel and Mur (2009), focused largely on the management of solid waste. Moreover, little emphasis was laid on intervention programme about e-waste management. This study therefore, examined environmental health education and e-waste management among electronic technicians in Ibadan Metropolis, Nigeria.

Statement of the Problem

The leftover and non-reusable parts of e-wastes are disposed poorly in waste dumpsites, sometimes burnt in some abandoned empty cans in the environment. Dumpsites are always located at designated points, where reusable parts are easily accessed. Currently, improper dumping of e-waste has a serious health implication on human and the environment; particularly on individuals health due to toxic components of the materials. E-waste accumulates on land surfaces and contaminates it with toxic substances. This was evident through the process in which water percolates through the soil. The change in water chemistry affects organisms that depend on this water for survival.

It has been ascertained that toxic constituents from e-waste had constituted burden to both individuals and environment in some parts of Nigeria, through contamination of the environment (Adekunle, Adekunle, Akintokun, Akintokun and Arowolo, 2010; Adediran and Abdulkarim, 2004). Due to inappropriate recycling process, many tonnes of e-waste materials as well as repair deposits end up in workshops, backyards, road sides, open fields, irrigation canals, river banks, ponds and rivers; which later can cause environmental pollution or blockage of the streams and rivers. Similarly, indiscriminate disposal of e-waste in the environment has negative effect like leaching of poisonous substances into the soil towards ground water, which eventually might end up in food chain. Frequent contact with these substances can lead to harm on the body system. In addition, Ana and Fabunmi (2016) noted that, wastes generated in Nigeria are improperly utilized and poorly managed. On the other hand Ogunsola and Shobayo (2017) revealed that government regulations, peer pressure, organization's culture and organization's reputation have predictive relationships with the e-waste management practices that information and communication technology artisans adopt.

Proper management of e-waste has a direct positive effect on the environment. It has value chain effects on the economy of a given society with respect to job opportunity and economic empowerment of the individual and government. People's knowledge and positive attitude towards e-waste management should be properly annexed for the benefits of humanity and the environment. In addition, good practice on the part of all the stakeholders concerning e-waste management has significant influence on the improvement of the environment.

Despite the several benefits of effective e-waste management to the society, much efforts have not been made to inculcate its practices into people and the society. Knowledge and attitude towards e-waste management among technicians remain poor. A preliminary explorative survey conducted by the researcher in 2015 revealed that the knowledge and attitude of electronic technicians in Ibadan North Local Government Area about e-waste management were poor. Furthermore, previous studies revealed the effect of contaminated environment on human health. Also, other empirical findings focused largely on the management of solid waste, while little emphasis was laid on intervention programme about e-waste related studies. This study therefore, provided appropriate solution to e-waste management that is rooted in adequate knowledge, attitude and practice among electronic technicians with the view to making the environment safe for humanity and ecosystem. Hence, this study examined the effects of environmental health education on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis, Nigeria.

Main Objective of the Study

The main objective of the study was to determine the effects of environmental health education on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis, Nigeria.

Specific Objectives of the Study

The specific objectives were to:

1. Examine the effects of environmental health education intervention on knowledge, attitude and practices of e-waste management among electronic technicians in Ibadan Metropolis.
2. Investigate the moderating effects of years of work experience on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
3. Determine the moderating effects of educational background on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
4. Determine the interaction effects of treatment and years of work experience on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
5. Identify the interaction effects of treatment and educational background on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
6. Assess the 2-way effect of years of work experience and educational background on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
7. Determine the 3-way effect of treatment, years of work experience and educational background on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.

Research Questions

These research questions were answered;

1. Do electronic technicians in Ibadan metropolis have knowledge of appropriate e-waste management?
2. What is the attitude of electronic technicians in Ibadan metropolis towards e-waste management?
3. Do electronic technicians in Ibadan metropolis have good practice of e-waste management?

Hypotheses

The following hypotheses were tested in the study:

1. There is no significant main effect of treatment on:
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.
2. There is no significant main effect of years of work experience on:
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.
3. There is no significant main effect of educational background on:
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.
4. There is no significant interaction effect of treatment and years of work experience on;
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.
5. There is no significant interaction effect of treatment and educational background on;
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.

6. There is no significant interaction effect of years of work experience and educational background on:
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.
7. There is no significant interaction effect of treatment, years of work experience and educational background on;
   a. Knowledge of e-waste management
   b. Attitude towards e-waste management
   c. Practice of e-waste management among electronic technicians in Ibadan metropolis.

Delimitation of the Study

The study was delimited to the following:

1. Pretest-posttest control group quasi-experimental research design.
2. All electronic technicians in Ibadan metropolis, Oyo State as population
3. One hundred electronic technicians in Ibadan metropolis as sample size.
4. Multistage sampling procedure
5. Self-developed questionnaire as instrument for data collection.
6. Dependent variables of knowledge, attitude and practice of e-waste management.
7. Independent variable of environmental health education.
8. Moderating variables of years of work experience and educational background.
9. Environmental health education package for the treatment group and nutrition education for the control group.
10. Descriptive statistics of frequency counts, percentages, charts and graphs to analyze demographic attributes of the participants and research questions, while parametric statistics of ANCOVA was used to test the hypotheses.
11. Ten trained research assistants were used

Limitation of the Study

The below limitation was encountered in the process of carrying out the study:

The participants were initially reluctant in responding to the question items. However, the researcher persuaded and guaranteed them of the confidentiality of their responses.

Significance of the Study

The study was significant in the following ways:

The findings of the study would enhance the acquisition of knowledge of the electronic technicians on environmental health education about e-waste management. This would be of benefit to the participants by having informed knowledge of side effects inherent in the handling of e-wastes indiscriminately. It would also enhance positive change of attitude of the electronic technicians towards environmental health education. It is also hoped that the findings would be a veritable tool in the hands of health educators and those in control of wastes, particularly, e-waste on its implication on human health.

The findings of the study might be used for planning, review and development of information materials to enhance the knowledge of e-waste management among the populace, particularly electronic technicians. The findings may also provide empirical intervention data based information on the contribution of each variable towards the health implications of e-waste management.

The findings of this study might enhance the need to design health education intervention that would provide further experimental design with the aim of promoting health knowledge and attitude. Furthermore, the findings would be very useful to research institutions, health institutions, business and other relevant sectors. The study may help government and non-governmental organization to focus on the relevance of policy guidelines on e-waste management and disposal.

Operational Definition of Terms

The following terms were defined operationally.

- **E-waste:** Consist of wastes from electronic devices which are no longer suitable for their original intended uses; but predetermined for recovery, recycling or disposal. These include scrap radio, television, iron and so on.
- **E-waste management:** This is an effective system that is planned for the purpose of controlling the generating, storing, collecting, transporting and disposing of used or left over electronic equipment in a sanitary and acceptable manner.
- **Electronic technicians:** These are the individual skilled in the repairs of electronic equipment.
- **Environmental health education:** This is a planned programme that is intended to increase electronic technicians' acquisition of knowledge that bring about positive attitude and practice in relation to e-waste management.
- **Nutrition education:** It is a planned programme that is aimed at improving electronic technicians' acquisition of knowledge on the process of absorbing nutrients from food and how such foods are processed in the body in order to keep healthy.
- **Hazardous wastes:** These are e-wastes that have potential menace to individual's health and the environment. Such hazardous wastes may manifest in different physical states like gaseous, liquid or solid. Such wastes contain toxic components like mercury, lead, cadmium and lithium.

CHAPTER TWO

LITERATURE REVIEW

The review of related literature was discussed under the following sub-headings:

1. **Conceptual Framework for the Study**
2. **Theoretical Framework for the Study**
   - Sustainable E-waste Supply Chain Model
3. **Conceptual Review:**
   (a) Concept of waste
   (b) Concept of e-waste
   (c) Components of e-waste
   (d) Concept of e-waste management
      i. Meaning of e-waste
      ii. Method of e-waste management
      iii. Importance of good e-waste management
      iv. Involvement of stakeholders in e-waste management
   (e) Impact of e-waste management on health and environment
      i. Health impact of e-waste
      ii. Environmental impact of e-waste management
   (f) Socio-economic impact of e-waste management
   (g) Flow of e-waste into Nigeria
   (h) E-waste in Nigeria
   (i) Policy and legislation on e-waste in Nigeria
   (j) Overview of Ibadan
4. **Empirical Review of Studies on Environmental Health Education**
   i. Environmental health education and knowledge of e-waste management
   ii. Environmental health education and attitude towards e-waste management
   iii. Environmental health education and practice of e-waste management
5. **Appraisal of Reviewed Literature**

CONCEPTUAL MODEL FOR THE STUDY

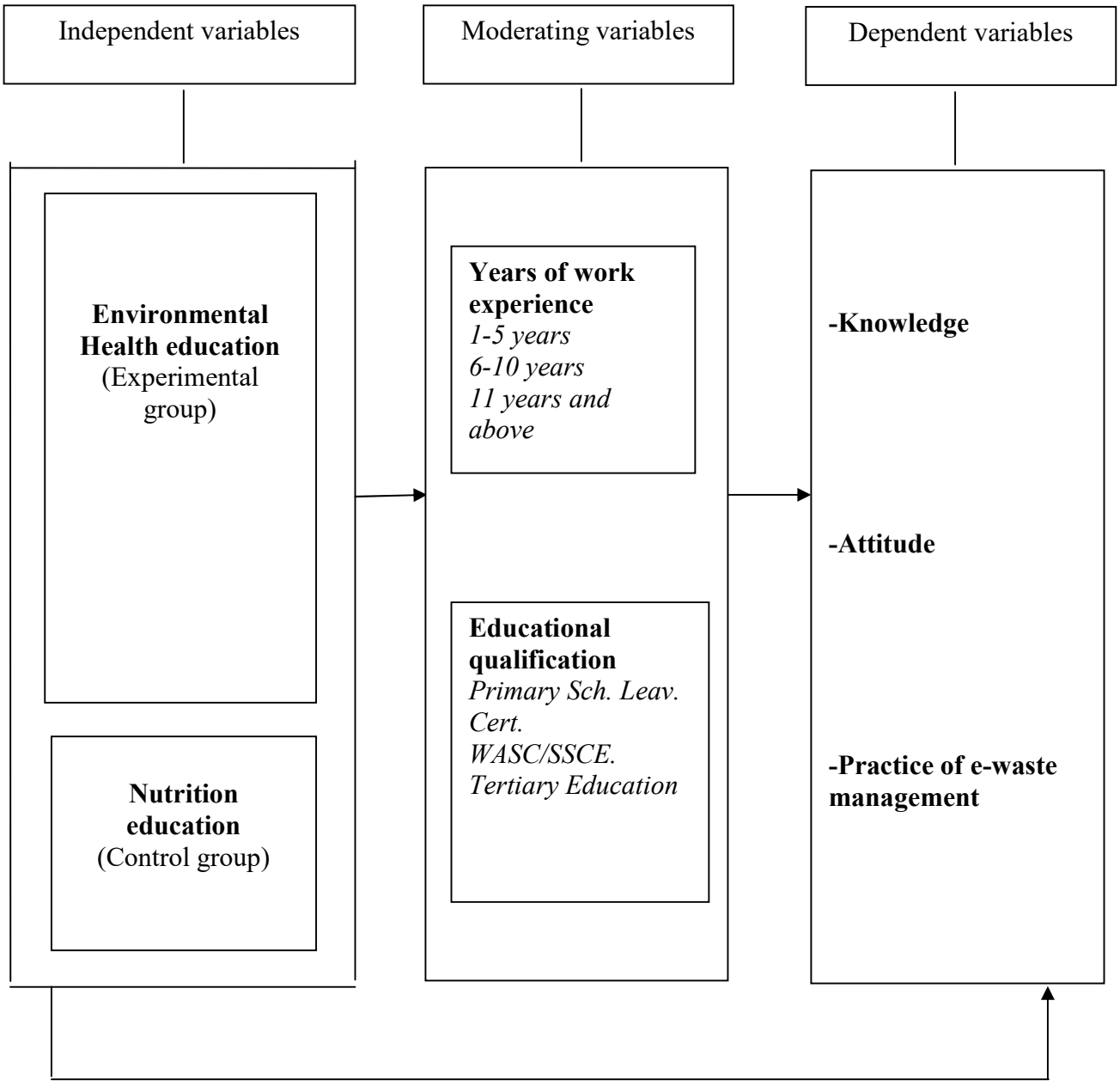

Figure 2.1: Conceptual framework about effects of environmental health education on e-waste management

Source: Self Developed, 2018.

The conceptual framework gives a description of interaction of the independent variables with dependent variables. The independent variable is environmental health education, while dependent variables are knowledge, attitude and practice of e-waste management. The independent variable is a rectangular shaped box on the left side; the moderating variables are in the middle, while the box for dependent variable is on the right hand side. The arrow that links each of the independent variables with dependent variables shows the relationship between them. The moderating variables are years of work experience and educational background.

Theoretical Framework for the Study

Sustainable E-waste Supply Chain Model

The Sustainable E-waste Supply Chain Model was adapted to guide the design of the study. It is a management model that was developed in Mexico to explain transportation and proper disposal of old electronic products. The Sustainable E-waste Supply Chain Model was aimed at drawing attention to components that must be considered in waste management as well as the favourable conditions and challenges to transition from treatment handling with practices that lack environmental and technical support to sustainable management. Sustainable E-waste Supply Chain Model has six components; namely, waste electrical electronic (WEEE) volume collected, collected system, infrastructure, monitoring and control, extended producer responsibility and communication strategies; with legal framework and financing system connecting the components together.

In the model, legal frame work was considered as a paramount factor in electrical and electronic management. The model established that municipalities are responsible for providing public cleaning services; in charge of collecting, transporting, treating and final disposing waste. It was further established that the core environmental law that regulates hazardous waste is the General Law of Ecological Balance and Environmental Protection (LEGEEPA) in Mexico. In the same vein, the Ibadan Solid Waste Authority has some laws that regulate hazardous wastes in Ibadan Metropolis. The sustainable management of WEEE requires a financing system. This was based on a feasible financing system which ideally, includes collecting, transporting, treatment and disposing phases.

Worldwide, waste electrical electronic comprises a typical waste types in streams and water bodies. This component emphasis on how it is important to estimate with accuracy, the amount of waste produced and managed at each stage of a product's life cycle. Consequently, accurate estimation might help the waste authority to be ready and face associated problems when handling WEEE. This in turn, will allow to improve the accountability of its management in a sustainable way. Pertinent that users need to know, how and where to deliver obsolete equipment. This, a collecting system must be implemented where users have easy access in delivering items after the end of their useful life and promote the system for users' sensitization. In order to have a good functioning of the system and establish collecting sites to meet certain basic standards of environmental protection with sufficient storage of equipment over a specific period of time.

This EEE generation are emphasised on the production of small equipment. It is established that formal sector and informal sector are involved in dealing with waste management. Considering the formal sector, there are governmental management instruments to deal with electronic waste. In considering the informal sector, electrical and electronic waste focused on any component that has a value that can be commercialized. Management is usually done at illegal sites and when selecting WEEE from urban waste. Extended producer responsibility (EPR) programme is another important component of Sustainable E-waste Supply Chain Model. The EPR will make each creator responsible for the entire lifecycle of each EEE produce in the consumption of collecting, recovering and final disposing. An EPR has to be implemented across all WEEE management instruments with a set of economic instruments that vary across each electrical and electronic stage. These instruments are taxes, deposit refunds and subsidies. The arrangement of these instruments will determine how to apply a specific EPR (individually, collectively, or a combination of both).

Health is a problem associated with recovery activities in the third world countries. This is as a result of large shares of the recycling process that is covered by the informal sector. The informal sector reconditions and selects materials from EEE by using technicians and waste pickers that do not use appropriate equipment with little or no knowledge about potentially hazardous elements. Lack of knowledge and equipment

lead to the exposure to informal waste of electrical electronics allied workers, including general public on health problems. Therefore, appropriate control and communication strategies should be used to tackle the problems.

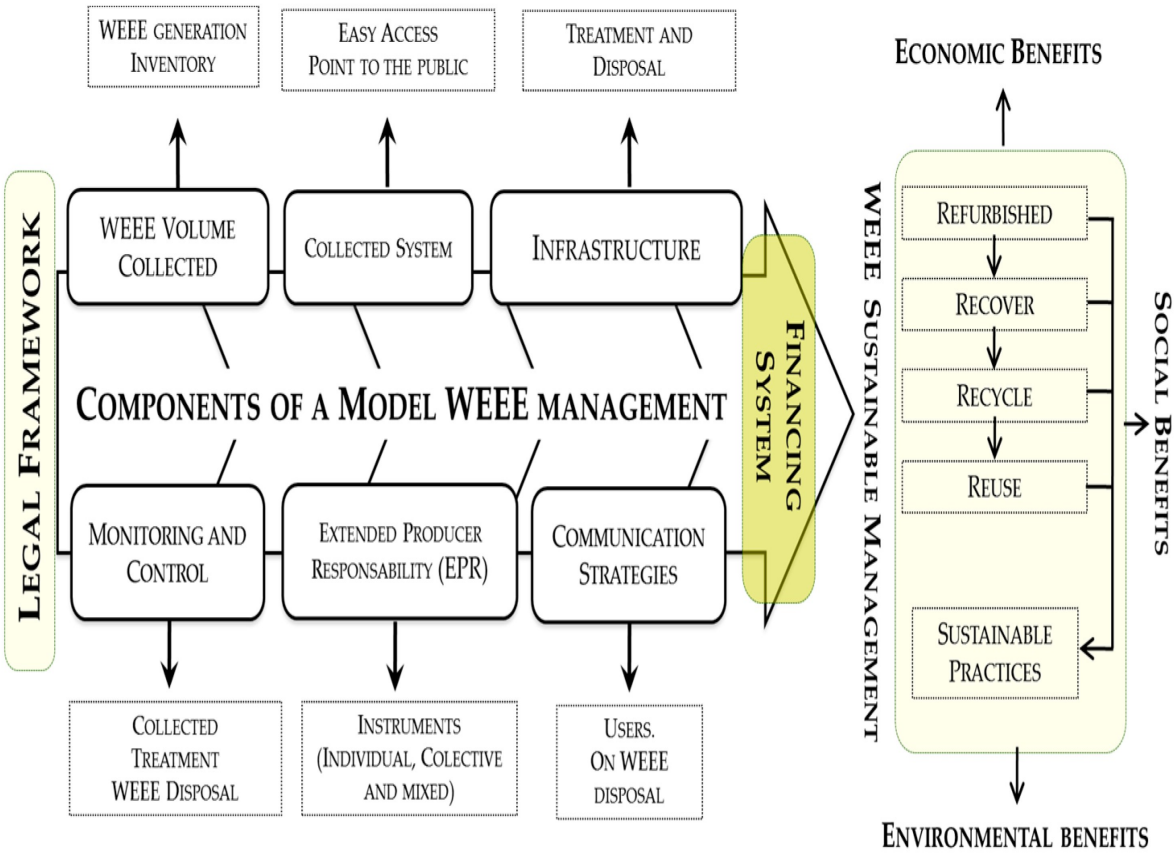

Fig.2.2: Sustainable E-waste Supply Chain Model applied to effect of environmental health education on e-waste management

Source: E-Waste Supply Chain in Mexico: Challenges and Opportunities for Sustainable Management (2017)

Figure 2.2 shows the application of Sustainable E-waste Supply Chain Model to effect of environmental health education on e-waste management. The model comprise waste electrical electronic (WEEE) volume collected, collected system, infrastructure, monitoring and control, extended producer responsibility and communication strategies; with legal framework and financing system connecting the components together.

CONCEPTUAL REVIEW

(a) Concept of Waste

Generally, the issue of materials that were not used came from various like household, industry and a host of other related areas is an unavoidable public health issue all over the word. According to Sirdhar (2015), waste is necessary material resulting from household industrial activities without economic benefits but disposed of. Elemile, Ana and Sridhar (2017) established that waste can be gaseous, liquid or solid. The solid include municipal waste, industrial waste and biomedical or hospital waste. The classes of waste, solid waste generation is a leading challenge in waste processing across the world, particularly developing nations.

Solid waste is described as any solid substance that comes from domestic, commercial, industrial, agricultural and demolition activities which are regarded as unwanted by those who own them. It is usually produced by household, health care, industrial, commercial, agricultural and mineral extraction activities in public places. It was also revealed that the classes of sources of solid waste in the community include residential, institutional, construction and demolition, municipal services, agricultural waste, industrial solid waste as well as treatment plant wastes (Chati, 2012).

(b) Concept of e-waste

i. Meaning of e-waste

E-waste involves types of EEE that can enter the waste stream, used for household and business items with circuitry components with battery supply that has reached its end-of-life. Electronic waste has the mixture of broad and increasingly growing range of electronic devices of household types such as (refrigerators and air conditioners and mobile). Also, electronic waste is described as appliance using an electric power supply that has reached its end-of-life (OECD, 2001).

Ruediger and Federico (2013) explained that for some decades in the past, the electronics industry has revolutionized: electrical and electronic items have become ubiquitous of today's life planet. The products are used in such areas as medicine, transportation, education, health, food supply, communication, security, environmental protection and culture. Common equipment comprise home iterms such as refrigerators, washing machines, mobile phones, personal computers, printers, toys and televisions.

These thrown away at end-of-life– after re-use cycles in countries different from those where they were initially sold becoming what is commonly called e-waste.

Electronic waste represents any equipment that is dependent on electric currents electromagnetic fields for it to function adequately , comprising equipment in generating, transferring and measuring current (Onwughara, Nnorom, Kanno and Chukwuma, 2010). United Nations Environment Programme, UNEP (2013) expressed Waste Electrical and Electronic Equipment; however, as discarded computers, office electronic equipment, mobile phones, electronics, refrigerators and television sets which are destined for reuse, resale, salvage, recycling or disposal.

ii. Categories of e-waste

Tonetti (2007) reported that e-waste is defined by categorization. The US Environmental Protection Agency (EPA) defined electronic waste based on non-harmful wastes like household electronic waste and scrap metals met for recycling and non-waste which comprise articles and commodities meant for recycling as scrap metals, circuit boards and Cathode Ray Tube glass (CRT). Paradoxically, EPA considers discarded CRT monitors as harmful domestic waste. CRTs are set aside for testing or reusable parts of working and repairable electronics as well as scrap materials. These are secondary scrap (copper, steel, plastic and a host of others); when not abandoned, speculatively accumulated left unsecured due to weather and other damage. Additionally, the EPA policy states that out dated electronics are not considered waste until a specialized decision is made stating their incessant usability (Tonetti, 2007).

E-waste is narrowed to Information and Communication Technology articles in Northern America. Also, electronic waste is in four product categories including TVs, air conditioners, refrigerators, and washing machines in Japan. Electronic waste from ICT-devices including computers, laptop computers, printers, calculators, telephones, hand-held digital apparatuses, cell phones, TV's and all its accessories (SBA, 2009).

Waste Electrical and Electronic Equipment is one of the fastest growing waste streams in the world. In developed countries, it equals to 1% of total solid waste on an average. There exists a pressing need in addressing electronic waste management, specifically in the third world countries (UNEP, 2007). All over the world, electronic waste is increasing as consumers, in developed and developing countries, purchase

devices and throw their old ones away. It was also established that between 20 and 50 million tonnes of e-waste which are generated across the globe. The amount is growing almost three times faster than the overall municipal solid waste stream (Schluep et al., 2010).

In recent times, the rate at which electronic waste is promptly increasing in developing countries as they join the global information society is alarming (Olakitan, Innocent, Oladele and Mathias, 2012). This is in consonance with the report of Michelle, Carol, Kwadwo, Linda, Ake, Marie-Noel, Irena, David, Aimin, Xia, Mostafa, Philip, Landrigan, Federico, Fermando, Maria, Magdy, Antonio, Mathuros, Leith and Peter (2015) that electronic waste is created in astounding quantities, which is approximated worldwide at 41.8 million tonnes in 2014. As stated by Osibanjo and Nnorom (2008) and cited in Olakitan, Innocent, Oladele and Mathias (2012); there are three major sectors in which electronic waste is generated. These include small businesses and individuals; big businesses, institutions, and governments and original equipment manufacturers.

A number of reasons exist for an article to reach it end-of-life. The reasons consisted of technical obsolescence; economic undesirability (new products in the market are more economic in terms of cost); feature obsolescence (new products have come onto the market that offer more or better features); and, aesthetic obsolescence (new products in the market have a nicer look or more fashion-able design from the point of view of the consumer). Ruediger and Federico (2013) further showed in their research ; UNU and World Health Organisation Survey on electronic waste and its health effect on children that:

1. the levels of EoL electronics, or “e-waste”, have been increasing and are expected to continue to rise.
2. e-waste contains materials that are considered toxic, such as lead, mercury, cadmium, arsenic, PBDEs, PCBs, PCDD/Fs and PFAS which are inimical to the environment and human health. Safe disposal is very complicated.
3. the mixtures of toxic substances found in electronic waste are often unique and not well studied.
4. e-waste contains valuable materials and recovery of these materials can alleviate mining of virgin materials.

5. in several instances cases the costs of recycling electronic waste is higher the revenues generated from the recovered materials. This is due to the complexity nature of product design and difficulty of separating highly commingled materials.

Table 2.1 Categories of Electrical and Electronics Waste

S/N	CATEGORY	TYPICAL EXAMPLES
1	Large Household Appliances	Refrigerators, freezers, washing machines, clothe dryers, microwaves, heating appliances, radiators, fanning/exhaust ventilation/conditioning equipment
2	Small Household Appliances	Vacuum cleaners, other cleaners, sewing/knitting/ weaving textile appliances, toasters, fryers, pressing iron, grinders, opening/sealing/packaging appliances, knives, hair cutting/drying/shaving devices, clocks, watches
3	IT and Telecommunication Equipment	Mainframes, microcomputers, printers, PC (desktop, notebooks, laptops), photocopiers, typewriters, fax/telex equipment, telephones
4	Consumer Equipment	Radio and TV sets, video cameras/decoders, Hi-fi recorder, audio amplifiers, musical instruments
5	Lighting Equipment	Luminaires for fluorescent lamps, low pressure sodium lamps
6	Electrical and Electronic Tools (excluding large-scale industrial tools)	Drills, saws, sewing machines, turning/milling/sanding/sawing/cutting/shearing/drilling/punching/folding/bending equipment, riveting/nailing/screwing tools, welding/soldering tools, spraying/spreading/dispersing tools,
7	Toys, Leisure and Sports Equipment	Electric trains, car racing sets, video games, sports equipment, coin slot machines, biking/diving/running/ rowing computers
8	Medical Devices	Devices for radiotherapy/cardiology/dialysis, ventilators, analyzers, freezers, fertilization tests, detecting/preventing/monitoring/treating/alleviating illness, injury or disability
9	Monitoring and Control Instruments	Smoke detectors, heating regulators, thermostats, measuring/weighing/adjusting appliances for household or laboratory use, other industrial monitoring and control instruments
10	Automatic Dispensers	for hot drinks, hot or cold bottles/cans, solid, products, money, and all kinds of products

Source: UNEP, 2004a

The constituent of electronic waste varies in articles in categories. It common ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards,

concrete and ceramics, rubber and other items. Iron and steel components of nearly 50% of the e-wastes next by plastics (21%), non ferrous metals (13%) and other components. Non-ferrous metals have metals like copper, aluminium and precious metals ex. silver, gold, platinum, palladium and so on. The existence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in electronic waste classifies them as dangerous (Meena, 2008).

Main Sources of E-Wastes;

According to Olanrewaju (2011), in Nigeria there are five major sources of electronic waste;

i. Waste electronic products from household;
ii. Waste electronic products from institutions, enterprises and governments;
iii. Defective electronic products (Imported);
iv. Used Electrical and Electronic waste (e-waste and near end of the life EEE);
v. Illegal imports of electronic waste

c) Components of e-waste

Technological increase resulting from obsolescence of electronics products results to increase in the volume of electronic waste generated. It is convenient to change malfunctioning equipment than to repair or fix them; while electronics products may contain reusable and valuable materials. Most of the components in electronic wastes are however dangerous and toxic, hence unsafe to the environment as shown in table. The cathode ray tube of a or computer monitor, for example, contains lead, antimony, phosphorous and so on; in some proportions, while circuit boards in diverse electric items contain lead, beryllium, antimony and brominated flame retardant. Other toxic substances contained in various electronic items comprise selenium, antimony trioxide, cadmium, cobalt, manganese, brome and barium, amongst many others (Adediran and Abdulkarim, 2012).

Table 2.2: Hazardous Components in E-waste Items

S/N	Element	Hazardous (Dangerous)Components
1	Cathode Ray Tube	Lead, antimony, mercury, phosphorous
2	Liquid Crystal Display	Mercury
3	Circuit Board	Lead, beryllium, antimony, BFR
4	Fluorescent Lamp	Mercury, phosphorous, flame retardants
5	Cooling systems	Ozone depleting substance (ODS)
6	Plastic	BFR, phthalate plasticizer
7	Insulation	ODS in foam, asbestos, refractory ceramic fibre
8	Rubber	Phthalate plasticizer, BFR, lead
9	Electrical Wiring	Phthalate plasticizer, BFR
10	Batteries	Lead, lithium, cadmium, mercury

Source: UNEP, 2007a; MoEF, 2008; ENVIS, 2008

It was also stated by Meena (2008) that electronic waste is classified into three broad groups, namely;

i. Large Household Appliances
ii. IT and Telecom and
iii. Consumer Equipment. Refrigerator and Washing Machine represent large household appliances and Personal Computer.

Monitors and Laptop represent IT and Telecom, while Television represents consumer equipment. Each of the electronic waste are grouped in twenty six common components, which could be found in them. The constituents form the “Building Blocks” of each item and are readily “identifiable” and “removable”. The constituents are metal, motor/ compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, BFR-containing plastic, batteries, external electric cables, refractory ceramic fibers, radioactive substances and electrolyte capacitors (Meena, 2008).

i. Dangerous constituent are refractory ceramic fibers, electrolyte capacitors (over L/D 25 mm), without and magnetron item.

ii. Plastic, circuit board and external electric cables are present in majority of items. BFR containing plastic is present in refrigerators, laptops and televisions.

iii. Refrigerators are unique items because it has CFC/HCFC/HFC/HC, cooling, insulation, incandescent lamp and compressor.

iv. Heating element is found in washing machine, while thermostat is found in both refrigerator and washing machine.

v. Fluorescent lamp is found only in laptop

vi. Metal and motor are found in majority of items except refrigerator

vii. Transformer is not found in washing machine and refrigerator

viii. CRT is found in personal computer and TV, while LCD is found in PC and TV

ix. Batteries are found in PC and laptop

x. Concrete is found in washing machine

xi. Rubber is found in refrigerator and washing machine

xii. Wiring/ Electrical is found in all the items

Large household appliance (refrigerator) may consist of electric motor, a circuit board, a transformer, capacitor, thermal insulation, switches, wiring, plastic casing that contain flame retardants and so on. A typical washing machine may consist of the metal casing, concrete ballast, inner and outer drums, a motor, a pump, washing cycle controller unit, switches and other components. The latest trends in these appliances is the phase out of the use of ODS and improvement of energy efficiency. Old washing machines are likely to contain large capacitors, while in relatively new machines, variable speed motors are controlled from the circuit board. IT and Telecom equipment sector is observing a trend of "micro miniaturization", while CRTs are being replaced by LCD screens. The range of various articles found in electronic waste is diverse classifying it a waste of complex nature. However, it shows that electronic waste from these items can be pulled apart into relatively small number of common composition for further treatments. The composition and hazard content of each of these components is being described in following section to establish the overall hazardousness of each item of electronic waste (Meena, 2008).

E-waste involves waste from electronic and electrical items at their end- of- life period nor fit for their original intended use, predetermined for recovery, recycling or

disposal. It involves computers accessories: monitors, printers, keyboards, central processing units; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other domestic articles (Agnihotri, 2011). The existence of components such as lead, mercury, arsenic, cadmium, selenium, hexavalent chromium, and flame retardants beyond threshold quantities make electronic waste hazardous to nature. It contains over 1000 distinct substances, majority of them are dangerous and creates serious pollution upon disposal. Out dated computers create the most significant environmental and health threat on electrical and electronic wastes (Agnihotri, 2011).

According to United Nations Environmental Programmes (UNEP), (2007), indicated three constituents of electrical and electronic waste management.

I. WEEE/E-waste collection, sorting and transportation system

II. WEEE/E-waste treatment system

III. WEEE/E-waste disposal system.

I. WEEE/E-waste collection, sorting and transportation

Electrical and electronic waste collection process consists of producer/retailer take back, municipal and recycler's / dismantler's collection systems. Since electrical and electronic waste is dangerous in nature, it is collected, sorted, stored and transported under controlled conditions. Each of the agencies has its own electrical and electronic waste collection and storage centres. The collection means will vary, following distances, rural or urban patterns, and the size of collected appliances. Several groups will require specific collection routes like flatbed collection (for fridges and other reusable household appliances). An efficient electrical and electronic waste collection and transportation system will ensure reuse, recycle and adequate electrical and electronic waste management including avoiding damage or breaking components that contain dangerous substances. The major factors, which determine the efficiency of collection system, are given below. Accessible and efficient collection facilities ensure minimal movements of products minimize manual handling aim to remove dangerous substances separate reusable appliances adequate and consistent information to the users (UNEP, 2007).

II. WEEE/E-waste treatment system

The major electrical and electronic waste treatment systems are decontamination and disassembly or repair followed by shredding of different fractions. Electrical and electronic waste fractions emitted after shredding go for metal recovery. The remaining of electrical and electronic waste portions are disposed of either in landfills or incinerated (UNEP, 2007). The electrical and electronic waste treatment options include the following unit operations.

A) Decontamination/ Dismantling: Decontamination/ Dismantling is done manually. It includes the following steps:

(i) Removal of parts containing hazardous substances (CFCs, Hg switches, PCB).

(ii) Removal of easily accessible parts containing valuable substances (cable containing copper, steel, iron, precious metal containing parts, for instance, contacts)

(iii) Segregation of hazardous substance and removal of easily accessible parts

B) Segregation of ferrous metal, non-ferrous metal and plastic: This separation is generally carried out after shredding and followed by mechanical and magnetic separation process.

C) Recycling of valuable materials: electrical and electronic waste fractions after segregation consisting of ferrous and non-ferrous metals are further treated. Ferrous metals are smelted in electrical arc furnaces, non-ferrous metals and precious metals are smelted in smelting plants.

D) Treatment/disposal of dangerous materials and waste. Shredder light fraction is disposed of in landfill sites or sometimes incinerated, CFCs are treated thermally, Poly Chlorinated Biphenyl (PCB) is incinerated or disposed of in underground storages, Mercury (Hg) is often recycled or disposed of in underground landfill sites (UNEP, 2007).

III. Electrical and electronic waste disposal system

The existence of hazardous components in e-waste offers the possibility of increasing the intensity of their discharge in environment due to land filling and incineration. The possible treatment dumping options based on the composition are given below:

i. Land filling
ii. Incineration

1. Land filling

Landfills are very difficult and run over a wide time span. At present it is not possible to quantify environmental impacts from E-waste in landfills for the following reasons:

i. Landfills contain mixtures of various waste streams;
ii. Emission of pollutants from landfills can be delayed for many years;
iii. According to climatic conditions and technologies applied in landfills (For instance, leachate collection and treatment, impermeable bottom layers, gas collection), data on the concentration of substances in leachate and landfill gas from municipal waste landfill sites differ with a factor 2-3.

One of the studies on landfills reports that the environmental risks from land filling of electronic waste cannot be ignored because the conditions in a landfill site are different from a native soil, specifically concerning the leaching behaviour of metals. In addition it is known that cadmium and mercury are emitted in diffuse form or via the landfill gas combustion plant. Although the risks cannot be estimated and traced back to e-waste, land filling does not appear to be an environmentally sound treatment method for substances, which are volatile and not biologically degradable (Cd, Hg, CFC), persistent (PCB) or with unknown behaviour in a landfill site. As a consequence of the complex material mixture in electronic waste, it is not possible to exclude environmental (long-term) risks even in secured land filling (Meena, 2008).

2. Incineration

The benefit of incineration of electronic waste is the reduction of waste volume and the utilization of the energy content of combustible materials. Some plants eliminate iron from the slag for recycling. By incineration some environmentally dangerous organic substances are converted into less dangerous compounds. Disadvantage of incineration are the emission to air of constituents escaping flue gas cleaning and the large amount of residues from gas cleaning and combustion. There is no available research study or comparable data, which indicates the effect of electronic waste emissions into the total performance of municipal waste incineration plants. Waste incineration plants influence

significantly to the annual emissions of cadmium and mercury. In addition, heavy metals not emitted into the atmosphere are transferred to slag and exhaust gas residues and can re-enter the environment on disposal. Therefore, electronic waste incineration will increase these emissions, if no reduction measures like removal of heavy metals from are taken (Meena, 2008).

(d) Concept of e-waste management

i. Meaning of e-waste management

E-waste management can be referred to as a designed system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of electronic waste in a sanitary, aesthetically, acceptable and economic manner. The word waste management in this context is conceptualized as the care in manipulation, treatment, use or control of electronic waste in an acceptable, aesthetically and economic manner (Audu, 2013).

Ruediger and Federico (2013) noted that electrical and electronic waste is commonly considered as a waste problem, which can cause environmental damage and human health if not safely. According to Adediran and Abdulkarim (2012), electronic waste management has become a topical issue; particularly because such waste now easily find their way into developing countries where they are carelessly and uncontrollably dumped in landfills. It is increasingly causing concern all over the world because of its dangerous effects on humans, and the environment if not properly disposed of. Essentially, everyone is a stakeholder in the generation of e-waste as consumer, seller, producer, importer and so on. Therefore, effective management of electrical and electronic waste worries everyone who must play their role so as to make the environment safe and healthy. The NSREA intervention in Nigeria is therefore a welcome development.

For effective electronic and electrical waste management, there is a requirement to quantify and characterize this waste stream, identify major waste generators, and evaluate the risks involved. A scientific, safe and environmentally sound management system, including policies and technologies, needs to be improved and implemented. Electronic and electrical waste is a complex mixture of hazardous and non-hazardous

waste, which comprised items of economic value. Therefore, it requires specialized segregation, collection, transportation, treatment and disposal (UNEP, 2007).

Majority of electronic waste constituents consist of appliances which use electricity which have reached the end of their life tenure. The articles include computers, refrigerators and other forms of consumer electronics. Many of such appliances retain some value even when they are discarded and may also be inimical to health due to the various components of which they are made of. Many computers, LCD screens, cooling appliances, mobile phones may consist of precious metals, plastics with brominated flame retardant, chlorofluorocarbons (CFC) foam and other materials. Thus, e-waste management consists of the effective recovery of all reusable materials from electrical and electronic for the safe disposal of the hazardous substances in them so as to prevent their pollution of the environment (Adediran and Abdulkarim, 2012).

ii. Methods of E-waste Management

Normally in waste management, waste materials are collected, transported, disposed, processed and recycled with the aim of reducing their negative impacts on health, the environment or aesthetics. It is also carried out so as to recover resources from it. Some of the methods used in handling e-waste include the following:

i. Disposal to Landfill

In this method, which is one of the most widely used methods of waste disposal, e-waste is buried. Mining voids or borrow pits can be used in land filling. However, this has the disadvantages of uncontrolled fires which can release toxic fumes and also that toxic constituents of electronic waste may pollute ground water and the environment.

ii. Incineration

Here, the waste materials are burnt in incinerators at high temperatures. When e-waste is incinerated, there is a reduction in the waste volume and the energy content of combustible materials can be utilised. However, this method results in pollution, more so because most electrical and electronic wastes contain some quantities of lead-tin solders and therefore should not be encouraged.

iii. Re-use Methods

In this method the original equipment is put into second hand use or use after modifications. This method equally has an advantage of reducing the volume of electrical and electronic waste generation.

iv. Avoidance and Reduction Methods

Waste reduction comprises the prevention of electronic waste from being created. This method is good in waste management because it is only when waste is generated that it has associated waste management costs. Moreover, it helps in resources conservation.

v. Extended Producer Responsibility (EPR)

Usually producers push the responsibility for the end-of-life product management to the general public. However, this method places it appropriately on the shoulders of the producers and all entities involved in the product chain. With this in mind, product designers are challenged to ensure that at every stage of products lifecycle, there is minimisation of effect on human health and the environment.

vi. Legislation

The issue of electronic waste has sparked off a number of initiatives around the world with the aim of promoting the reuse of electronic devices and mandating manufacturers to use safer substances in their products. For instance, in some states in the USA developed policies banning cathode ray tubes from landfills due to the fear that the heavy metals contained in them would contaminate ground water. Also in Europe, legislation has been drafted to deal with the problem.

vii. Export of electronic devices to developing countries

Some developed countries have adopted a method of exporting e-waste to developing countries like China, India and Nigeria under the guise of sale or donation of second hand electronics. The countries have progressively become their e-waste dump sites extensions. The exporting countries carry out their illegal business because they see it as less expensive than normal disposal.

viii. Recycling

The best method of e-waste management is to recycle the equipment. Recycling is the process of extracting resources of value from e-waste. Here the equipment is

disassembled and the valuable components are recovered and are used for manufacturing new products.

Electronic and electrical waste management in developing countries

Most developing countries on the contrary fall short of a solid waste management system that minds the problems and hazards of poor e-waste handling. According to Mundada, Kumar and Shekdar (2004) majority of developing countries do not have both the essential infrastructures and effective legislation to avert the hazards that emerge from poor e-waste management. Rather, the prominent method of e-waste handling in developing countries involve low-end treatment methods such as backyard recycling, open dump disposal, disposal in water bodies and open burning (Furter, 2004). These in most cases stem from the lack of recycling and recovery infrastructures.

The overall level of research work and scientific understandings about electronic waste handling and management is low in developing countries. Nnorom and Osibanjo (2008) indicated that South Africa is the only country to have a well-established e-waste recycling data registration system in Africa and the availability of such data in all the rest countries is scarce. As limited the understanding in these countries as it is, the main problem remain a less progressive action to implement the available research outputs. Basically, the electronic waste stream in developing countries originate from two distinct sources; local generation and importation of second hand electronic materials from the developed nations in the name of 'bridging the digital divide'. Specifically, the latter is adding much to the existing challenge of electronic waste management developing nations since much of this imported second hand electronic materials soon reach the height of their designed service life and get discarded. In some cases, these imported second hand electronics are totally dysfunctional. For example, BAN (2005) noticed that about 25-75% of the imported second hand computers to Nigeria are unusable junk. The setting up an effective and sustainable e-waste management systems in developing countries yet seem far-flung.

iii. Importance of good e-waste management

1. Recycling Benefit

In the same vein, electronics can include constituents that are important for recovery. A mobile phone, for example, can contain more than 40 elements, which include base metals like copper, special metals such as cobalt, and precious metals such as gold that are desirable for recycling. Valuable and special metals such as platinum, indium, and ruthenium that are used widely in modern electronics are naturally available in limited amounts. At the same amount of material, such as copper, necessary for any one mobile phone is miniscule, when six billion global mobile-cellular subscriptions are considered (ITU, 2014).

It is obvious that electronic products are a major driver for the demand of certain metals. This demand is unlikely to subside. Recycling metals contained in electronic goods may reduce the need for mining virgin materials. However, many of these valuable resources are lost every day due to low electronic waste collection rates and inadequate recycling or low-efficiency end processing for EEE. It is estimated that only 25 percent of valuable metals are recovered during informal electronic waste recycling (UNEP 2008).

iv. Involvement of stakeholders in e-waste management

The process of generation of electrical and electronic waste involves a number of stakeholders. Often in the case of the television, personal computers and a host of others; the consumers discard their old items for the sake of latest version, features and options to meet their present need. In India, the EEE may find more than one user, as the first user may resale or give the used EEE to their relation or friend for further use in case of domestic use. UNEP (2009) recognized three levels of electrical and electronic waste generation hierarchy in India; which give rise to three types of stakeholders involved in the generation of e-waste. All the stakeholders in developing countries operate at three levels of electronic waste generation hierarchy described below.

1. First level: Preliminary E-waste generators.
2. Second level: Secondary E-waste generators.
3. Third level: Tertiary E-waste generators.

The input to preliminary electrical and electronic waste generator comes from formal organized market like manufacturers, importers, offices and organized markets, where e-waste from domestic consumers comes either in exchange schemes or as a discarded item. Consequently, the major stakeholders are scrap dealers/dismantlers who purchase e-waste from the first level in bulk quantities. These stakeholders have limited capacity of dismantling and are involved in trading of e-waste with secondary e-waste generators. The market between first and second level is semiformal, that is, part formal, while the market between second and third level is completely informal.

Stakeholders falling under secondary electrical and electronic generators have limited financial capacity and are involved in item/component wise dismantling process and segregation. Instance, dismantling of CRT, PCB, plastic and glass from E-waste. "Tertiary level stakeholders" are the major stakeholders between second and third level and are metal extractors, plastic extractors and electronic item extractors. The extractors use extraction process, which are hazardous in nature. Uncontrolled emissions are discharged in air and water during recycling, while the remaining WEEE/E-waste fractions after recycling are dumped in open dump sites (UNEP, 2009).

According to UNEP (2009), some of the major stakeholders recognized along the flow include importers, producers manufacturers, retailers (businesses/ government/ others), consumers (individual households, businesses, government and others), traders, scrap dealers, dissemblers/dismantlers, smelters and recyclers. Along the flow, later electrical and electronic waste becomes generated in at each and every level. In the context of India, the last three stakeholders in e-waste trade value chain consisting of electronic waste processing, production / end article and a part of e-waste generation fall entirely in the informal sector. The remaining stakeholders fall somewhat or completely in formal sector. However, the scenario is changing with the evolution of formal e-waste recycling units in the country. The various stakeholders included in the e-waste generation are described as follow:

Manufacturers and Retailers

The electrical and electronic waste produced by the manufacturers and retailers include the products that fail quality tests. It also includes the products that are under the guarantee period as replacement items. The fringe electronic and electrical items

produced during the manufacturing of EEE add up as the e-waste stream produced by manufacturer or retailer. For instance, in the case of computers, e-waste generated from this sector comprises defective IC chips, motherboards, CRTs, other peripheral items produced during the production process (UNEP, 2009).

Imports

Importation of electrical and electronic waste by some of the developing countries like China and India is a major concern. Over the last few decades, India has become a major destination for electrical and electronic waste exports from the developed nations. Huge quantities of e-waste like keyboards, monitors, printers, projectors, CPUs, typewriters, mobile phones, PVC wires and so on are imported to India from OECD countries in the names of charitable or reusable items.

IT Industries

It is a globally acceptable fact that IT companies are one of the largest generators of electrical and electronic waste. Industries that provide IT services exclusively depend on the working of ICT and hence a large number of ICT equipment are in function in these industries. The hard products are very regularly replaced in this sector because of the introduction of newer and adapted versioned software every few months as the company always prefers the latest software version. In most cases, old hard products are not compatible with new soft products. The average life of computers in the IT giants was found to be four to five years. Therefore, it could be deduced that the generation of electronic waste in this sector is huge.

India is rapidly emerging as an IT hub of the world. Looking at the potential of India to be grown as an IT hub, large number of global IT giants has created their branches in the country. Most of such giants are still coming to the country. Cities like Bangalore, Pune and Hyderabad are the upcoming. Considering the advent of IT industries, the pile of electronic waste is growing at an alarming rate. However, till date, the management of electronic waste in the country is rudimentary. No proper management measures are considered to address the ever increasing volume of e-waste. India has the potential to soon become the electronic waste hub of the world.

Public and Private Sector, Government Departments, Corporate and Business Establishments

The business sector was the earliest users of IT and IT products and today they account for a sizable amount of total installed ICT equipment. The field study carried out in the banking sector in Pune shows that with the computerized banking system all across the country, today, the banks need to convincingly set up a large numbers of computers in their branches. Comparable to the IT sector, the incompatibility of old systems to cater for the present needs and requirements, prompts them to pass the outdate electrical and electronic equipment to dismantlers/recyclers, who pick up these items based on auction or other standard business practices (UNEP, 2007).

Educational Institution

Starting from the kindergarten to the university level, the use of ICT equipment is ever present across the country. The study conducted in the about sixteen educational institutions in Pune revealed the significant use of computers. The usage of computers in this sector is uprising at a rapid pace (UNEP, 2007).

Individual households

Individual households contribute the least e-waste generation, being only 20% of the overall market. However, it is on an increasing trend today. The field study in Pune reveals that in the middle to high income group societies, the amount of electronic waste generated is rising rapidly. People are enticed to the EEEs with new and modified feature. With the attractive and smart discount and exchange offers in the major Indian cities, people are obtaining more EEEs. Moreover, a tenacious view of electronic waste as a commodity causes reluctance among people to dispose of e-waste instantly (Sinha, 2011).

Traders/scrap dealers/dissemblers/dismantlers

These are very important agents in relation to e-waste. Most of the stakeholders here operate as a part of the informal sector. Hence, the amount of e-waste processed by them is extremely tricky to measure. These stakeholders are responsible for treatment of e-waste received from other stakeholders like importers, producers or manufacturers, retailers, consumers like individual households, businesses, government and so on. The scrap dealers in India are responsible for collecting the electronic waste. Immediately after securing e-waste from various sources, scrap dealers decide which item ought to be

dismantled and which to be retained for resale. This resolution is based on the resale of used articles. The not-to-be-resold electronic waste item/components find their way to the store houses for dismantling. Rather than producing electronic waste, these stakeholders are responsible for recycling and treating the existing. E-waste generated by other stakeholders. E-waste made by these stakeholders includes all the peripheral electronic and electrical constituents created during dissembling and dismantling activities.

Recyclers/smelters

Recycling activity is a major concern for the developing countries including India as most of such activities are involved in the informal sector with a lot of potential for environmental and occupational health hazards. Normally, these stakeholders are not concentrated in a single place, but spread over diverse areas, each handling a different aspect of recycling. The general practices viewed in case of recycling in developing countries are open roasting, smelting and acid bath in informal sector to recover different metals. These stakeholders play important role in managing the electronic waste and have negligible role in the creation of electronic waste. The electronic waste generated includes peripheral electronic and electrical components produced during the recycling operations.

Media

The media`s voice sounds louder than normal. This group ensures that the other stakeholders, specifically, the general public is aware of the things going on in their environment. Moreover, they exercise the power to influence the public. Such media include the radio stations, newspapers, social media, television stations and magazine providers.

Non- Governmental Organization (NGO)

Non- Governmental Organization is a legally constituted organization established by person or groups of persons, which operates independently outside a government but must be registered with a government. An NGO means a non-profit organization. This status helps them to be critical in their decisions and judgments, without any bias. In waste management in Nigeria, they play active role such as supporting the municipality in collection of waste and place them in collection points. Also, they are engaged in cleaning, beautifying and keeping the surrounding healthy. Moreover, they also provide

awareness, education and support programs in waste management to communities. Further, they occasionally are involved in recycling process

Competitors

This is cribbed as one selling or buying goods or services in the same market as another. Competition in business environment is inevitable as the players contest for both resources and market share. Such attribute defines the strength and credibility of a company in a particular market. Competition is described in four main forms, which are pure competition, monopoly, monopolistic and oligopoly. Pure competition is described as a market characterized by a large number of independent seller of standardized products or provider of standardized service. In this form of competition, there is low entry barrier, free flow of information, no central dominant business and low exit barrier. Hence each seller or provider is a price taker, rather than a price maker.

Competition in management of e-waste is based on factors such as the market size, and the levels existing in the management process. In the collection and transporting, the competition can be pure competition due to the low degree of professionalism, skills and capital needed in such business. However, in the recycling for precious materials, the competition can either be monopoly, slight monopolistic or oligopoly. It could be attributed to greater need for capital, human resources, skills, capacity, capability, consumer reach and technology.

(e) Impact of e-waste management on health and environmental

i. Health impact of E-waste

Alake and Ighalo (2012) revealed that electronic waste has many dangerous and dangerous substances/materials which are sources of environmental pollution and contamination of groundwater, surface water, air and soil. The risk from e-waste affects the entire ecosystems and it is a major environmental health risk to wildlife and humans (Terada, 2012). E-waste comprise the generated wastes from used electronic gadgets and house hold articles which are not fit for their original intended use and are predestined for recovery, recycling or disposal. These wastes encompass wide range of electrical and electronic devices such as personal stereos, computers, hand held cellular phones, involving large household, air conditioners, appliances such as refrigerators, and so on. E-wastes contain over 1000 different constituents many of which are dangerous and

potentially dangerous to environment and human health, if these are not handled in an environmentally sound manner (Meena, 2008).

In recent times, the problems associated with electronic waste have been recognized. E-waste is highly complex to handle due to its composition. It is made up of multiple components some of which contain dangerous substances that have adverse influence on human health and environment if not handled properly. Often, these challenges arise out of improper recycling and disposing methods. It stressed the need for suitable technology for handling and disposal of these chemicals (Agnihotri, 2011).

Agnihotri (2011) further posited that waste from electronic manufactured article include toxic constituents such as cadmium and lead in the circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and PVC cable insulation that releases highly toxic dioxins and furans when burned to retrieve copper from the wires. Most of these constituents are toxic and carcinogenic. The materials are complex and have been found to be difficult to recycle in an ecologically bearable manner in developed countries.

It was found that almost sixty chemical elements can be found in various complex electronics, including lead, cadmium, chromium, mercury, copper, manganese, nickel, arsenic, zinc, iron, and aluminium, many of which are possibly, hazardous. In most developing nations, handling and disposal of discarded EEE is normally unregulated. Safety concerns arise due to the fact that e-waste also contains dangerous constituents such as lead, mercury and chromium, certain chemicals in plastics, and flame retardants. Documentation is increasing about health effects related to pollution in air soil, and water for people working and living at or near informal e-waste processing sites. The observed adverse health effects and increasing number of e-waste sites, make protecting human health and the environment from e-waste contamination an expanding challenge.

Electronic waste exposure is a complex process because there are many routes and sources, different exposure time periods and possible inhibitory, synergistic or additive impact of chemicals. Exposure irregularity may come from the type and amount

of electronic waste, length of processing history at sites, techniques and locations of processing activities and physiological vulnerability, especially in pregnant women and children. Although, the extent to which contamination from e-waste contributes to adverse health effects is not known, which is believed to be a significant factor in or near communities where informal recycling takes place (Grant et al, 2013).

Related works carried out in China and India indicates that dangerous materials from e-waste can extend beyond processing sites and into ecosystems. People are exposed to hazardous substances in e-waste through multiple routes, including water, air, soil, dust, and food. Cumulative exposures are predictably high where informal recycling sites have operated for more than decades. For instance, rice and dust samples gathered from homes close to electronic waste sites had concentrations of lead, cadmium and copper were nearly twice the maximum permissible concentrations. An exposure of infected food such as rice combined with inhaling lead through house dust puts children at high risk for neurotoxicity and unfavourable developmental effects (Zhang et al. 2013).

As a result of the frequent interaction of children with the environment, they have high tendencies to be exposed to a lot of toxicants than any other category of people. An essential exposure source of such is toxicants is nutrition. Grant et al (2013) revealed that regular bad behaviour in children can increase exposure to chemicals from dust or play items. Substances can accrue in children's bodies because their immature systems are unable to process and excrete some toxic materials effectually. Breast feeding at electronic waste sites suggests elevated exposure to toxicants, such as dioxin, compared with milk from mothers at a reference site. In the event that the exposure is direct or indirect, the health and environmental effects from many of the individual hazardous substances often found in electronic wastes are well confirmed from existing studies, including studies in children.

A published review of e-waste and child health included residential and occupational exposures, specific chemical and physical hazards, recent research advances, and methodologies used in exposure assessment, Empirical findings validated that serum in children and pregnant women comprise many contaminants found in e-waste. The review deduced that health consequences arise from electronic waste exposure are plausible, and may include changes in thyroid function, altered cellular expression

and function, adverse neonatal outcomes, cognitive and behavioural changes and reduced lung function (Michelle et al., 2015).

The developmental neurotoxicants are seen in electronic -waste, such as lead, mercury, cadmium, and brominated flame retardants, which can lead to irreversible cognitive deficits in children and behavioural and motor skill dysfunction across the lifespan. Youths might directly encounter poisonous substances in fumes or dust through inhalation, skin contact, or oral intake through dismantling activities they perform themselves or that are performed by others nearby. Exposures that are not direct paths for children, as well as highly susceptible fetuses, also include polluted air and drinking water. Variation in exposure among children also depends on parental engagement at processing sites, either in or away from the home, and the daily activities of the child. The health of most people, with particular concern for children, is harmed by the contamination resulting from electronic waste. Dangerous substances move from discarded EEE across the environment where people are exposed through air, water, soil, and even the food they eat. Thus, the threat of adverse environmental health is immediate in many places that accept and informally handled e-waste (Chen et al. 2011, Grant et al. 2013; Heacock et al, 2015).

Shashi and Arun (2014) revealed that a cell phone can contain more than 40 elements e-waste is more dangerous than many other municipal wastes because electronic gadgets can contain thousands of constituents made of potentially toxic chemicals such as lead, cadmium, chromium, mercury, beryllium, antimony, polyvinyl chlorides (PVC), brominated flame retardants, and phthalates. Exposure for long period to these compounds usually affects the nervous system, kidneys, bones, and reproductive and endocrine systems. Pregnant women who grew up in a recycling site would have an even longer exposure history and higher body burden in physiologic deposits (For example, bones and adipose tissues) than women who moved to an e-waste recycling site at the time of marriage. The developing fetus and child are specifically vulnerable to several known and suspected developmental neurotoxicants in electronic waste. Infants and children can be exposed to these neuro toxicants from contaminated indoor and outdoor air, water, and soil. If the food and drinking water also come from contaminated community wells, the exposure to toxic constituents will aggregate to advanced level.

Neuro developmental deficits are serious concerns when evaluating exposure to e-waste toxicants because children living in electronic waste recycling communities may have been exposed to high- levels of toxicant mixtures during their lifetime. Also, the toxicant body-load can be higher with infants and young children because they have relatively low body weight. Developing fetuses and young children are at serious windows of neuronal growth, distinct, migration, synaptogenesis, and myelination, which can increase the toxic effects of exposure. Disruption of these fine-tuned processes in human neurodevelopment can have harmful effects (Dietrich, 2010).

ii. Environmental Impact of E-waste Management

It has been established that the discouraging effects of electronic waste in developed nation and growing concern in developing nations, most especially those that serve as global dump ground. Hence, Nigeria as a member of the global dump ground for electronic waste has a growing concern on the effects of e-waste to both the environment, public health and the economy at large. Electrical and electronic waste covers over 1000 substances. Some are valuable and others are toxic. Therefore, their treatment and disposal method necessitates appropriate mechanism and infrastructures. The act of using landfill and burning operate as a disposal management methods contributes immensely to environmental and public health problems. Uncontrolled and poorly managed dumping in the landfill can result to poisonous materials being leached into the soil and water bodies, thus polluting the soil and water bodies. In addition, burning can also leak damaging contents into the atmosphere, which can be inhaled by livestock and humans, or can dissolve in rainwater and is assimilated by plants (Nnaemeka, 2011).

It is absolutely important to know the negative impact of some of the material compositions in electrical and electronic appliances, in order to take proper precautions and measures for their management. Research has revealed that in most developing nations such as China, India, Pakistan and Nigeria where crude and unconventional means of WEEE are used, most of the workers in this area end up with perennial life threaten diseases and illnesses (Nnaemeka, 2011).

The dumping of electronic waste is a particular challenge faced in many regions across the globe. Environment and human health is affected by e-waste. E-waste takes up space in the communities it invades and can be very inimical to humans and animals. It is

of concern mainly due to the toxicity and carcinogenicity of some of the substances if they are not processed properly. Electrical and electronic waste is considerable more poisonous than many other municipal wastes because electronic gadgets comprise thousands of components made of deadly chemicals and metals like lead, cadmium, chromium, mercury, polyvinyl chlorides (PVC), brominated flame retardants, beryllium, antimony and phthalates. Long term exposure to these substances damages the nervous systems, kidney and bones, and the reproductive and endocrine systems, and some of them are carcinogenic and neurotoxic. Ancient recycling or disposal of e-waste to landfills and incinerators causes lasting environmental damage by polluting water and soil, and contaminating air. Employees and local residents are susceptible to dangerous chemicals through inhalation, dust ingestion, dermal exposure and oral intake. Inhalation and dust ingestion impose a range of possible occupational dangerous including silicosis (Prakash, Manhart, Amoyaw-Osei, and Agyekum, 2010; Nimpuno and Scruggs, 2011; Lepawsky and McNabb, 2010; Yu, Welford and Hills, 2006).

Some Specific Effects of E-waste

Lead

Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans (Naumann, Dick, Kern and Johann, 2011). The impact happening on the endocrine system has been detected and its serious negative effects on children's brain development are well documented. Lead accrues in the environment and has high acute and chronic impact on plants, animals and micro-organisms (Agency for Toxic Substances and Disease Registry, 2006). The core applications of lead in computers are: glass panels and gasket (frit) in computer monitors (3-8 pounds per monitor), and solder in printed circuit boards and other constituents.

Cadmium

Cadmium compounds are toxic with a possible risk of permanent effects on human health, and accumulate in the human body, particularly the kidneys (US Department of Labour, 2011). Cadmium occurs in certain constituents like SMD chip resistors, infra-red detectors, and semiconductor chips. Cadmium is also a plastics stabilizer and some older cathode ray tubes contain cadmium.

Mercury

Mercury is employed in the manufacture of parts of electronic gadgets such as thermostats, sensors, relays, switches commonly found on printed circuit boards, mobile phones and in batteries. As an alternative to cathode ray tubes, the use of mercury is likely to increase in flat panel displays. Mercury seriously affects vital organs of the body including damage to the brain, fetus and kidneys. Developing fetus is highly vulnerable via maternal exposure to the prevalence of mercury in the environment. This results in miscarriages. Mercury also affects water as inorganic compounds. It forms methylated compounds in bottom sediments of water. In addition, mercury easily accumulates in living organisms and concentrates through the food chain, particularly via fish. It is assessed that 22 % of the yearly world consumption of mercury is from electrical and electronic equipment (Naumann, Dick, Kern and Johann, 2011).

The plastics that include Poly-vinyl-chloride (PVC)

Plastics make up 13.8 pounds of an average computer. The largest volume of plastics (26%) used in electronics has been poly-vinyl-chloride (PVC). PVC is mostly present in computer and cable casings. In recent times, more manufacturers are making computer moldings with somewhat more benign ABS plastics. PVC is used for its fire-retardant properties; hence when burnt under a certain temperature, it produces dioxin compounds. Dioxins can persist in the environment for years; lodging into the air, land and food chain. Health danger from dioxin consumption includes infant birth defects, cancer, developmental disorders among children and sterility (Onwughara, Nnorom, Kanno and Chukwuma, 2010).

Brominated Flame Retardants (BFRs)

BFRs are commonly used in the manufacture of plastic casings of electronic gadget to prevent flammability. These are also present in the circuit boards. As a result of its toxic nature, BFRs have been banned from electronic devices in the EU. This instruction came into force in 2006 (European Parliament and the Council, 2003).

Barium

Barium is a soft silvery-white metal that is used in computers in the front panel of a CRT, to protect users from radiation. Studies have shown that short-term exposure to

barium has caused, muscle weakness, damage to the heart, liver, brain swelling and spleen (ATSDR, 2004). There is inadequate of data on the impacts of chronic barium exposures to humans. Animal studies however, reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time.

Beryllium

Beryllium is a steel-grey metal that is non-magnetic, a good conductor of electricity and heat and extremely lightweight. These properties make beryllium a preferred material for the manufacture of electronic applications like computers. In computers, beryllium is commonly found on mother-boards and "finger clips" as a copper beryllium alloy used to strengthen the tensile strength of connectors and tiny plugs while upholding electrical conductivity (Puckett, 2002). Beryllium has recently been classified as a human carcinogen as exposure to it can cause lung cancer (US Department of Labour, 2011).

The primary health concern is inhalation of beryllium dust, fume or mist. Workers who are constantly showed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (beryllicosis), a disease which primarily affects the lungs Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps (ATSDR, 2004). Studies have shown that individuals can still develop beryllium disease after many years following the last exposure (Puckett, Byster, Westervelt, Gutierrez, Davis, Hussain and Dutta, 2002).

Toners

The plastic printer cartridge especially those containing black and colour toners, is one of the most admired item of electronic waste. The black toner contains a pigment commonly referred to as carbon black. Carbon black is also a general term used to explain the commercial powder form of carbon. It may also be referred to as furnace black, acetylene black or thermal black. Infection occurs by inhalation; intense exposure may lead to respiratory tract itching.

Environmental impact of poor e-waste management

According to Onwughara, Nnorom, Kanno and Chukwuma (2010), individual exposure to lead from electronic gadgets is more challenging because of illegitimate recycling in cottage industries in developing countries that have little or no regulatory oversight. Without a well developed recycling and refurbishing program in developed countries, we can expect that health risks associated with outmoded electronic products will continue to be shifted from one part of the world to another. At present, the majority of electronic waste in Nigeria is processed in backyards or small workshop such as manual disassembly or open burning to recover metals and reduce the volume of waste. The remaining parts are disposed or stockpiled directly. The existing informal recycling and disposal of electronic waste in Nigeria have caused serious consequence to the surrounding environment and human health. Some of the toxic effects of the heavy metals from electronic wastes are:

1) **Lead:** which cause damage to the central and peripheral nervous systems, blood system, kidney and reproductive system in human. This lead is known neurotoxin (kills brain cells), and excessive blood lead levels in children have been connected to learning disabilities, attention deficit disorder (ADD), hyperactivity syndromes, and reduced intelligence and school achievement scores.
2) **Cadmium:** cadmium and its compounds are toxic, they can biaccumulate and pose a risk of irreversible affect human health. It causes kidney and liver dysfunction, brittle bones and adversely affects reproduction and survival.
3) **Mercury:** this can cause damage to various organs in the body such as brain and kidney; that the greatest risk for harm, even with only minute or short-term exposure, is to infants, young children and pregnant women.
4) **Hexavalent chromium:** breathing high levels of chromium (VI) can cause irritation to the nose, such as runny nose, nosebleeds and ulcers and holes in the nasal septum. Skin contact with chromium (VI) compounds can cause skin ulcers
5) **Silver and silver compounds:** can cause biological effects such as digestive tract irritation and agryria, which is depicted by a permanent blue-gray pigmentation of the skin, eyes, and mucous membranes.

6) Antimony and its compounds can cause severe digestive tract irritation with abdominal pain, nausea, vomiting and diarrhea.

7) Copper and copper compounds: can cause severe digestive tract irritation with abdominal pain, nausea, vomiting and diarrhea.

8) Additional harmful substances in WEEE can include arsenic, polychlorinated biphenyls (PCBs), chlorofluorocarbons (CFCs) and hydrochlorofluoro carbons (HCFCs) and nickel. These toxic chemicals, even when present in small amounts, could be potent pollutants and contribute to dangerous landfill leachate and vapours, such as vaporization of metallic and dimethylene mercury.

During burning of electronic waste, toxic chemicals such as dioxins and furans may be released to the environment; furthermore runoff water carries leachate (ash acidic + water = toxic water) into the sea and affect the aquatic life, also the ash leached into the soil which make ground water contamination. Examining the environmental influence of poor e-waste management, Gaidajis, Angelakoglou and Aktsoglou (2010) reported that the most of the e-waste is led to (sanitary) landfill sites. The application of the appropriate, in this case, TCLP (Toxicity Characteristic Leaching Procedure) test has showed that electronic waste discarded at urban waste dumping sites do not produce leachates with heavy metals concentrations exceeding the environmental limits. Nevertheless, this chemical cocktail generated as leachate following the TCLP test from diverse electronic items was toxic for aquatic organisms. Moreover, the usual management practice of electronic waste compression before or during discarding in landfills may increase the leachate volumes due to the disturbance of the several electronic circuit parts and, for that reason, it is proposed to perform cement solidification on e-waste that increases pH and decreases the aqueous solutions' flow in the waste discarded.

Burning before discard at landfill sites increases heavy metals mobility contained in circuits covered with a plastic grid and, for that reason, while not being bio available following wash-out, they are released to the atmosphere during burning. At the same time, electronic waste recycling comprises disassembling and destroying the individual parts to retrieve several materials. Through recycling, 95% of a computer's useful materials and 45% of a cathode ray tube's materials can be retrieved.

Recycling techniques have minimum environmental impact when combined with the application of appropriate technology, such as in Japan, while, on the contrary, when using the practices followed in developing countries (For instance, child labour, e-waste burning and emission of several pollutants to the air, leachate seepage in underground and surface aquifers and so on) the final environmental benefit- impact balance is not always positive. It must be pointed out that any environmental benefit from recycling vanishes when the waste to be recycled is transported to great distance due to the adverse environmental impact of the energy consumed for its transportation, while, recycling, in any case, has smaller ecological footprint than e-waste dumping and burning (Gaidajis, Angelakoglou and Aktsoglou, 2010).

In spite of the hazardous effects on humans, it is discovered that electronic waste leaches into the soil due to the presence of mercury, cadmium, lead and phosphorus in it. Electronic waste can also cause uncontrolled fire risk, leading to toxic fumes. More so, uncontrolled burning, disassembly and disposal of e-waste can cause a variety of environmental problems such as groundwater contamination, atmospheric pollution, and occupational and safety effects among individuals directly or indirectly involved in the processing of e-waste (Adediran and Abdulkarim, 2012).

Effects of E-Waste on humans:

Poisonous Substances	Typical Sources	Effects on Humans
Mercury	Fluorescent lamps, LCD monitor, switches, flat panel screens	Impairment of neurological development in fetuses and small children, tremours, emotional changes, cognition, motor function, insomnia, headaches, changes in nervous response, kidney effects, respiratory failures, death
Lead	CRT of TV, computer monitor, circuit boards	Probable human carcinogen, damage to brain and nervous systems, slow growth in children, hearing problems, blindness, diarrhea, cognition, behavioural changes (For instance, delinquent), physical disorder.
Chromium	Untreated and galvanized steel plates, decorator or hardener for steel housings	Asthmatic bronchitis, skin irritation, ulceration, respiratory irritation, perforated eardrums, kidney damage, liver damage, pulmonary congestion, oedema, epigastric pain, erosion and discolouration of the teeth, motor function
BFR	Plastic casings, circuit boards	May increase cancer risk to digestive and lymph systems, endocrine disorder
Cadmium	Light-sensitive resistors, as corrosion retardant, Ni-Cd battery	Inhalation due to proximity to hazardous dump can cause severe damage to the lungs, kidney damage, cognition

Source: **UNEP (2007a);**

(f) Socio-economic impact of e-waste management

Employment creation

The sector also impacts positively economically on the nearby communities. The sector creates jobs for near-by residents as they supply/sell food and water to the operators. Nearby residents may also be engaged as security for collected scraps and so on. Scrap dealers also pay rent for open spaces used for storage points. Nearby resident may be engaged in loading of e-scraps into trucks for transport to recyclers. The quality of jobs compared to local alternatives at the same level of education is fair. The number of jobs provided by the e-waste sector both formal and informal is substantial considering the level of unemployment in the each of the state inventorised. Working registered population at the dump sites at Olusosun, Odo iya alaro, Alaba rago is between 600-4000. These are low skilled workers, though few of them are educated but the level of education is low with about 10% being graduate especially the second hand dealer, while the formal sector should be between 10,000-20,000 at most.

UNEP (2013) on the economic impact of e-waste revealed that;

i. Load of used cell phones (6000 units) yields $15,000 in precious metals.
ii. Recycling aluminum from E-waste saves 90% of the energy necessary for mining new aluminum.
iii. Computer reuse creates 296 more jobs than disposal for every 10,000 tons of material disposed each year.

The social and economic effect of the used EEE and e-waste recycling formal and informal sector in Lagos were assessed. The official operators as well as informal workers and individuals of the (second-hand) EEE sector are partially organized in associations, which are existing in the large cities like Lagos and Kano. These associations are often used to resist pressure from government agencies to pay taxes or conform to set out rules. From the survey there is no indication of prerequisite formal education for the collecting and sorting of electronic wastes, but a sizeable number of graduates are in the business of repairing and refurbishing, while the recyclers also have no formal education. In spite of their limited formal education, all of the waste collectors and recyclers interviewed had very good ‘knowledge’ of the kind of wastes they were

interested in collecting and recycling (Manhart, et al. 2011; Olakitan, Innocent, Oladele and Mathias, 2012).

Based on the assessed cities, more than 70 % of the waste collectors were male, women are often involved as brokers paying the cash. All the collectors interviewed were single and 80 % are of the northern extraction from the rural areas up north. There is a community in Kano that has prides itself to be experts in scrap business. The wage structure is according to the waste volumes gathered or treated hence the motivation for most individuals is the economic returns/benefits, rather than environmental is their main motivation. There is no additional profit to wages given in return for volume/ weight of e-waste collected or treated.

Informal recycling also provides jobs and livelihood to mostly recent rural migrants who, possessing no special skills come to the city in search of the non-existent greener pastures. Between 144kg/week and 1985kg/week of e-waste mixed with other metal scraps is collected by a waste picker. The collected e-waste is co-mingled with other metal scrap. Up to 80000 persons (34000-80000) are involved in this sector in Nigeria. The main sources of collected materials are homes/dump sites, refurbishes, streets, importers. The waste picker sells to scrap dealers or vendors. A typical vendor gets N3000-N5000/week approximately (US$ 20-30) when he sells his scraps. Mobile phone repairers often require the customers to register by paying a certain fee before the phones are investigated for the faulty. This charge is usually not part of the repair charge. Revenue per refurbished EEE is between N1000-N3000 depending on the nature of the fault. In some cases when faulty components or modules are to be replaced the charge may be higher. An estimated 52000 persons are engaged in the refurbishing business in Nigeria (Olakitan, Innocent, Oladele and Mathias, 2012).

Almost 66-68% of electrical and electronic wastes are taking along to repairers and refurbishers shops are effectively repaired. Un-repairable EEE that are abandoned in the repairer's shops are disposed /sold between 6months to 3 years (mean 1 and a half years) of storage in the repairers shop. 12-25% of the repair dispose all e-waste generated in their operations with general waste. Others estimated at 66% store and sell the waste to collectors while the wastes that are not useful are disposed with general waste. The metal /steel sector and the plastic sectors of the country have been the main beneficiary of the

informal collection of scraps and recyclable items. The e-waste aspect is also becoming a profitable venture for those into exporting of the printed circuit board through the various informal channels of the downstream vendors across the land border (Olakitan, Innocent, Oladele and Mathias, 2012).

Economic Importance of E-waste

The electronic waste stream is a small portion of global municipal waste; it serves as significant employment role in the recycling sectors of some countries like India, Malaysia, China, Thailand, the Philippines, Vietnam, Pakistan, Ghana, and Nigeria. For example, in Guiyu, China, possibly the largest e-waste recycling location in the world, about 100,000 people are used as e-waste recyclers (Lundgren, 2012).

How to Minimize the Negative Impact of E-waste

Measurement to manage e-waste and its hazardous substances in an environmentally sound manner and without risks for human health are lacking in most developing and emerging countries. It is clear evidence that the practice of exploits women and child labourers who cook circuit boards, burn cables and submerge equipment in toxic acids to extract precious metals such as) and subjects them and their communities to damaged health and a degraded environment. The handling of non-dangerous wastes can cause significant harm to human health and the environment if not undertaken in an environmentally sound manner (Schmidt, 2006).

According to the International Labour Organization, an environmentally sound e-waste recycling chain contains the following steps:

i. Demanufacturing into subassemblies and components – this involves the manual disassembly of a device or component to recover value.
ii. Depollution – the removal and separation of certain materials to allow them to be handled separately to minimize impacts, including batteries, fluorescent lamps and cathode ray tubes (CRTs)
iii. Materials separation–manually separating and preparing material for further processing

iv. Mechanical processing of similar materials – this involves processing compatible plastic resins, metals or glass from CRTs to generate market-grade commodities

v. Mechanical processing of mixed materials – this involves processing whole units followed by a series of separation technologies

vi. Metal refining/smelting – after being sorted into components or into shredded streams, metals are sent to refiners or smelters. At this stage, thermal and chemical management processes are used to extract metals (Basel Convention, 2012 and Lundgren, 2012)

Olakitan, Innocent, Oladele and Mathias (2012) is of the opinion that domestically modified recycling technologies for Nigeria should make use of the abundant lab or force instead of deploying expensive shredding and sorting machinery. To ensure a maximum yield of valuable recycling fractions, Nigerian recyclers are inspired to interlink with international recycling companies and networks for developing market outlets for their pre-processed e-waste fractions for a maximized return of value for secondary raw materials. A sustainable electronic waste management system will also need an adequate financing scheme, a level playing field and appropriate market incentives. It is thought that similar to policies in OECD countries, an e-waste recycling system in Nigeria could be developed in line with the principle of extended producer responsibility.

Plans on how to reduce the negative impact of e-waste was further stated by Obaje (2013) who gave the following recommendations;

a) The entire interested parties (government, industry, environmental groups, and citizens) must work in cooperative collaboration with NESREA to effectively manage and mitigate the problems of e-waste in Nigeria.

b) Nigeria should immediately ratify the Bamako Convention and entrench stringent enforcement regime of the National Environmental (Electrical/Electronic Sector) Regulations 2011 and the Nigerian Decree of 1988 prohibiting all imports of hazardous wastes.

c) The “Extended Producer Responsibility Programme” to buy-back WEEE should be fully enforced internationally.

d) Producer companies should use non-toxic raw materials in the manufacture of EEE to reduce the production of e-waste.

e) Develop national database infrastructure on e-waste management in Nigeria.

f) Full enforcement of the proof of testing and categorization with respect to the Basel Convention on trans boundary movement and management of e-waste.

g) All members of the Organization for Economic Cooperation and Development (OECD) and the European Union countries should implement in full the Basel Convention.

h) The USA should be made to comply with OECD Council Decision regarding export of hazardous e-waste.

i) Ban all import of UEEE labeled for repair or refurbishing in developing countries.

j) All exporting countries should enforce control and ratify the Basel Convention in promotion of human and environmental justice and fairness to achieve a win-win scenario in bridging the digital divide.

k) Increase the tempo of the awareness campaigns in local and indigenous languages on the dangers of e-waste to human and environmental health.

l) Create incentives to encourage citizens to shun e-waste and willingness to release all e-waste in their possession.

m) Develop local capacity for the recovery of copper, steel, lead, silver, gold, platinum group metals, plastics, etc. from e-waste.

n) Develop national e-waste collection centres and e-waste management infrastructure in Nigeria.

(g) Flow of e-waste into Nigeria

Basel Action Network (BAN 2005) revealed that, about 500,000 used computers annually are imported into Nigeria through the Lagos port alone; About 25% of the imports are functional used electronics, while the remaining 75% is junk or unserviceable, which is all been eventually burnt dumped carelessly; A preliminary survey conducted in Lagos area after the BAN study revealed that the volume of imported electronic equipment were: Computer village (15 tons), Alaba International Market (100 tons), Oshodi Market (15 tons), Lawanson Market (30 tons) and West

Minister (40 tons); These figures have reduced drastically as a result of the steps taken to monitor the importation of used EEE into Nigeria. However, there are presently, no specific figures (Miranda, 2013)

Majority of the consumed electrical and electronic wastes are imported into Nigeria, while there are only some assembling companies. In 2010 import statistics indicate that the share between new and used EEE was about 50% that is 600,000 of new EEE and 600,000 of used EEE imported into Nigeria. However this data was gathered at a time when stronger enforcement by the Nigerian government made it less attractive to import used EEE. Hence it is thought that the share of used EEE imports could have been higher in the years before (that is, up to 70%). Approximately, 30% of second-hand imports were non-functioning (therefore need to be declared as e-waste): half of this amount was repaired locally and sold to consumers and the other half was un-repairable. In the case of Nigeria, this was at least 100,000 tonnes of e-waste entering the country illegally in 2010 (Olakitan, Innocent, Oladele and Mathias, 2012).

The bringing in of used electronic assumed an alarming dimension in the last ten years especially considering that un-reusable goods (wastes) destined for recycling are exported into Nigeria in the name of reuse. Besides the presence of a large highly educated and well trained but low waged informal sector technicians and engineers with an impressive ability to repairing and refurbishing of used electrical electronics equipment for local resale has fuelled the importation of used and out dated electrical and electronic equipment from developed countries primarily from Europe and North America for such refurbishing purpose in the interest of bridging the digital gap (Olakitan, Innocent, Oladele and Mathias, 2012).

Currently, three ships at different times laden with toxic products, otherwise known as e-wastes, reached the Lagos port and the Federal Government of Nigeria received an alert through a Dutch agency, VROM-Inspectorate and the International Network for Environmental Compliance and Enforcement (INECE) before the arrival of the ships. The ships which berthed at the Tin-can Port (Lagos), were detained on the orders of officials of the National Environmental Standards Regulations Enforcement Agency, NESREA and made to return with the e-waste at all the occasions (Olakitan, Innocent, Oladele and Mathias, 2012).

h. E-Waste in Nigeria

Olakitan, Innocent, Oladele and Mathias (2012) revealed that private households were the biggest consumers with an installed base of 6,400,000 tonnes of large and small household appliances, as well as IT, telecommunication, and consumer equipment. The installed base for institutional and corporate consumers was estimated at 400,000 tonnes, mainly constituting of IT and telecommunication equipment. All together approx. 1.1 Mio tonnes of EEE become obsolete each year. However only around 440,000 tonnes ends up as e-waste: the remaining volume is either stored at the consumer, or given a second life as donations and sales to repair and refurbishment shops.

As at 2010, it was estimated that the non-formal recycling sector collected and processed around 360,000 tonnes of e-waste 100,000 originating from the illegal e-waste imports and 160,000 from private households. Another 180,000 tonnes of WEEE was collected through communal collection via household waste, which sums up to 540,000 tonnes of e-waste being collected in one or the other way. This indicates a combined informal and formal collection efficiency of 75% for end-of-life equipment destined to be disposed of as waste, the remaining 25% being in storage at the consumer (Olakitan, Innocent, Oladele and Mathias, 2012).

In the same vein, the informal sector was recovering about 52% of the materials contained in the collected waste. This equals to approx. 280,000 tonnes, which were channelled further to the formal recycling industry and subsequently were sold to the inland or export market as secondary raw material. While ferrous metals, aluminium and copper have high recovery rates, precious metals and plastics are only recovered to some extent, and other materials are mostly lost through burning and dumping (Olakitan, Innocent, Oladele and Mathias, 2012).

(i) Policy and Legislation on E-waste in Nigeria

Electrical and electronic waste differs chemically and physically from urban or industrial waste. It contains both hazardous and valuable materials requiring special treatment and recycling practices to avoid adverse environmental effect and harmful impact on human health. Retrieving the valuable and base metals is possible by recycling e-waste, but the high labour cost and the strict environmental legislation have consolidated these activities' implementation mostly in Asian countries such as China

and India by use of obsolete methods and inadequate emphasis on the employees' protection . As a result, the e-waste disposal issue has attracted the interest of politicians, non-governmental organizations, such as Greenpeace, Basel Action Network , Silicon Valley Toxics Coalition and the scientific community (Gaidajis, Angelakoglou and Aktsoglou, 2010).

Policies at the International Level

From a scientific point of view, e-waste is no doubt a hazard to both environment and humans; socially speaking, it is plainly inhumane to introduce materials embedded in e-waste into communities just for the sake of making quick money and avoiding responsibilities. From a legal standpoint, however, the issue has become murky and is dependent on how seriously a government intends to deal with the hazards and its effects. Domestically, e-waste regulations exist among countries. Internationally, besides the Bamako Convention which is a treaty of African nations prohibiting the importation of any hazardous waste, the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal also known as BAN (Basel Action Network) seems to be the only internationally recognized body in charge of poisonous waste management.

The Basel Convention

The Basel Convention controls the trans boundary movement of dangerous wastes and their disposal, and is the most significant multilateral environmental agreement (MEA) in relation to tackling the issues surrounding e-waste and its management. As of September 2010, the Convention had 178 signatories (Herat and Agamuthu, 2012). On the other hand, the US, a major actor, has not ratified it. The Convention largely relates to trade measures, although it includes several non-trade measures. It presents four main aims related to the waste hierarchy of prevention, reduction, recovery and final disposal. Thus it attempts: first, to reduce hazardous waste generation at its source; second, to promote and ensure the environmentally sound management (ESM) of hazardous waste; third, to promote the proximity principle, advocating disposal as close to the source as possible; and fourth, to regulate and monitor the remaining trans-boundary movements of hazardous waste.

Basel Convention enacts a series of trade restrictions as set out by the aim of regulating and monitoring. Provided no outright ban on hazardous wastes has been implemented by the importing country, wastes may only be exported should the exporting state lack ESM capacity or should the wastes be destined for recycling and recovery operations. Should all these criteria be met, the hazardous waste shipment must undergo the prior informed consent (PIC) procedure. Under Article 6 of the Convention, this system requires exporters to notify the destination country, as well as any intermediary countries, of its intent to conduct trade in hazardous waste, through a notification of consent prior to the trans-boundary movement. The Basel Convention also provides for the development of tools and training activities through the Green Customs Initiative (GCI), to assist Parties to enforce the Convention and to combat illegal traffic. This initiative also involves the secretariats of the relevant MEAs with trade-related components involving hazardous chemicals and wastes.

The Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants (POP) was adopted in 2001 and entered into force in 2004. The Convention requires Parties to take measures to eliminate or reduce the release of POPs into the environment (Bell and McGillivray, 2013). E-waste contains many chemicals classified as POPs. The Convention aims to protect human health and the environment from chemicals that remain persistent in the environment for long periods, are distributed globally and accumulate in the fatty tissue of humans and animals. There are three identified categories of POPs: pesticides, industrial chemicals and unintentionally produced by-products.

Bamako Convention

The Bamako Convention on the Ban of the import into Africa and the Control of Trans boundary Movement and Management of Hazardous Wastes within Africa was signed in Bamako, Mali, in January 1991 and entered into force in 1998. This Convention aims to prohibit the import of all poisonous waste, for any reason, to Africa from non-contracting parties. Even parties which are not signatories to the Basel Convention are prohibited from exporting e-waste to Africa (Tutu, 2014).

The Convention was executed in order to impose a stronger message about trade in hazardous waste and management within Africa (Tutu, 2014.). However, enforcement remains a challenge because of the lack of adequate and predictable resources. Moreover, the extent to which the instrument has been streamlined within national legislation has not been formally documented and there is a need for stronger cross-border cooperation (Munyua, 2010). According to the African Union, in 2010, 24 of the 52 countries which form the African Union have ratified the Bamako Convention (Gaidajis, Angelakoglou and Aktsoglou, 2010).

Electrical and Electronic Equipment Directive

The WEEE Directive of the European Parliament and of the Council (2002) entered into force in 2003. The aim of the legislation is the prevention of e-waste generation, and to promote the reuse, recycling and other forms of recovery of such waste so as to reduce disposal. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment and, in particular, those operators directly included in the treatment of e-waste (Reck and Graedel, 2012). It is based on the principle of producer responsibility and promotes the green design and production of electronic products. It involves separate collection of e-waste, and the use of best available treatment, recovery and recycling techniques, and makes producers responsible for financing the take-back and management of e-waste (Dickenson, 2006). The global electrical and electronics industry has come under increasing pressure to adopt EPR policies because of the European Directives (Yu, Welford and Hills, 2006).

In spite of the huge legislation targeting the e-waste problem, experience in the first few years of implementation of the WEEE Directive has shown that it is facing difficulties. Less than half of the collected e-waste is presently treated and reported according to the Directive's requirements. The occurrences of loopholes and difficulties in enforcement have reduced the effectiveness of the EU legislation. It has been found that, of the vast majority of e-waste, 67 per cent is completely unaccounted for, being either landfilled or destined for illegal export to developing countries (Mittra, 2013).

In totality, the objective of the proposed directives is to develop a better regulatory environment-one that is simple, understandable, effective and enforceable

(Reck and Graedel, 2012). The EC adopted a directive in 2012 that, both improve the amount of e-waste which must be collected annually by member states and establishes producer responsibility. In addition, the scope of the legislation was widened so as to cover all e-waste in principle.

National Policies on E-waste in Nigeria

Nigeria has ratified the Basel Convention, the BAN Amendment and the Bamako Convention (Wanjiku, 2008). The National Environmental (Electrical Electronics Sector) Regulations and the Harmful Waste (Special Criminal Provisions) Act entered into force in 2011. The law restricts the import of hazardous wastes for final disposal in the country (Lagos State Environmental Protection Agency, 2011). In addition, a multi-stakeholder Consultative Committee on e-waste has been established to prepare national policy guidelines on e-waste management and an action plan. The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established in 2007 to enforce all environmental laws, regulations and guidelines, including monitoring and control of e-waste (Benebo, 2009). The National Toxic Dump Watch Programme (NTCWP) has recently been reactivated. It requires importers of e-waste to be registered with NESREA (Manhart, Osibanjo, Aderinto and Prakash, 2011).

Overall, control of e-waste in Nigeria is inadequate. There has been insufficient enforcement of environmental laws and difficulties in implementing EPR and producer take-back, together with a general lack of awareness and funds. With no material recovery facility for e-waste and/or appropriate solid waste management infrastructure in place, waste materials often end up in open dumps and unlined landfills (Wanjiku, 2008).

The National laws and regulations relating to e-waste control harmful waste (special criminal provisions) act cap I, 2004:

The Act prohibits;

i. The carrying, deposition and dumping of harmful waste on any land, territorial waters and matters relating there.
ii. Penalty imprisonment for any other thing used in the transportation or importation of the waste to the Federal Government of Nigeria.

iii. Where the offence is being committed by a corporate body through the negligence or consent of the principal officers of the company, the officer and the body corporate shall be punished accordingly (Miranda, 2013)

National Laws and Regulations Relating to E-waste Control II

The National Environmental (Sanitation and Waste Control) Regulation 2009 The Act provides that

i. No person is to engage in any activity likely to generate hazardous waste without permit by the Agency;
ii. A generator of waste shall ensure a secured means of storing such !
iii. Every person who generates hazardous waste shall cause such waste to be treated using acceptable methods;
iv. No person shall export or transit hazardous waste without permit by the Agency;
v. No person shall transit toxic waste destined for another country through the territory of Nigeria without prior informed consent of such movement by the Agency
vi. Any person who fails to comply with the above obligations shall be guilty of an offence punishable with a fine of N5,000,000 or imprisonment for five years or both (Miranda, 2013).

National Laws Relating to E-waste Control III

The following are the Guide for Importers of UEEE:

i. The Central Government of Nigeria allows the importation of new EEE and functional UEEE;
ii. Nigeria has banned the importation of WEEE and near end of life electrical/electronic equipment;
iii. Any WEEE imported into Nigeria shall be sent back to the country of origin; manegarial punitive fee shall be imposed on the carrier of WEEE or UEEE mixed with WEEE;
iv. Every carrier of UEEE shall be accompanied by:
v. Cargo Movement Requirement (CMR) document;
    a. Proof of evaluation/testing and certificate containing testing information on each item;

b. Declaration of the liability by the importer (Letter of Indemnity);
c. Copy of permit to import.

vi. Adopts the Polluter Pays Principle.

National Laws Relating to E-waste Control IV

The National Environmental (Electrical Electronic Sector) Regulations SI No 23 of 2011 The Regulation is based on life cycle approach and covers all aspects of the electrical/electronic sector from the cradle to the grave;

i. The principles are anchored on the 5Rs which are; Reduce, Repair, Reuse, Recycle and Recover as the primary drivers of the sector;
ii. Ensuring the habit of Environmentally Sound Management (ESM); and
iii. Delineating Stakeholders responsibilities and roles Activities that require permit under the regulation:
iv. Exporting or transiting of e-waste must be with a valid trans boundary movement permit issued from the Federal Ministry of Environment (Miranda, 2013).

National Laws Relating to E-waste Control V

Extended Producer Responsibility: The Role of Key Stakeholders!

All importers, exporters, manufacturers, assemblers, distributors, and retailers, of various brands of EEE products shall subscribe to an Extended Producers' Responsibility (EPR) Programing including the Buy Back:

i. The importers/distributors for all EEE equipment traded or institutions, public or body corporate by whatever means, shall comply with the EPR Program;
ii. Manufacturers and Importers of EEE shall partner with the Agency on the Extended Producers' Responsibility Program within two years of commencement of these Regulations in order to achieve the Buy Back Program within a period of two years (Miranda, 2013).

National Laws Relating to E-waste Control VI

Specific Provisions of the EEE Sector Regulations;

i. Importation of CRT is banned;
ii. Manufacturers, Importers, Distributors or Retailers are to take back the end of life EEE and collection points /centres;
iii. Ecologically Sound Management of e-waste from collection points or centres;

iv. Consumers are to return end of life EEE to the collection points or centres; and
v. All importers of new and/or used EEE are to pay an administrative cost to NESREA to promote Environmentally Sound Management of WEEE (Miranda, 2013).

Implementation of the Sector Regulations Progress Made Since Gem2

The Agency is still discussing with the Original Equipment Manufacturers (OEM-Dell, Hp, Phillips) and a UK based recycler on the execution of the provision of the Regulations on the Extended Producer Responsibility (EPR). The Recycler has submitted a Feasibility study to establish Facility which is currently being considered. Significant progress has been made to ensure that a reputable recycler of e-waste establishes a plant in the country to take care of the in-country generated e-waste (Miranda, 2013).

Implementation of the Sector Regulations II

Draft Guidelines for Implementation of EPR for the EEE Sector has recently been developed with the key items derived from the extant laws on hazardous waste;

Key definitions

Producer means importer, manufacturer, producer and assembler. Specifically, "Producer" includes any person who:

i. manufactures and sells EEE under his or her own brand;
ii. imports and resells EEE produced by other manufacturers;
iii. imports and resells EEE produced by other suppliers under his or her own brand;
iv. imports electrical and electronic equipment as a business; and
v. exports electrical and electronic equipment as a business, or distributes electrical and electronic equipment from a manufacturer.
vi. EEE Registry means the registered body/organization that maintains the register of producers/recyclers/waste organizations and inventory of WEEE/Ewaste nationwide (Miranda, 2013).

Implementation of the EEE Sector Regulations III

The draft guidelines also provide for the following:

i. Identification of Electrical and Electronic Equipment
ii. Criteria for registration and participation of producers

iii. National Criteria for WEEE Recycling including the Standards for various categories (Taiwan standard, stewards and the R2 were used as reference to develop this)
iv. Product Identification and Marking
v. Framework and Functions of the Registry requirement for importation of UEEE into Nigeria (Miranda, 2013).

The Regulatory Framework Related and Influencing E-waste

The Constitution of the Federal Republic of Nigeria (CFRN) of 1999 provides the general thrust of the nation's environmental policy through S.20 that provides; "the state shall protect and improve the environment and safeguard the water, air and land, forest and wildlife of Nigeria". Subsequently, subsidiary laws and regulations have been made and international conventions and other instruments entered into pursuant to the constitution's set objectives.

These include:

Laws and regulations, standards, policies, codes and recommended practices relating to the industry sector by the Nigerian Government and its Agencies such as the Federal Ministry of Environment, the National Environmental Standards and Regulatory Enforcement Agencies, and State's Ministry of Environment, Ministry of Physical Planning, and the Lagos State Environmental Protection Agency (LASEPA).guidelines and conventions to which Nigeria is a signatory. National policy on Environment (1989) and reviewed in 1999.

Federal regulatory bodies

The Federal Ministry of Environment (1999 Presidential Directive)

The Federal Environmental Protection Agency (FEPA) was established by Decree No. 58 of 1988 and subsequently amended by Decree 59 of 1992 with further amendment by Decree 14 of 1999. FEPA was absorbed into the Federal Ministry of Environment (FMENV) in 1999 by a presidential directive and its functions among others are now the responsibility of the new Ministry. Though the FEPA Act has now been repealed in the NESREA Act No. 25 of 2007, the Regulations pursuant to it are still valid in Regulatory terms (Olakitan, Innocent, Oladele and Mathias, 2012).

National Environmental Standards and Regulations Enforcement Agency (NESREA) Act No. 25 of 2007

The Agency, shall, subject to the provisions of this Act, have responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural re-sources in general and environmental technology, including coordination of environmental standards, regulations, rules, laws, policies and guidelines (Olakitan, Innocent, Oladele and Mathias, 2012).

State regulatory bodies

At the state levels in almost the 36 states of the federation, there are similar regulatory bodies responsible for the environment protection, physical planning, solid waste management and environmental enforcement (Olakitan, Innocent, Oladele and Mathias, 2012).

Environmental legislation in Lagos State

The challenge of environmental management and regulation is immense in a state that has a megacity such as Lagos. Over the years, legislation has evolved. With the enactment of the Environmental Pollution Control Edict, 1989 and the Lagos State Environmental Protection Agency, Edict 9 of 1997, the Environmental Sanitation Edict of 2002, the various rules and notifications, and the State Environment Policy, a credible legislative and policy base has been created.

The Lagos State Environmental Protection Agency, Edict 9 of 1997 in particular specified the responsibilities and functions of the Agency which include:

a) Advising the State Government on all environmental management policies.
b) Giving direction to the affairs of the Agency on all environmental matters.
c) Preparing periodic master plan to enhance capacity building of the Agency and for the environment and natural resources management.
d) Carrying out appropriate tests on insecticides, herbicides and other agricultural chemicals.
e) Carrying out public enlightenment and educate the general public on sound methods of environ-mental sanitation and management.
f) To monitor and control disposal of solids, gaseous and liquid wastes generated by both government and private facilities in the State.

g) Monitoring and controlling all forms of environmental degradation from agricultural, industrial and government operations.

h) Setting, monitoring and enforcing standards and guidelines on industrial effluent, air emissions (vehicular & stationary).

i) Surveying and monitoring surface, underground and potable water, air, land and soil environment in the State to determine pollution level in them and collect baseline data.

j) Promoting co-operation in environmental science and technologies with similar bodies in other contrives and international bodies connected with the protection of environment, and

k) Co-operation with the Federal, State and Local Governments, statutory bodies and research agencies on matters relating to environmental protection.

All the states in Nigeria have power to make laws with respect to the environment. This is because the subjects relating to the environment are contained in the Concurrent Legislative List. Other relevant States Statutory Laws, Regulations, Legislations and Guidelines related to industrial activities include the following.

i. Lagos State Environmental Law, 1994 as amended in 1997

ii. Lagos State Sanitation Edict, 2002

iii. The Lagos State Town and Country (Building)Plan Regulations Of 1986.

iv. Lagos State Urban and Regional Planning Board Law 1997

vi. Lagos State Urban and Development Regional Planning and Development Law Of 2005 (Olakitan, Innocent, Oladele and Mathias, 2012).

The Specific E-waste Management Legislation

There are Regulations which may be cited as the National Environmental (Electrical / Electronics Sector) Regulations S.I. No. 23, adopted in 2011:

The principal thrust of the regulations is to prevent and minimize pollution from all operations and ancillary activities of Electrical/ Electronic Sector to the Nigerian environment. The regulations are based on life cycle approach and shall cover all the aspects of the electrical/electronic sector from cradle to grave. Also the regulations are anchored on the 5Rs (‘Reduce, Repair, Recover, Recycle and Re-use,’) principle as the

primary drivers of the sector and shall encompass all the categories and lists of electrical/electronic equipment.

NESREA also developed a guide for importers of used EEE into Nigeria, which contains the guiding principles, requirements for import of used EEE, and the description of items that are not allowed to be imported to Nigeria. According to this guide, all importers of used EEE in Nigeria are required to register with NESREA (Olakitan, Innocent, Oladele and Mathias, 2012).

Regulating Electronic Waste

Some governments are getting involved in the problem by passing laws or advocating changes in the waste management policies of the private sector. Government officials feel it is important that not just companies, but consumers are made aware of the issue, with many pressing for educational efforts geared at educating the general public about the dangers of ignoring and the potential benefits of recycling e-waste. Many corporations and waste management companies also feel it's of the utmost importance that the average consumer understands which electronics need special care when it comes time to dispose or recycle them; pointing out that even though large companies do produce a large amount of e- waste the bulk comes from individuals (William, 2010).

It was further revealed by William (2010) that one major resolution was that e-waste should not be considered waste. It is a resource. Useful materials such as glass, copper, aluminum, plastic and other contituents can often be extracted and reused. Some manufacturers have even referred to e-waste as a valuable source of materials. Many landfills and waste processing plants have instituted new procedures to assure that the valuable materials found in e-waste are not accidentally buried and forgotten. Waste management services in Australia, Asia, Europe and North America have begun concerted efforts to capture these precious resources rather than let them be discarded forever. Some companies around the globe even have made a business model based on the excavation of disused landfills. Recycling valuable materials form years gone by. With an increasing array of environmentally- friendly options now available, people should consider recycling or donating their old electronic devices. With either choice, we can reduce the amount of e-waste and actually put our old items to good use.

(j) Overview of Ibadan

Ibadan is regarded as one of the largest cities in Africa. The city is the capital of Oyo State in South-western Nigeria. The City is located at over 120 km inland northeast of Lagos and 530 km southwest of Abuja; and is a prominent transit point between the coastal region and the areas in the hinterland of the country. The population of the city is over 3 million, it is the most populous city in the state, and the third most populous city in Nigeria, after Lagos and Kano; it is the country's largest city by geographical area. At Nigerian independence, Ibadan was the largest and most populous city in the country and the third in Africa after Cairo and Johannesburg (Falola and Aderinto, 2010)

Ibadan had been the centre of administration of the old Western Region since the days of the British colonial rule, and parts of the city's ancient protective walls still stand to this day. The principal inhabitants of the city are the Yorubas, as well as various communities from other parts of the country. The city is a main transit point between the coast and areas to North. Ibadan is the centre of trade in farming area, producing cocoa, palm oil, cassava, corn and fruit (Falola and Aderinto, 2010)

The City rose quickly in the mid 19th century when the Yoruba civil war shook the region. The city attracted soldiers and refuges displaced by the wars and by Fulani incursions to the north. The City came into existence in 1829, during a period of turmoil that characterized Yoruba land at the time. It was in this period that many old Yoruba cities such as old Oyo (Oyo ile), Ijaye and Owu disappeared; and newer ones such as Abeokuta, new Oyo (Oyo atiba) and Ibadan sprang up to replace them. It was also established that, the city was founded by Lagelu; and was initially intended to be a war camp for warriors coming from Oyo, Ife and Ijebu. As a forest site containing several ranges of hills, varying in elevation from 160 to 275 metres, the location of the camp offered strategic defence opportunities (Falola and Aderinto, 2010)

In addition, its position at the fringe of the forest (from which the city got its name) promoted Ibadan emergence as a marketing centre for traders and goods from both the forest and grassland areas. Ibadan thus had initially begun as a military state and remained so until the last decade of the 19th century. The city-state also succeeded in building a large empire from the 1860s to the 1890s which extended over much of northern and eastern Yoruba land. As at 2006, the population estimate was 3,570,000.

The city is the site for several major institutions, notably current extent people, University of Ibadan, Lead City University and the Polytechnic Ibadan (Falola and Aderinto, 2010).

Empirical Review of Studies on Environmental Health Education:

i. Environmental Health Education and Knowledge of E-Waste Management

Poor management of the e-wastes might be attributed to some factors like illiteracy, social influence and economic status, non provision of e-waste disposal equipment/facilities, location of such equipment/facilities as well as in ability of government agencies to inspect how the waste are being disposed. Lauren and Louise (2005) revealed that there is a lack of awareness surrounding the disposal of WEEE. There is shortage of recycling of small WEEE - 97% of items are not recycled and the majority are disposed of via civic amenity (CA) sites (33%) or in the household refuse (26%).

The inadequate waste handling attitudes and practices may be adduced to poor knowledge of the impact of improper waste management on health. Another major waste management problem in the urban areas as it was revealed is lack of refuse collection. Waste management authorities collect refuse from households and public containers on a regular basis only in very few urban communities. As a result, most urban households resort to open dumping of refuse, engage private refuse collectors or burn or bury solid waste. It was further cited that in majority of towns, the mounds of decomposing rubbish provide breeding grounds for rats, flies, and mosquitoes, contributing to unhealthy environment (Audu, 2013).

The level of education of individuals has impact on understanding of the health implication of waste management, in which e-waste is included. According to Komolafe (2012), high rate of illiteracy, Ignorance, uncivilized culture of indiscriminate waste littering and violation of town planning regulations were identified as factors responsible for improper disposal of solid waste in the past five decades in Ibadan Municipality. Similarly, Adekunle, Adekunle, Akintokun, Akintokun and Arowolo (2010) opined that few traders in Ibadan are aware of neither the recycling plant nor the importance of having it.

Adequate understanding of the impact of waste management on health can help people to protect themselves from diarrhea, typhoid fever, cholera, hepatitis, malaria and other infections. Adequate knowledge of the negative impact of poor refuse disposal may encourage people to adopt positive waste management practices and positive waste management practices may also promote personal hygiene and the health of the environs. Despite various programmes by different tiers of government to address the issues of waste management, many Nigerians including the environs of Jos South Metropolis seem to possess low level of knowledge, negative waste management attitudes and practices.

Regrettably, the poor knowledge, attitudes and practices associated with waste management might have predisposed the environs of Jos South Metropolis to the dangers of air borne diseases such as whooping cough, asthma, measles, tuberculosis; water borne diseases such as typhoid fever, dysentery, cholera, hepatitis and insect/rodent borne diseases such as malaria, plague and Lassa fever. Diseases associated with poor waste management have caused numerous illnesses and the deaths of many Nigerians in general and Jos south Metropolis in particular. This therefore necessitated the present study on knowledge, attitudes and practices associated with waste management in Jos South Metropolis.

In a study by Anuj (2014) to examine the general awareness of the public of both toxic chemicals in WEEE and federal policies governing proper disposal and management, the first study of its kind in India. The questionnaire data greatly substantiated previous claims that technological innovation has led to rapid product obsolescence, as a majority of respondents indicated that the need or desire for new technology motivates them to purchase new products. The data also pointed to a lack of government incentive for the consumer to participate in formal e-waste management strategies – strikingly, the number of respondents who knew of formal services outnumbered those who actually participate in them.

The perspectives of e-waste collectors, and AMC and GPCB officials similarly asserted a lack of e-waste reaching formal systems. Perceptions of unused electronics indicated that approximately a quarter of respondents recognized the possibility of end-of-life recycling and reprocessing, while other responses suggested a disconnect from proper e-waste management. Very importantly, very few respondents understood specific

information about the health and environmental hazards of e-waste, along with the e-waste (management and handling).

These findings are disconcerting, as consumers who are knowledgeable about both the responsibilities of various stakeholders and the consequences of improper handling of e-waste are necessary for pushing producers compliance with this new legislation. While some government officials in Ahmedabad are quite active and invested in tackling the e-waste issue, there is an overall lack of financial resources and government prioritization for management strategies. Thus, gaining momentum behind implementation of the Rules, which already have their shortcomings, proves to be very challenging. However, it is encouraging to see initiatives from both the local government and various NGOs to build public awareness, and to establish links between consumers, informal workers, collectors, and formal recyclers in Ahmedabad and Gujarat. It is hoped that these efforts result in a change of public mindset, and thus a change in how all stakeholders operate within e-waste management (Anuj, 2014).

iii. Environmental Health Education and Attitude Towards E-waste Management

Lauren and Louise (2005) revealed that stakeholders and policy makers have to become proactive in their approach to managing this type of waste as soon as possible, this is because, with current consumer trends, the disposal and management problem is only set to increase. Further research exploring consumers' attitudes is required in order to improve and optimise the location and format of new recycling schemes for these products.

It was further revealed that there is existence of a variation in behaviour based on the annual income of households. Those with lower incomes are less likely to visit CA sites to dispose of small WEEE than respondents with higher incomes. It was also noted that femininity seems to have an impact on disposal behaviour. The findings indicate that men are more likely to visit CA sites than women, although this trend changes with women that recycle regularly, who are as likely as men to visit CA sites. Households that recycle regularly are more likely to dispose of small WEEE via a CA site in comparison to those who infrequently or never recycle. It appears that the act of recycling other

household items (paper, glass, plastic and a host of others), has a positive effect on the way small WEEE are disposed of (Lauren and Louise, 2005).

On the other hand, there existence of partial information on the Indian public's awareness of the use of toxic chemicals in these products, government policies regarding e-waste management, and proper practices of disposal. Additionally, the general population's perception of unused electronics, whether or not they consider it to be a form of waste is still unclear. An assessment of public awareness at the level of the individual is vital to understanding what is missing from management strategies, and to understanding the public's behaviour toward e-waste. Indeed, building public awareness will be key to active and effective participation in e-waste systems. Awareness is also necessary if India hopes to have active consumers who will demand more responsibility from electronics producers and more action from policymakers. Additionally, if producers become responsible for the end of- life costs of their products, a feedback loop will be created to encourage product developers to reduce such costs, by making their product less toxic and more amenable to material recycling (Anuj, 2014).

According to Orhan and Kadir (2014), environmental health and safety will be possible only through awareness of the community. Therefore, environmental health education should be provided extensively. The prioritized purpose of environmental education in various countries is the acquisition of positive attitudes and behaviours by individuals. Attitudes are developed on the basis of feelings, knowledge and thoughts and on individual and social values and beliefs and they change from individual to individual. The attitude of an individual is the combination of what he thinks, what he believes in, how he feels and how he acts.

It is identified through research that lack of environmental awareness and the extent of environmental damage is caused by lack of environmental health education. Meanwhile, many researchers stressed that environmental health education should be an interdisciplinary course. it is observed that environmental education is provided as a part of science classes. It was also stated that today, it is known that raising awareness in environmental issues is possible through environmental education. Therefore, interest and attitudes are crucial in environmental education (Orhan and Kadir, 2014).

In the same vein, it has been ascertained that knowledge and attitude are effective in individuals' behaviour towards the environment. Orhan and Kadir (2014) expressed that lack of effective environmental education opportunities negatively affect the measures that will be taken in environmental conservation and solution of environmental problems. Acquisition of positive attitudes towards the environment is closely related to environmental awareness. Similarly, attitudes of primary school students to environment have been undertaken to reveal the existence of serious problems in environmental education despite the revised and renewed primary school curriculum.

Environmental Health Education and Practice of E-Waste Management

Unfavourable or bad behaviour in relation to e-waste management has strong influence on the health of the people. Mburu and Tuduetso (2013) in the study carried out in Bostwana, revealed that, families are aware of the dangers of e-waste but they do not know what to manage it. It was further established that there is lack of appropriate policy in Botswana guiding how to dispose electronic waste. Due to the unavailability of necessary logistics, it is very difficult for consumers to rightly dispose e-waste. The City Council has not put mechanism in place to ensure that waste is separated. At the same time the recycling aspect has not been well embraced as a business venture in Botswana. Solid waste from the commercial sector also contributes significantly to the amount of landfilled e-waste where the yearly movement of discarded electronic products from industries and institutions appear more or less prominent. The research indicates a variety of challenges and strengths to e-waste management in Botswana, demonstrating the need for considerations on how to improve e-waste disposal and especially sensitizing households on waste separation. Short and long term strategies on how to tackle e-waste need to be developed as the current situation poses a danger to the society and children which end up inhaling all the dangerous chemicals found in this waste.

In the study conducted in India, Usha (2014) revealed the main factors that influence the purchase of the EEE gadgets are necessity, new features, status symbol, higher incomes and advertisements. Personal computers and mobiles are considered as an essential requirement of every household. It was further established that increase in income has led to an increase in possession of more EEE gadgets. Furthermore, it is established that the two gadgets which were purchased are invariably new gadgets. The

most preferred mode to obtain EEE gadgets is to buy new items. Moreover, the occurence of replacement of EEE gadgets suggests that frequency of replacement is maximum for mobile phones due to frequent introduction of new models with advanced features and lower prices.

In relation to health seeking behaviours, it was revealed that electronic waste workers in Ghana passed through different kinds of ailments. They involved physical injuries, chest and respiratory tract associated symptoms, malaria, headaches, body pains and stomach discomfort. They reported seeking health care from multiple sources, and the main determinants of health seeking behaviour were severity of illness, perceived benefit of treatment, accessibility of service, quality of service, ease of communication with service provider and cost of health care (Asampong, Dwuma-Badu, Stephens, Srigboh, Neitzel, Basu, and Fobil, 2015).

Appraisal of Reviewed Literature

The review of literature emphasised on the variables that are pertinent to the study. A conceptual framework was developed to explain the interaction of the major independent variable (environmental health education) and the dependent variables (knowledge, attitude and practice of e-waste management). The Sustainable E-waste Supply Chain Model was adopted as the model for the study. This was used to explain the theoretical frame work for the study. Theoretical review covered areas such as; concept of waste, concept of electronic waste, component of e-waste, concept of electronic waste management health and environmental impact of e-waste management, socio-economic impact of e-waste management, flow of e-waste into Nigeria, problem of electronic waste in Nigeria as well as policy and legislation on e-waste, while the empirical review was made on effects of knowledge, attitude and practice on e-waste management.

The studies on environmental health education revealed that little concentration was laid on experimental studies in relation to the subject matter. The meta-analysis on environmental health education and knowledge of e-waste management revealed that majority of the studies conducted on the subject matter were focused on awareness. Also, the studies were mainly on survey, with little concentration on experimental study.

Lauren and Louise (2005) focused on awareness surrounding the disposal of WEEE; while Anuj (2014) examined awareness of public of both toxic chemicals in WEEE and federal policies governing proper disposal and management. Similarly, the some studies that were conducted awareness in Ibadan were mostly on solid wastes. These include Adekunle, Akintokun, Akintokun and Arowolo (2010) that investigated awareness on recycling of organic wastes; and Komolafe (2012) that focused on integrated Solid Waste Management. However, this present study focused on environmental health education and knowledge of electronic waste management.

The review of literature on environmental health education and attitude showed that majority of the findings carried out on the subject matter were emphasised on attitudes towards the disposal waste electrical and electronic equipment; which was mainly survey studies, with little concentration on experimental. In addition, most of these studies were mostly carried outside Nigeria. The studies include, Lauren and Louise (2005) who evaluated consumers' attitudes towards the disposal of small waste electrical and electronic equipment in Britain. In addition, Orhan and Kadir (2014) examined attitudes of Primary School Students towards environment in relation to e-waste. Conversely, this present study focused on environmental health education and attitude towards e-waste management.

Previous studies on environmental health education and attitude showed that most of the studies on the subject matter focused on practice of e-waste; and the studies were mainly survey studies, with little concentration on experimental studies. In addition, most of these studies were mostly carried out outside Nigeria. Such studies include exploration of consumer behaviour on discarding of electrical/electronic waste in Bostwana, which was conducted by Mburu and Tuduetso in 2013. Asampong et al (2015) carried out a similar study in Ghana. On the other hand, the present study was carried out in Ibadan, Nigeria and the focus was environmental health education and knowledge, attitude and practice of e-waste management.

CHAPTER THREE
METHODOLOGY

This chapter presents the methodology that was adopted for the study. The chapter was discussed under the following sub-headings:

1. Research Design
2. Population of the Study
3. Sample and Sampling Techniques
4. Research Instrument
5. Validity of the Instrument
6. Reliability of the Instrument
7. Field-Testing of the Instrument
8. Ethical Consideration
9. Procedure for Data Collection
10. Procedure for Data Analysis

Research Design

The pretest-posttest control group quasi experimental design was used for this study. This was carried out through the use of 2x3x3 factorial matrix. The design was adopted because the participants for the study were already in two existing groups; however, assignment into treatment and control group was done by ballot. This afforded the researcher the opportunity to compare participants in the control and experimental groups; for the purpose of examining the difference in their measured outcome as a result of the intervention in the study.

The use of the selected factorial matrix was as a result of the fact that, the study involved the use of independent variables at two levels; the treatment and the control. Moderating variables of years of work experience (1-5yrs, 6-10yrs and 11years above) and educational background (primary, secondary and tertiary education) were also used at three levels.

Research design is schematically illustrated as follows:

0_1 x_1 0_3…… The scheme experimental

$0_2 x_2$ 0_4……. Control

0_1……Represent pretest experimental group

0_2……Represent pretest control group

0_3……Represent posttest experimental

0_4……Represent posttest control group

x_1……...Represents environmental health education programme for treatment group

x_2……This Represents nutrition education for control group

Table 3.1: 2 X 3 X 3 factorial matrix

Groups	Years of Work Experience	Educational Background
(Experimental)	1-5years	Primary Education
	6-10years	Secondary Education
Environmental	11>years	Tertiary Education
Health Education Programme		
(Control)	1-5years	Primary Education
Nutrition Education Programme	6-10years	Secondary Education
	11>years	Tertiary Education

Population of the study

The population for this study comprised all electronic technicians in Ibadan Metropolis.

Sample and Sampling Techniques

The sample size comprised one hundred (100) electronic technicians in Ibadan Metropolis. The participants were selected using multistage sampling procedure. The stages involved in the procedure are explained as follow:

Stage 1: Purposive sampling technique was used to choose two (2) Local Governments Areas out of five (5) that made up Ibadan Metropolis (Ibadan North and Ibadan South West). This is because the two selected areas had high density of electronic technicians.

Stage 2: Purposive sampling technique was used to select fifty male electronic technicians from each of the selected two (2) Local Governments Areas as the participants. The participants were considered due to the fact that they were duly registered with the trade association and had high stocked used electronics that they deal with.

Stage 3: Simple random sampling technique was used to randomly arrange the volunteered participants to experimental (Ibadan North) and control (Ibadan South West) groups respectively.

Table 3.2: List of Local Government Areas and the Technicians' Secretariats

S/N	Name of Local Government Areas	Secretariat/Meeting Venue
1	Ibadan North Local Government Area	Agodi Gate Market
2	Ibadan North East Local Government Area	Agodi Gate Market
3	Ibadan North West Local Government Area	Agodi Gate Market
4	Ibadan South East Local Government Area	Oke Ado Market
5	Ibadan South West Local Government Area	Oke Ado Market

Table 3.3: Description of the Sampling Procedure

S/n	Study Location	Treatment Group	LGAs	Registered Member	Total Sample Selected
1	Agodi-Gate Market (Ibadan North)	Environmental Health Education	IBN LGA IBNE LGA IBNWLGA	94 73 47	50
2	Oke Ado Market (Ibadan South West)	Nutrition Education	IBSE LGA IBSW LGA	61 62	50
Total				**337**	**100**

Inclusion Criteria

This study engaged participants who are registered members of electronic technicians association in selected LGAs.

Exclusion Criteria

The electronic technicians who are not registered members and those who registered, but do not attend meetings regularly were excluded.

Research Instruments

The research instruments include:

1. **Self-developed Manual on E-waste Management**

   A self-developed manual on e-waste management was used as a training guide for the experimental group. The manual guide is validated by experts review in line with the variables under study.

2. **Self- developed Questionnaire**:

In order to examine the effect of environmental education and e-waste management among electronic technicians in Ibadan Metropolis, Oyo State, Nigeria, a self-developed questionnaire of three (3) sub-sets was developed. These are explained as follow:

Knowledge, Attitude and Practice of E-waste Management Questionnaire (KAPEMQ)

The questionnaire consisted of Knowledge of E-waste Management Scale (KEWMS), Attitude towards E-waste Management Scale (ATEWMS) and Practice of E-waste Management Scale (PEMS). The instrument was divided into four sections, namely; sections A, B, C and D. Section A covered socio-demographic characteristics of the respondents, sections B, C and D elicited information in line with the tested variables in the hypotheses and research questions. The items in the questionnaire were developed based on review of concepts and empirical studies on e-waste management.

The questionnaire items were developed based on the initial exploratory discussion with people that share similar characteristics with the actual study population. In stage one, sixty nine (69) items were generated based on the exploratory survey

discussion after which the questionnaire was presented to professional Health Educators and an expert in psychometrics. The items were later reduced to sixty (60). The implication was that the instrument was validated through expert review. This in turn helped to remove ambiguities and item construction problems. This instrument was then subjected to exploratory factor analysis. A Kaiser-Meyer-Olkin (KMO) of 0.60, 0.62 and 0.61 were obtained for KEWMS, ATEWMS and PEMS respectively; which met with the benchmark of 0.60. This indicates that the sample size of each of the scales is adequate for the conduct of factor analysis. The test of sphericity of each of the scales was statistically significant which support the factorability of the correlation matrix as the p-value stands at 0.000 respectively.

The sections of the questionnaire are explained as follows:

Section A: This section elicited information on socio-demographic characteristics of the respondents. Six items were developed and reacted to by the respondents. The items include sex, age, marital status, tribe, years of work experience and educational qualification.

Section B: Knowledge of E-Waste Management Scale (KEWMS)

Knowledge of E-Waste Management Scale (KEWMS) was used to elicit information from participants on meaning of e-waste, electronic gadget that constitute e-waste, health effects of improper management of e-waste, components and substances commonly found in e-waste. Fifteen items were generated and reacted to by the respondents during the pre-testing of the instrument. The data generated were then subjected to factor analysis, with 0.60 as criterion for retention of items. The result of the analysis showed that twelve (12) items met 0.60 criterion, thus, the items were retained, while the items that did not meet the criterion were expunged. Each response was scored on a Yes and No format; Yes= 2, No=1. A Cronbach alpha method was used to test the internal consistency of KEWMS and it yielded a reliability of 0.70.

Section C: Attitude Towards E-Waste Management Scale (ATEWMS)

This scale was used to obtain information from respondents on their attitude towards e-waste management. Twelve items were generated and reacted to by the respondents during the pre-testing of the instrument. The data generated were then subjected to factor analysis, with 0.60 as criterion for retention of items. The result of

the analysis showed that seven items met 0.60 criterion, hence the items were retained; the three that had 0.5 were restructured. Each response was scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with allotment of points in the following order; SA = 4, A=3, D=2, SD =1. A Cronbach alpha method was used to test the internal consistency of ATEWMS and it yielded a reliability of 0.72.

Section D: Practice of E-Waste Management Scale (PEMS)

Practice of E-Waste Management Scale (PEMS) was used to obtain information from participants on practice of e-waste management. Ten items were generated and reacted to by the respondents during the pre-testing of the instrument. The data generated were then subjected to factor analysis, with 0.60 as criterion for retention of items. The result of the analysis showed that eight items met 0.60 criterion, hence the items were retained; while the two items that had 0.3 were restructured. Each response was scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with allotment of points in the following order; SA= 4, A=3, D=2, SD =1. A Cronbach alpha method was used to test the internal consistency of PEMS and it yielded a reliability of 0.81.

Altogether, thirty eight (38) items were generated in the questionnaire (KAHDABQ); including items on socio-demographic characteristics of the respondents (6 items) and the three scales (32 items) were used in the study. A Cronbach alpha method was also used to test the internal consistency of the three scales (KEWMS, ATEWMS and PEMS) which yielded a reliability of 0.75. The questionnaire met Nunnally (1998) criterion of 0.70, which is expected for psychometric measures.

Validity of the Instrument

Validity is the ability of a tool to measure what it is purported to measure (Thomas, Nelson and Silverman, 2005). In order to ensure validity of the research instrument, a draft of the questionnaire was presented to researcher's supervisor, experts in the Department of Human Kinetics and Health Education, University of Ibadan as well as experts outside the Department; for content and construct validity of the instruments.

Their comments, criticism, suggestions and modifications of the instrument were effected to improve the quality of the instrument.

Reliability

Nworgu (2006) opined that reliability is the degree of consistency between two sets of scores or observations obtained with the same instrument. In order to establish the reliability of the instrument, the validated items of questionnaire were administered on thirty (30) electronic technicians in Akinyele Local Government Area who were not part of the study. The completed copies of such questionnaire were collected, coded and analysed by using Cronbach alpha method to test the internal consistency of the three scales (KEWMS, ATEWMS and PEMS). KEWMS had a reliability of 0.70, ATEWMS yielded a reliability of 0.72, PEMS had a value of 0.81; while the entire questionnaire had a reliability of 0.75.

Field-Testing of the Instrument

The validated instruments were administered on thirty (30) electronic technicians in Akinyele Local Government Area who were not part of the study. The field-testing was essential before the actual study was carried out to find out whether the instrument for the research was reliable, accurate, meaningful and suitable. The field-testing, provided additional knowledge to the quality of the instrument, this helped to improve and validate the research study. It also helped the researcher to be familiar with the study terrain, the procedures and probable constraints which could be met in the real study.

Ethical Consideration

The researcher presented the required information to the Social Sciences and Humanities Research Ethics Committee (SSHEC), University of Ibadan, Ibadan, Nigeria. Such vital information included copies of research proposal, informed consent form, important information on the researcher and participants; as well as letter of introduction from the Head of Department of Human Kinetics and Health Education, University of Ibadan, Nigeria. The proposal was reviewed by the committee, upon which necessary corrections were made by the researcher. Consequently, a full approval was given with reference number UI/SSHEC/2016/0002. The ethical approval was therefore, obtained

from the Chairman, Social Sciences and Humanities Research Ethics Committee (SSHEC), University of Ibadan, Ibadan, Nigeria; in conjunction with Collaborative Institutional Training Initiative (CITI PROGRAM).

The researcher further ensured that ethical consideration was followed during the field work by ensuring that the participants signed informed consent forms before participating in the study. In addition, the privacy of the participants was protected by through anonymous responses and were treated with utmost confidentiality. Moreover, the safety of the participants was protected by ensuring that the participants were not exposed to undue stress. The researcher also ensured that the participants were not put under any personal risk or harm.

Procedure for Data Collection

A letter of introduction was collected from the Head of Department of Human Kinetics and Health Education, University of Ibadan; which was presented to the Chairmen of Electronic Technicians Association in each of the two LGAs that were used for the study. This was done in order to seek for permission to carry out the study in their respective LGAs. The purpose was explained to the participants, while consent forms were filled to show their interest and willingness to participate this made them eligible to take part in the study.

The research assistants were trained by the researcher on what to do. The research assistants were educated on the study purpose and the roles they were supposed to perform to assist in carrying out the research. The date for the commencement of the training programme, the venue and the responsibility of each research assistants were well defined. Grouping of the research assistants were the next thing in relation to the assignments they handled. They were grouped into two, each one taking a group each, that is treatment group that were educated with the environmental health education and the health risks associated with e-waste. Group two (2) was assigned to the control group for nutrition education. The following activities were performed by the researcher and her research assistants. The names and addresses of the participants were put down in a register with traceable addresses and phone numbers. The participants were grouped as group 1 and group 2 as earlier mentioned. They were trained in different venues, pretest

was later administered to the groups. The eight (8) week intervention training programme then commenced at their meeting place, while activities were for two (2) hours per day. The study was conducted in three (3) parts;

Part I: was baseline survey of electronic technicians.

Part II: was the intervention aspect. This includes environmental health education and nutrition education.

Part III: was the post intervention assessment. Only interested and volunteers were used for the study. Familiarization meeting was scheduled for discussion with the electronic technicians on the issue of the programme; what is before them, their meeting days, the aims and purposes of the training. Fifty (50) electronic technicians were selected for experimental group and fifty (50) electronic technicians for control group to sum up to one hundred (100) participants. To provide for the risk of attrition (participant morbidity or mortality) the number of participants was increased above the required. The experimental group was exposed to a treatment for a period of eight (8) weeks on health education package treatment, while placebo treatment of nutrition was given to the control group.

The activities performed at the Environmental Health Education training was pretested, which was given to the experimental and the control group to observe pre-treatment base line knowledge, attitude and practice of e-waste management. At the end of the eight (8) week intervention programme, post treatment observation on knowledge, attitude and practice of e-waste management was carried out on all the participants. The difference between the scores of the two groups in the pre and post-tests of the experimental group were compared to determine whether the treatment has any impact on the previous or entry knowledge of electronic technicians.

Treatment Procedure for participants in experimental group

The experimental group were taken through environmental health education. The intervention lasted for eight weeks. Hence, the summary was stated as follows:

SESSION ONE

Topic: General Orientation and Administration of Pre-test instrument.

Objectives of the session:

1. To state the purpose of the meetings
2. To explain the procedures to be followed by the trainers as well as participants
3. To administer the pre-test instrument on the participants' activity.

Step 1: The researcher welcomed the participants warmly

The participants introduced themselves with the aim of familiarization.

Step 2: The researcher stated and explained the purpose, objectives and benefits of the training. Day, duration, number of hours for each contact, venue for the interaction and other relevant information were discussed with the participants.

Step 3: Regulations guiding the training were explained to them. These include punctuality, regular attendance, cooperation and participation during discussions.

Step 4: The researcher and the trained research assistant later administered the pre-test instrument on the participants and the the instruments were collected at the venue as soon as the instrument was completed.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Session Two

Topic: E-waste (Concept, categories and main sources of e-waste)

Objectives: At the end of the session, the participants were able to:

1. Define e-waste
2. State the categories of e-waste with typical examples
3. Mention the main sources of e-wastes

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week was introduced and explained to the participants by the researcher.

Step 3: The researcher asked the participants questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Session Three

Topic: Hazardous components in e-waste and their effects on human

Objectives: At the end of the session, the participants were able to:

1. List hazardous components in e-waste
2. State the effects of the hazardous components on human life.

Activity

Step 1: The session commenced with an overview of previous session

Step 2: The researcher introduced and explained the topic for the week

Step 3: The researcher asked the participants questions to evaluate the topic taught and corrected them where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. They were reminded of the time and venue for the next training session.

Session Four

Topic: Concept and method of e-waste management

Objectives: At the end of the session, the participants were able to:

1. Define e-waste management
2. List the methods involve in e-waste management
3. Explain appropriate methods involve in e-waste management

Activity

Step 1: Researcher welcomed the participants

Step 2: The topic for the week was introduced and explained

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. They were reminded of the time and venue for the next session.

Session Five

Topic: Health and environmental impact in e-waste management

Objectives: At the end of the session, the participants were able to:

1. Explain health impact of e-waste management
2. Explain the environmental impact of e-waste management

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week was introduced and explained.

Step 3: The researcher were asked the questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue of the next training session.

Session Six

Topic: Management of e-waste and its hazardous substances

Objectives: At the end of the session, the participants were able to:

1. Explain how e-waste and its hazardous substances could be managed without risk for human health.
2. Explain plans on how to minimize the negative effects of e-waste.

Activity

Step 1: The researcher welcomed the participants.

Step 2: The topic for the week was introduced and explained.

Step 3: The researcher asked the participants questions to evaluate the topic taught and make correction where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next training session.

Session Seven

Topic: Promotion of positive attitude towards e-waste management

Objectives: At the end of the session, the participants were able to:

1. Describe positive attitude that could enhance e-waste management in the workplace.
2. Provide education on the need for attitudinal change that will bring about improved e-waste management.

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week was introduced and explained

Step 3: The researcher asked the participants questions to evaluate assimilation of the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next training session.

Session Eight

Topic: Revision of Previous Sessions and Administration of Post-test Instrument

Objectives: At the end of the session, the participants were able to:

1. Give a summary of what the participants had learnt during the training programme.
2. Express their willingness to continue to improve on attitude towards e-waste management.

Activity

Step 1: The participants were welcomed

Step 2: Questions were asked on all topics taught to know how participants have internalized the training.

Step 3: Post-test instrument were administered on the participants. The instrument was collected on the spot with the help of trained research assistants.

Closing Remarks

1. Participants were appreciated for sparing their time for the training.
2. The researcher served refreshment.
3. The participants were released with appreciation.

TRAINING PROGRAMME FOR PARTICIPANTS IN EXPERIMENTAL GROUP

Training Objective	Topic(s)/Content	Audience	Wk/Day/Time
At the end of this session participants were able to • Familiarize with each other • Fill the questionnaire	• Pre-test administration	All participants in Experimental Group	Week 1, 2hrs.
At the end of this session, participants were able to: • Define e-waste • State the categories of e-waste with their typical examples • Mention the main sources of e-wastes	• Module 1 E-waste (concept, categories and main sources of e-waste).	All participants in Experimental Group	Week 2, 2 hrs.
At the end of this session, participants were able to: • List the hazardous components in e-waste • State the effects of the hazardous components.	• Module 2 • Hazardous components in e-waste and their effect on human.	All participants in Experimental Group	Week 3, 2 hrs.
At the end of this session, participants were able to: • Define e-waste management • List the methods of e-waste management • Explain the method of e-waste management	• Module 3 Concept and method of e-waste management	All participants in Experimental Group	Week 4, 2 hrs.
At the end of this session, participants were able to: • Explain the health impact of e-waste management • Explain the environmental impact of e-waste management	• Module 4 Health and environmental impact of e-waste management	All participants in Experimental Group	Week 5, 2 hrs.
At the end of this session, participants were able to: • Explain how e-waste and its hazardous substances could be managed without risk for human health • Explain plans on how to minimize the negative impact of e-waste	• Module 5 • Management of e-waste and its hazardous substances	Participants in Experimental Group	Week 6, 2 hrs.
At the end of this session, participants were able to: • Describe attitudes that could enhance e-waste management in the workplace • Provide education on the need for attitudinal change that will bring about source separation and improved e-waste disposal habits	• Module 6 Promotion of positive attitude towards e-waste management	All participants in Experimental Group	Week 7, 2 hrs.
At the end of this session, participants were able to: • Fill the questionnaire (Post-test)	• Post-test administration	All participants in Experimental Group	Week 8, 2 hrs.

Treatment Procedure for Participants in Control Group (Nutrition Education)

The placebo treatment lasted for eight weeks. Summary of the treatment package was stated as follows:

Topic: General Orientation and Administration of Pre-test instrument.

Objectives of the session:

1. To state the purpose of the meetings
2. To explain the procedures that to be followed by the trainers as well as participants
3. To administer the pre-test instrument on the participants' activity.

Step 1: The researcher welcomed the participants. The participants introduced themselves with the aim of familiarization.

Step 2: The researcher stated and explained the purpose, objectives and benefits of the training. Day, duration, number of hours for each contact, venue for the interaction and other relevant information were discussed with the participants.

Step 3: Regulations guiding the training were explained to them. These include punctuality, regular attendance, cooperation and participation during discussions.

Step 4: The researcher later administered the pre-test instrument on the participants through help of trained research assistants. Completed instruments were collected on the spot.

Closing Remarks

1. The participants were appreciated for sparing their time for the training
2. The participants were reminded of the time and venue for the next training session.

Session Two

Topic: Concept of nutrition and nutrients

Objectives: At the end of the session, the participants were able to:

1. Define nutrition and nutrients.
2. State the six classification of nutrients.

Activity

Step 1: The researcher welcomed the participants.

Step 2: They topic for the week were introduced and explained by the researcher.

Step 3: The researcher asked the participants questions to evaluate the topic taught. and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next training session.

Session Three

Topic: Concept of adequate/balance diet and importance of diet in the body.

Objectives: At the end of the session, the participants were able to:

1. Define adequate diet
2. Define balance diet
3. Mention three importance of adequate diet to the body

Activity

Step 1: The session was commenced with an overview of previous session.

Step 2: The researcher introduced and explained the topic for the week.

Step 3: The researcher asked questions to evaluate the topic taught and correct where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. They were reminded of the time and venue for the next session.

Session Four

Topic: Concept of Protein and Carbohydrate

Objectives: At the end of the session, the participants were able to:

1. List two types of protein
2. Mention two importance of protein in the body
3. List two examples of carbohydrate
4. Mention two importance of carbohydrate in the body

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week was introduced and explained

Step 3: The researcher asked the participants questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. They participants were reminded of the time and venue for the next session.

Session Five

Topic: Concept of fats and oil as well as vitamins

Objectives: At the end of the session, the participants were able to

1. List two examples of fats and oils
2. Mention two importance of fats and oil in the body
3. List two examples of vitamins
4. Mention two importance of vitamins to the body

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week was introduced and explained.

Step 3: The researcher asked the participants questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. They were informed of the time and venue for the next session.

Session Six

Topic: Concept of minerals and water

Objectives: At the end of the session, the participants were able toS

1. List two examples of minerals
2. Mention two importance of minerals in the body
3. Mention two importance of water in the body

Activity

Step 1: The researcher welcomed the participants.

Step 2: The topic for the week was introduced and explained

Step 3: The researcher asked questions to evaluate the topic taught and make correction where necessary

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were told of the time and venue for the next session.

Session Seven

Topic: Effect of unhealthy diet

Objective: At the end of the session, the participants were able to:

1. Mention four effects of unhealthy diet

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week were introduced and explained

Step 3: The researcher asked the participants questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

SESSION EIGHT

Topic: Review of Previous Sessions and Administration of Post-test Instrument

Objectives: At the end of the session, the participants were able to

1. Summarize what the participants have learnt from the training programme.
2. Express their willingness to continue to improve on attitude towards e-waste management.

Activity

Step 1: The participants were welcomed

Step 2: Questions were asked on all topics taught to know how participants have internalized the training.

Step 3: Post-test instrument were administered on the participants. The instruments were collected on the spot with the help of trained research assistants

TRAINING PROGRAMME FOR PARTICIPANTS IN CONTROL GROUP

Training Objective	Topic(s)/Content	Audience	Wk/Day/Time
At the end of this session participants were able to • Familiarize with each other • Fill the questionnaire	• Pre-test administration	All participants in Control Group	Week 1, 2 hrs.
At the end of this session, participants were able to: • Define nutrition • State the six classification of nutrients	• Module 1 Concept of nutrition and nutrients.	All participants in Control Group	Week 2, 2 hrs.
At the end of this session, participants were able to: • Define adequate diet • Define balance diet • Mention three importance of adequate diet in the body	• Module 2 Concept of adequate/ balance diet and its importance in the body.	All participants in Control Group	Week 3, 2 hrs.
At the end of this session, participants were able to: • List two examples of protein • Mention two importance of protein in the body • List two examples of carbohydrate • Mention two importance of carbohydrate in the body	Module 3 Concept of protein and carbohydrate	All participants in Control Group	Week 4, 2 hrs.
At the end of this session, participants were able to: • List two examples of fats and oil • Mention two importance of fats oil in the body • List two examples of vitamins • Mention two importance of vitamins in the body	• Module 4 concept of fats and vitamins	All participants in Control Group	Week 5, 2 hrs.
At the end of this session, participants were able to: • List two examples of minerals • Mention two importance of minerals in the body • Mention two importance of water in the body	• Module 5 concept of minerals and water	All Participants in Control Group	Week 6, 2 hrs.
At the end of this session, participants were able to: • Mention four effects of unhealthy diet	• Module 6 Effect of unhealthy diet in the body	All participants in Control Group	Week 7, 2 hrs.
At the end of this session, participants were able to: • Fill the questionnaire (Post-test)	• Post-test administration	All participants in Experimental Group	Week 8, 2 hrs.

Procedure for Data Analysis

The completed copies of the instrument were collected; coded and analysed with the use of descriptive and inferential statistics. Bar charts was used to describe the demographic characteristics of the participants. In addition, descriptive statistics of frequency counts, percentages, mean and standard deviation were used to answer research questions 1, 2 and 3. The weighted mean of 1.5 and 2.5 were considered as the criteria for inferences for the research questions respectively. The obtained mean values that were below 1.5 and 2.5 respectively, were considered low; while the obtained mean values from 1.5 and 2.5 upward were regarded as high. Inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 alpha level.

CHAPTER FOUR

RESULTS AND DISCUSSION OF FINDINGS

Chapter four presented results of the analyses and discussion of findings. The results and discussion of findings were presented based on demographic characteristics of the participants, research questions and hypotheses as follows:

Demographic Characteristics of the Participants

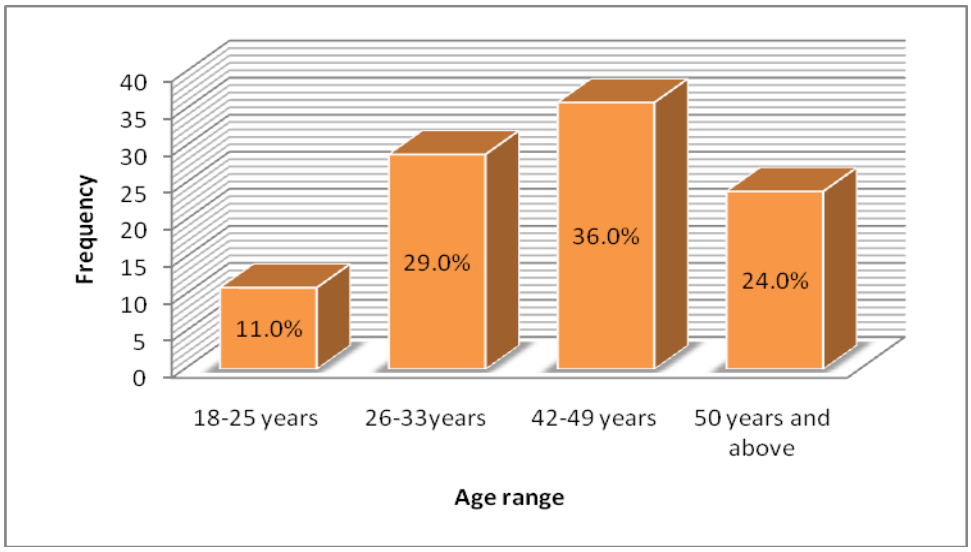

Figure 4.1: Bar chart illustrating age range of the participants

Fig. 4.1 revealed that 11 (11.0%) of the participants were between 18-25 years, 29 (29.0%) were between 26-33 years, 36 (36.0%) were between 42-49 years, while 24 (24.0%) were over 50 years. This showed that majority of the participants were between 42-49 years of age.

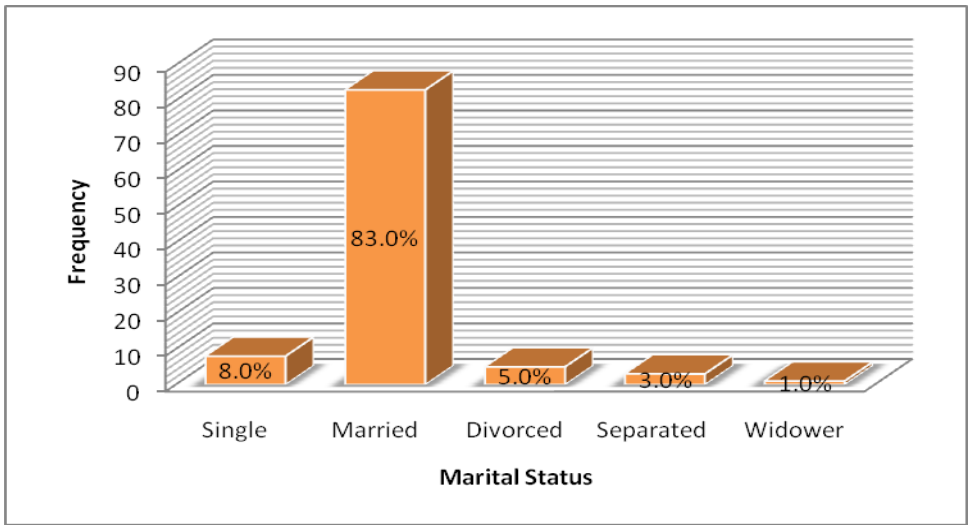

Figure 4.2: Bar chart illustrating marital status of the participants

Fig. 4.2 revealed that 8 (8.0%) participants were single, 83 (83.0%) were married, 5 (5.0%) were divorced, 3 (3.0%) were separated, while 1 (1.0%) was a widower. This implied that most of the participants were married.

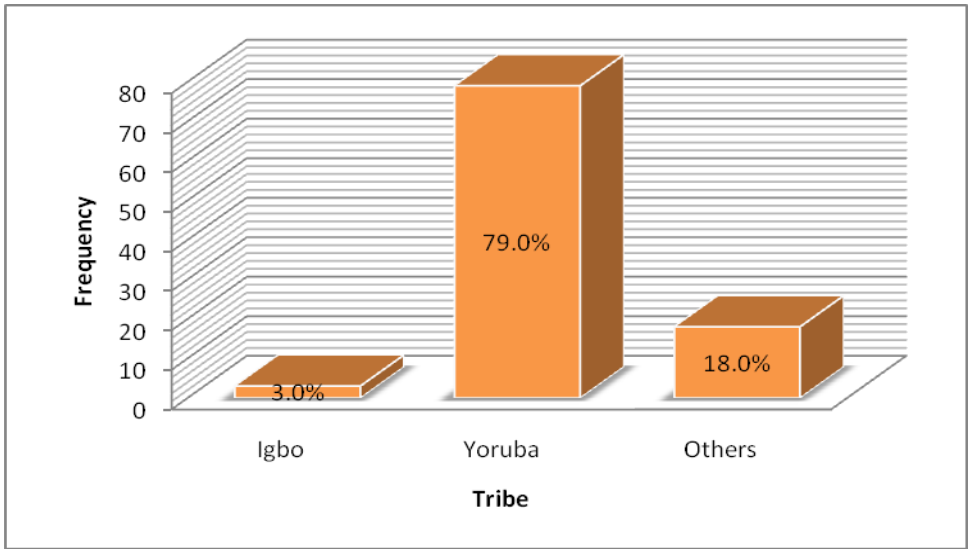

Figure 4.3: Bar chart illustrating tribe of the participants

Fig. 4.3 showed that 3 (3.0%) participants are Igbo,79 (79.0%) are Yoruba, while 18 (18.0%) are from other tribes. This implied that most of the participants are Yoruba.

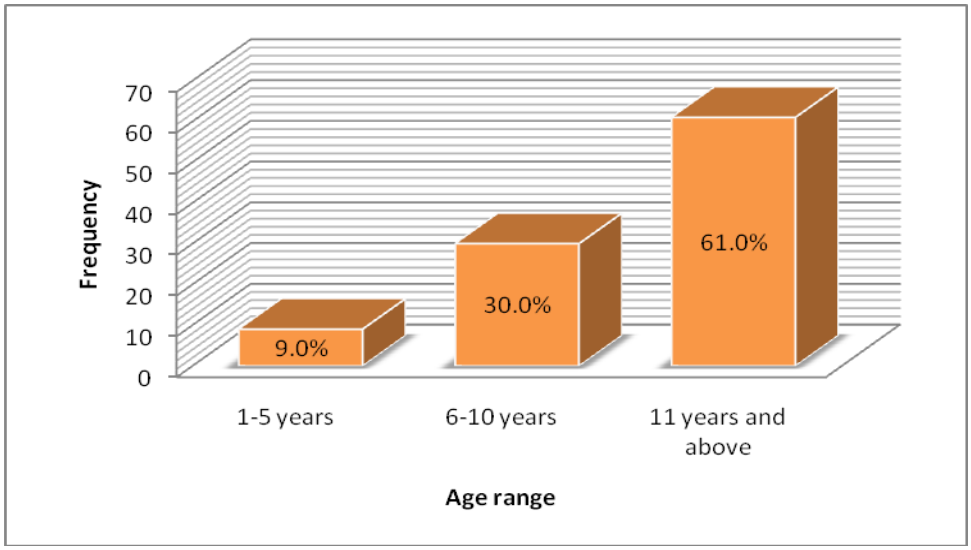

Figure 4.4: Bar chart illustrating years of work experience of the participants

Fig. 4.4 showed that 9 (9.0%) participants had spent 1-5 years, 30 (30.0%) had 6-10 years, while 61 (61.0%) had over 11 years of work experience. This implied that most of the participants had over 11 years work experience.

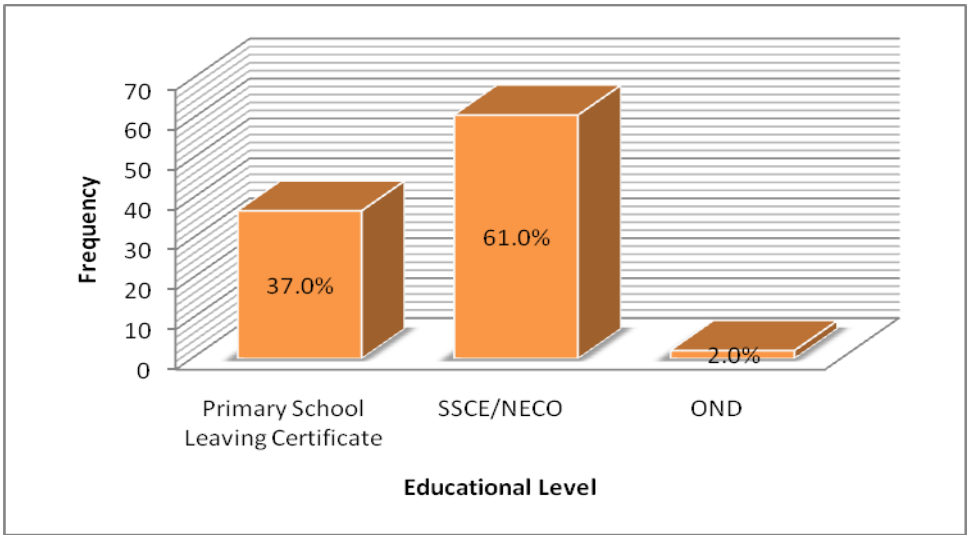

Figure 4.5: Bar chart illustrating educational background of the participants

Fig. 4.5: showed that 37 (37.0%) participants had Primary School Leaving Certificate, 61 (61.0%) possessed SSCE/NECO, while 2 (2.0%) had OND. This implied that most of the participants had SSCE/NECO.

Research Questions

The following research questions were answered:

Research Question 1: Do electronic technicians in Ibadan Metropolis have Knowledge of appropriate e-waste management?

Table 4.1: Distribution of participants' knowledge of e-waste management

S/n	Question items	Yes	No	Mean	Std. Dev.
1	E-waste (e-waste) includes scraps from electronic appliances.	17 17.0%	83 83.0%	1.17	0.38
2	E-waste include used electronic gadgets that are discarded for reuse, resale, salvage and recycling or disposing	21 21.0%	79 79.0%	1.21	0.41
3	Scraps from computers, radio and television are examples of e-waste.	19 19.0%	81 81.0%	1.19	0.39
4	Hazardous components that are found in e-waste could be injurious to the environment.	22 22.0%	78 78.0%	1.22	0.42
5	Hazardous components found in e-waste are unsafe for human consumption.	39 39.0%	61 61.0%	1.39	0.49
6	E-waste management involves all activities and actions needed to manage e-wastes from site to final state of disposal	48 48.0%	52 52.0%	1.48	0.50
7	The process of e-waste management includes sorting out storage, collection, recycling and disposal.	47 47.0%	53 53.0%	1.47	0.50
8	The use of personal protective equipment such as hand glove and nose mask are essentials at some stage of managing e- waste	44 44.0%	56 56.0%	1.56	0.50
9	Handling of hazardous component from other electrical garget parts requires the use of hand gloves	13 13.0%	87 87.0%	1.13	0.34
10	The resultant effects of improper storage and disposal of e-waste cause damage to the central nervous system, skin disorders and cancer.	30 30.0%	70 70.0%	1.30	0.46
11	Burning of e-waste constitutes harmful contents into the atmosphere, which are injurious to animals and human being.	21 21.0%	79 79.0%	1.21	0.41
12	Discharge of harmful contents from e-waste burning dissolve in rainwater and assimilated by plants.	18 18.0%	82 82.0%	1.82	0.39
				Weighted Mean= 1.35 Criterion= 1.5	

As indicated in table 4.1, 83(83.0%) participants affirmed that electronic waste (e-waste) included scraps from all electronics and electrical appliances, while 17 (17.0%) did not. Also, 79 (79.0%) participants responded that e-waste include used electronic gadgets that are discarded for reuse, resale, salvage and recycling, while 21 (21.0%) did not. Moreover, 81 (81.0%) participants reacted that scraps from computers, radio and

television are examples of e-waste, while 19 (19.0%) did not. Besides, 78 (78.0%) participants affirmed that hazardous components that found in e-waste could be injurious to the environment, while 22 (22.0%) did not. Furthermore, 61 (61.0%) participants indicated that hazardous components found in e-waste were unsafe for human consumption, while 39 (39.0%) did not. Again, 52 (52.0%) participants affirmed that e-waste management involved all activities and actions needed to manage e-wastes from initial site to final state of disposal, while 48 (48.0%) did not.

Table 4.1 further revealed that 53 (53.0%) participants reacted that the process of e-waste management included sorting out storage, collection, recycling and disposal, while 47 (47.0%) did not. In addition, 44 (44.0%) participants affirmed that the use of personal protective equipment such as hand glove and nose mask were essentials at some stages of managing e-waste, while 56 (56.0%) did not. Moreover, 87 (87.0%) participants affirmed that handling of hazardous components from other electrical gardget parts required the use of hand gloves, while 13 (13.0%) did not. In the same vein, 70 (70.0%) participants reacted that the resultant effects of poor storage and disposal of e-waste comprised injury to the central nervous system, skin disorders and cancer. Besides, 79 (79.0%) participants affirmed that burning of e-waste constitutes harmful contents into the atmosphere, which were injurious to animals and human being, while 21 (21.0%) did not. Also, 18 (18.0%) participants responded that discharge of harmful contents from e-waste burning can dissipate in rainwater and absorbed by plants, while 82 (82.0%) did not. Table 4.1 further showed that the obtained weighted mean value of 1.35 was less than the criterion of 1.50; hence, it was be inferred that electronic technicians in Ibadan Metropolis did not have adequate knowledge of e-waste management.

Research Question 2: What is the attitude of electronic technicians in Ibadan Metropolis towards e-waste management?

Table 4.2: Distribution of participants' attitude to e-waste management

S/n	Question items	SA	A	D	SD	Mean	Std. Dev
1	I prefer to use my bare hand while recycling e-wastes	7 7.0%	6 6.0%	85 85.0%	2 2.0%	2.82	0.58
2	I am indifferent to separation of hazardous e-waste from other components before storage	2 2.0%	13 13.0%	37 37.0%	48 48.0%	3.31	0.77
3	I am less concern with the health effects of improper management of e-waste	49 49.0%	44 44.0%	6 6.0%	1 1.0%	1.59	0.65
4	People show unnecessary concern about safety in e-waste management	25 25.0%	12 12.0%	61 61.0%	2 2.0%	2.40	0.89
5	I can burn e-waste to dispose them off my shop/facility	1 1.0%	16 16.0%	78 78.0%	5 5.0%	2.87	0.49
6	Using protective devices often while handling e-waste is a sign of lack of faith in God	51 51.0%	36 36.0%	12 12.0%	1 1.0%	1.63	0.73
7	I safeguard through use of necessary protective gadget myself while collecting e-waste anytime I feel like	52 52.0%	29 29.0%	18 18.0%	1 1.0%	1.68	0.80
8	I support environmental safeguards and protection against e-waste.	54 54.0%	36 36.0%	7 7.0%	3 3.0%	1.59	0.75
9	I am ready to join group on proper e-waste management in my area	55 55.0%	33 33.0%	11 11.0%	1 1.0%	1.58	0.73
10	Use of hand glove is not necessary while sorting e-wastes	47 47.0%	32 32.0%	19 19.0%	2 2.0%	1.76	0.83
						Weighted Mean= 2.12 Criterion= 2.5	

As shown in table 4.2, 13 (13.0%) participants disagreed that they preferred to use bare hand, while recycling e-wastes, while 87 (87.0%) disagreed. In addition, 25 (25.0%) participants agreed that they were indifferent to separation of hazardous e-waste from other components before storage, while 75 (75.0%) disagreed. Furthermore, 93 (93.0%) participants agreed that they were less concerned with the health consequence of in appropriate management of e-waste, while 7 (7.0%) disagreed. Moreover, 37 (37.0%) participants agreed that people showed unnecessary concern about safety in e-waste management, while 63 (63.0%) disagreed. Also, 17 (17.0%) participants agreed that they burnt e-waste to dispose them off their shop/facility, while 87 (87.0%) disagreed.

Table 4.2 further showed that 87 (87.0%) participants agreed that using protective devices often, while handling e-wastes was a sign of lack of faith in God, while 13 (13.0%) disagreed. Besides 81 (81.0%) participants agreed that they were

safeguard through the use of necessary protective gadget themselves, while collecting e-waste anytime they felt like, 19 (19.0%) disagreed. In addition, 90 (90.0%) participants agreed that they supported environmental safeguards and protection of e-waste, while 10 (10.0%) disagreed. Again, 88 (88.0%) participants agreed that they were ready to join group on proper e-waste management in their area, 12 (12.0%) disagreed, while 79 (79.0%) participants agreed that the use of hand gloves were not necessary, while sorting e-wastes. Table 4.2 further showed that the obtained weighted mean value of 2.12 was less than the criterion of 2.50; hence, it was inferred that electronic technicians in Ibadan Metropolis had negative attitude towards e-waste management.

Research Question 3: Do electronic technicians in Ibadan Metropolis have good practice of e-waste management?

Table 4.3: Distribution of participants' practice of e-waste management

S/n	Question items	O	RE	RA	N	Mean	Std. Dev
1	I sort e-wastes separately before storing or disposing them	53 53.0%	7 7.0%	22 22.0%	18 18.0%	2.05	1.22
2	I use hand gloves and nose mask while sorting e-waste	0 0.0%	65 65.0%	35 35.0%	0 0.0%	2.35	0.48
3	Gloves that are grossly contaminated during storing and parking are disposed off along with e-waste by me	10 10.0%	9 9.0%	63 63.0%	18 18.0%	2.89	0.82
4	I ensure that e-wastes are properly identified and packed before collection	0 0.0%	2 2.0%	89 89.0%	9 9.0%	2.93	0.33
5	I store e-wastes in a container with air-tight closure within the store room or workshop	54 54.0%	13 13.0%	33 33.0%	0 0.0%	1.79	0.91
6	I place residues of e-waste in an unbreakable labelled container before collection by refuse collectors	49 49.0%	10 10.0%	36 36.0%	5 5.0%	1.97	1.03
7	I sell discarded e-waste materials to those who will convert them to useful materials	0 0.0%	22 22.0%	65 65.0%	13 13.0%	2.91	0.59
8	I follow safety procedures while transporting wastes from where they are stored to the point of disposal	53 53.0%	18 18.0%	17 17.0%	12 12.0%	1.88	1.09
9	I disinfect e-waste container after disposal	56 56.0%	0 0.0%	19 19.0%	25 25.0%	2.13	1.32
10	I do not burn e-wastes	11 11.0%	8 8.0%	56 56.0%	25 25.0%	2.95	0.88
						Weighted Mean= 2.39 Criterion= 2.5	

Table 4.3 showed that 53 (53.0%) participants often sort e-wastes separately before storing or disposing them, 7 (7.0%) regularly engaged in it, 22 (22.0%) rarely engaged in it, while 18 (18.0%) never engaged in doing that. None of the participants used hand gloves and nose mask, while sorting e-waste, 65 (65.0%) regularly practiced it, 35 (35.0%) rarely engaged, while none of the participants practiced it. Ten (10.0%) often disposed off gloves that were grossly contaminated during storing and parking, 9 (9.0%) regularly engaged, 63 (63.0%) hardly engaged, while 18 (18.0%) practiced that. Besides, none of the participants ensured that e-wastes were properly identified and packed before collection, 2 (2.0%) regularly engaged, 89 (89.0%) rarely engaged, while 9 (9.0%) never practiced it. Also, 54 (54.0%) participants often store e-wastes in a container with air-tight closure within the store room or workshop, 13 (13.0%) regularly engaged in that, 33 (33.0%) rarely did that, while none of the participants practiced it.

Table 4.3 further revealed that 49 (49.0%) participants often placed residues of e-waste in an unbreakable labelled container before collection by refuse collectors again, 10 (10.0%) regularly engaged in that, 36 (36.0%) rarely involved, while 5 (5.0%) never practice it. In addition, none of the participants often sell discarded e-waste materials to those who will convert them to useful materials, 22 (22.0%) regularly engaged in that, 65 (65.0%) rarely involved in it, while 13 (13.0%) never practiced it. Moreover, 53 (53.0%) often follow safety procedures, while transporting wastes from where they were stored to the point of disposal, 18 (18.0%) regularly engaged in that, 17 (17.0%) participants rarely involved in it, while 12 (12.0%) never practiced it. About, 56 (56.0%) participants often disinfected e-waste container after disposal, none of the participants engaged in that regularly, 19 (19.0%) rarely engaged in it, while 25 (25.0%) never engaged in that. Also, 11 (11.0%) participants did not often burn e-wastes, 8 (8.0%) regularly engaged in it, 56 (56.0%) rarely involved in it, while 25 (25.0%) never involved in it. Table 4.3 further showed that the obtained weighted mean value of 2.39 was less than the criterion of 2.50; hence, it could be inferred that electronic technicians in Ibadan Metropolis did not have good practice of e-waste management.

Hypotheses

The following hypotheses were tested in the study:

Hypothesis 1(a): There is no significant main effect of treatment on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4: Summary of result showing the pre-post effects of treatment, years of work experience and educational qualification on knowledge, attitude and practice of e-waste

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Posttest Knowledge	1077.055	15	71.804	5.093	.000	.476
	Posttest Attitude	2026.857	15	135.124	2.597	.003	.317
	Posttest Practice	1071.470	15	71.431	2.415	.006	.301
Intercept	Posttest Knowledge	149.496	1	149.496	10.603	.002	.112
	Posttest Attitude	185.256	1	185.256	3.560	.063	.041
	Posttest Practice	210.425	1	210.425	7.115	.009	.078
Pretest Knowledge	Posttest Knowledge	5.900	1	5.900	.418	.519	.005
	Posttest Attitude	35.906	1	35.906	.690	.409	.008
	Posttest Practice	5.034	1	5.034	.170	.681	.002
Pretest Attitude	Posttest Knowledge	1.729	1	1.729	.123	.727	.001
	Posttest Attitude	60.132	1	60.132	1.156	.285	.014
	Posttest Practice	35.321	1	35.321	1.194	.278	.014
Pretest Practice	Posttest Knowledge	53.289	1	53.289	3.780	.055	.043
	Posttest Attitude	246.930	1	246.930	4.745	.032	.053
	Posttest Practice	20.317	1	20.317	.687	.410	.008
Treatment	Posttest Knowledge	275.999	1	275.999	19.575	.000	.189
	Posttest Attitude	254.975	1	254.975	4.900	.030	.055
	Posttest Practice	166.921	1	166.921	5.644	.020	.063
Years of Experience	Posttest Knowledge	61.393	2	30.697	2.177	.120	.049
	Posttest Attitude	121.635	2	60.818	1.69	.316	.027
	Posttest Practice	1.045	2	.522	.081	.982	.000
Educational Qualification	Posttest Knowledge	36.992	2	18.496	1.312	.275	.030
	Posttest Attitude	79.578	2	39.789	.765	.469	.018
	Posttest Practice	88.470	2	44.235	1.496	.230	.034
Treatment*Year of Experience	Posttest Knowledge	81.761	2	40.881	2.900	.061	.065
	Posttest Attitude	6.686	2	3.343	.064	.938	.002
	Posttest Practice	113.341	2	56.670	1.916	.154	.044
Treatment*Educ. Background	Posttest Knowledge	24.909	1	24.909	1.767	.187	.021
	Posttest Attitude	88.546	1	88.546	1.702	.196	.020
	Posttest Practice	66.193	1	66.193	2.238	.138	.026
Year of Exper.* Educ. backgr.	Posttest Knowledge	3.108	2	1.554	.110	.896	.003
	Posttest Attitude	114.707	2	57.354	1.102	.337	.026
	Posttest Practice	40.788	2	20.394	.690	.505	.016
Treatment* Yr. of Expr.*Educ.	Posttest Knowledge	105.562	2	52.781	3.744	.008	.082
	Posttest Attitude	139.784	2	69.892	1.343	.267	.031
	Posttest Practice	225.811	2	112.906	3.818	.026	.083
Error	Posttest Knowledge	1184.335	84	14.099			
	Posttest Attitude	4731.253	84	52.039			
	Posttest Practice	2484.170	84	29.573			
Total	Posttest Knowledge	37643.333	100				
	Posttest Attitude	74885.000	100				
	Posttest Practice	47908.000	100				
Corrected Total	Posttest Knowledge	2261.390	99				
	Posttest Attitude	6398.110	99				
	Posttest Practice	3555.640	99				

As indicated in table 4.4, there was a significant main effect of treatment on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$=19.575, p<0.05, partial η^2=0.189); hence, the hypothesis was rejected. This implied that the treatment contributed significantly to the variation in participants' scores on knowledge of e-waste management. The partial eta square value of 0.189 showed that the treatment had a contribution of 18.9% to participants' knowledge of e-waste management.

Table 4.5a: Estimated marginal means of participants' knowledge of e-waste management by treatment

Dependent Variable	Treatment Group	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Knowledge	Environmental Health Education	22.057	1.035	20.000	24.116
	Control group	16.097	.700	14.705	17.488

Table 4.5a showed that participants exposed to Environmental Health Education (treatment group) had higher posttest mean ($\bar{x}$) score of 22.057 on knowledge of e-waste management than their participants in the control group with posttest mean score of 16.097. This meant that participants exposed to Environmental Health Education (treatment group) performed better than those in the control group. It implied that Environmental Health Education is an effective programme that can increase knowledge on e-waste management.

Hypothesis 1(b): There is no significant main effect of treatment on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 showed a significant main effect of treatment on attitude to e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$=4.900, p<0.05, partial η^2=0.055); hence, the hypothesis was rejected. The implication was that the treatment contributed significantly to the variation in participants' scores on attitude towards e-waste management. The partial eta square value of 0.055 showed that the treatment had a contribution of about 5.5% to participants' attitude towards e-waste management.

Table 4.5b: Estimated marginal means of participants' attitude towards e-waste management by treatment

Dependent Variable	Treatment Group	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Attitude	Environmental Health Education (Treatment)	28.711	1.989	24.756	32.665
	Control	22.055	1.344	19.382	24.728

Table 4.5b showed that participants exposed to Environmental Health Education (treatment group) had a higher posttest mean ($\bar{x}$) score of 28.711 on attitude towards e-waste management than their participants in the control group with posttest mean score of 22.055. This meant that participants exposed to Environmental Health Education (treatment group) performed better than those in the control group. It implied that Environmental Health Education was an effective programme that brought about positive attitude on e-waste management.

Hypothesis 1(c): There is no significant main effect of treatment on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4, revealed a significant main effect of treatment on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$=5.644, p<0.05, partial η^2=0.063); hence, the hypothesis was rejected. This implied that the treatment contributed significantly to the variation in participants' scores on e-waste management practice. The partial eta square value of 0.063 showed that the treatment had a contribution of about 6.3% to practice of e-waste management among the participants.

Table 4.5c: Estimated marginal means of participants' practice of e-waste management by treatment

Dependent Variable	Treatment Group	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Practice	Environmental Health Education (Treatment)	23.559	1.499	20.578	26.540
	Control	17.861	1.013	15.846	19.876

Table 4.5c showed that participants exposed to Environmental Health Education (treatment group) had a higher posttest mean ($\bar{x}$) score of 23.559 on practice of e-waste management than the participants in the control group with posttest mean score of 17.861. This meant that participants exposed to Environmental Health Education (treatment group) performed better than those in the control group. It implied that Environmental Health Education was an effective programme that can bring about positive practice on e-waste management.

Hypothesis 2(a): There is no significant main effect of years of work experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was no significant main effect of years of work experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 2.177, p>0.05, partial η^2=0.049); Hence, the hypothesis was not rejected. This implied that years of work experience had no significant effect on participants' scores on knowledge of e-waste management. The partial eta square value of 0.049 showed that years of work experience had a contribution of about 4.9% to participants' knowledge of e-waste management.

Table 4.6a: Estimated marginal means of participants' knowledge of e-waste management by years of work experience

Dependent Variable	Years of Work Experience	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Knowledge	1 -5 years	19.871	1.273	17.340	22.402
	6 -10 years	18.811	1.036	16.751	20.871
	11 years and above	17.871	.543	16.792	18.950

Table 4.6a showed that participants with 1-5 years of work experience had highest posttest mean score of 19.871 on knowledge of e-waste management, followed by 6-10 years with posttest mean score of 18.811, while the participants who had over 11 years of work experience had the least posttest mean score of 17.871. This implied that participants that had 1-5 years of work experience had better knowledge of e-waste management than other groups.

Hypothesis 2(b): There is no significant main effect of years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

As shown in table 4.4, there was no significant main effect of years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=1.169, p>0.05, partial η^2=0.027); hence, the hypothesis was not rejected. This implied that years of work experience had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.027 showed that years of work experience had a contribution of about 2.7% to participants' attitude towards e-waste management.

Table 4.6b: Estimated marginal means of participants' attitude towards e-waste management by years of work experience

Dependent Variable	Years of Work Experience	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Attitude	1 -5 years	26.104	2.445	21.242	30.966
	6 -10 years	22.203	1.990	18.244	26.161
	11 years and above	27.805	1.043	25.731	29.879

Table 4.6b showed that participants with over 11 years of work experience had highest posttest mean score of 27.805 on attitude towards e-waste management, followed by 1-5 years with posttest mean score of 26.104, while participants with 6-10 years experience had least posttest mean score of 22.203. This implied that participants that with over 11 years of work experience had better attitude towards e-waste management than other groups.

Hypothesis 2(c): There is no significant main effect of years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis.

As shown in Table 4.4, there was no significant main effect of years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= .018, p>0.05, partial η^2=0.001); hence, the hypothesis was not rejected. This implied that years of work experience had no significant effect on participants' scores on practice of e-waste management. The partial eta square value of

0.001 showed that the treatment had a contribution of about 0.1% to e-waste management practice among the participants.

Table 4.6c: Estimated marginal means of participants' practice of e-waste management by years of work experience

Dependent Variable	Years of Work Experience	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Practice	1 -5 years	21.270	1.843	17.605	24.935
	6 -10 years	18.995	1.500	16.011	21.979
	11 years and above	21.581	.786	20.108	23.144

Table 4.6c showed that participants above 11 years of work experience had highest posttest mean score ($\bar{x}$ =21.581) on practice of e-waste management, followed by those with 1-5 years with posttest mean score of 21.270; while participants with 6-10 years had least posttest mean score ($\bar{x}$ =18.995). This implied that participants that had over 11 years of work experience practiced e-waste management better than other groups.

Hypothesis 3(a): There is no significant main effect of educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was no significant main effect of educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 1.312, p>0.05, partial η^2=0.030); hence, the hypothesis was not rejected. This implied that educational background had no significant effect on participants' scores on knowledge of e-waste management. The partial eta square value of 0.030 showed that educational background had a contribution of about 3.0% to participants' knowledge of e-waste management.

Table 4.7a: Estimated marginal means of participants' knowledge of e-waste management by educational background

Dependent Variable	Educational Background	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Knowledge	Primary School Leaving Cert.	13.708	2.769	8.202	19.215
	SSCE/NECO	18.502	1.020	16.474	20.531
	OND	20.050	.594	18.868	20.232

Table 4.7a revealed that participants that obtained OND had highest posttest mean score of 20.050 on knowledge of e-waste management, followed by those that possessed SSCE/NECO with posttest mean score of 18.502, while the participants with Primary School Leaving Certificate had the least posttest mean score of 13.708. This implied that participants that obtained OND had better knowledge of e-waste management than other educational groups.

Hypothesis 3(b): There is no significant main effect of educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

As shown in Table 4.4, there was no significant main effect of educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=.765, p>0.05, partial η^2=0.018); hence, the hypothesis was not rejected. This implied that educational qualification had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.018 showed that educational background had a contribution of about 1.8% to participants' attitude towards e-waste management.

Table 4.7b: Estimated marginal means of participants' attitude towards e-waste management by educational background

Dependent Variable	Educational Background	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Attitude	Primary School Leaving Cert.	14.204	5.320	3.625	24.784
	SSCE/NECO	25.748	1.142	23.477	28.019
	OND	26.326	1.960	22.429	30.223

Table 4.7b revealed that participants that possessed OND had highest posttest mean score of 26.326 on attitude towards e-waste management, followed by those that obtained SSCE/NECO with posttest mean score of 25.748, while the participants with Primary School Leaving Certificate had least posttest mean score of 14.204. This implied that participants that obtained OND had better attitude towards e-waste management than other educational groups

Hypothesis 3(c): There is no significant main effect of educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was no significant main effect of educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 1.496, p>0.05, partial η^2=0.034). Hence, the hypothesis was not rejected. This implied that educational background had no significant effect on participants' scores on practice of e-waste management. The partial eta square value of 0.034 showed that the educational background had a contribution of about 3.4% to e-waste management practice among the participants.

Table 4.7c: Estimated marginal means of participants' practice of e-waste management by educational background

Dependent Variable	Educational Background	Mean	Std. Error	95% confidence interval	
				Lower Bound	Upper Bound
Practice	Primary School Leaving Cert.	9.633	4.011	1.657	17.608
	SSCE/NECO	21.014	.861	19.302	22.726
	OND	21.777	1.477	18.840	24.715

Table 4.7c revealed that participants that possessed OND had highest posttest mean score of 21.777 on practice of e-waste management, followed by those that obtained SSCE/NECO with posttest mean score of 21.014, while the participants with Primary School Leaving Certificate had least posttest mean score of 9.633. This implied that participants that obtained OND had better practice of e-waste management than other educational groups.

Hypothesis 4(a): There is no significant interaction effect of treatment and years of work experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was no significant interaction effect of treatment and years of work experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 2.900, p>0.05, partial η^2=0.065). Hence, the hypothesis was not rejected. This implied that interaction effect of treatment and years of work experience had no significant effect on participants' scores on knowledge of

e-waste management. The partial eta square value of 0.065 showed that interaction effect of treatment and years of work experience had a combined contribution of 6.5% to participants' knowledge of e-waste management.

Table 4.8a: Estimated marginal means of participants' knowledge of e-waste management by treatment and years of work experience

Dependent Variable	Treatment Group	Years of Work Experience	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Knowledge	Environmental Health Education (Treatment)	1 -5 years	23.267	2.117	19.057	27.477
		6 -10 years	23.839	1.997	19.864	27.808
		11 years and above	19.070	.805	17.470	20.671
	Control	1 -5 years	16.475	1.389	13.712	19.237
		6 -10 years	15.461	1.170	13.135	17.787
		11 years and above	16.672	.855	14.972	18.371

Table 4.8a showed that participants in the treatment group with 6-10 years of work experience had the highest posttest mean score of 23.839 in knowledge of e-waste management, over participants with 1-5 years of work experience with a mean score of 23.267 and those that had over 11 years of work experience with a mean score of 19.070. This showed that participants in treatment group with 6-10 years of work of work experience had the best performance in knowledge of e-waste management than the participants with 1-5 years and those with over 11 years of work experience respectively.

In the control group, the participants with over 11 years of work experience obtained the highest mean score of 16.672 over participants with 1-5 years of work experience with a mean score of 16.475; and those that had 6-10 years of work experience with a mean score of 15.461. The overall comparison showed that participants with 6-10 years of work experience in treatment group had the highest mean, followed by participants with 1-5 years of work experience in the same group. This meant that, participants with 6-10 years of work experience had the best performance in knowledge

of e-waste management over their counterparts with diverse years of work experience and the participants in control group.

Hypothesis 4(b): There is no significant interaction effect of treatment and years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

As shown in table 4.4, there was no significant interaction effect of treatment and years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 0.064, p>0.05, partial η^2=0.002); hence, hypothesis 4(b) was not rejected. This implied that interaction effect of treatment and years of work experience had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.002 showed that interaction effect of treatment and years of work experience had a combined contribution of 0.2% to participants' attitude towards e-waste management.

Table 4.8b: Estimated marginal means of participants' attitude towards e-waste management by treatment and years of work experience

Dependent Variable	Treatment Group	Years of Work Experience	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Attitude	Environmental Health Education	1 -5 years	28.854	4.067	20.766	36.943
		6 -10 years	27.232	3.838	19.600	34.863
		11 years and above	30.046	1.546	26.971	33.121
	Control	1 -5 years	23.354	2.668	18.047	28.661
		6 -10 years	18.850	2.247	14.381	23.319
		11 years and above	25.564	1.642	22.299	28.829

Table 4.8b showed that participants in the treatment group with over 11years experience had the highest posttest mean score of 30.046 in attitude towards e-waste management, over participants with 1-5 years of work experience with a mean score of 28.854 and those that had 6-10 years of work experience with a mean score of 27.232. This showed that participants in treatment group with over 11years of work experience had the best attitude towards e-waste management than the participants within 1-5 years and 6-10 years of work experience respectively.

In the control group, the participants with over 11 years of work experience obtained the highest mean score of 25.564 over participants with 1-5 years of work experience with a mean score of 23.354; and those that had 6-10 years of work experience with a mean score of 18.850. The overall comparison showed that participants with over 11 years of work experience in treatment group had the highest mean, followed by participants with 1-5 years of work experience in the same group. This means that, participants with over 11 years of work experience in treatment group had the best attitude towards e-waste management over their counterparts with diverse years of work experience and the participants in control group.

Hypothesis 4(c): There is no significant interaction effect of treatment and years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that, there was no significant interaction effect of treatment and years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 1.916, partial p>0.05, partial η^2=0.044); hence, hypothesis 4(c) was not rejected. This implied that interaction effect of treatment and years of work experience had no significant effect on participants' scores on practice of e-waste management. The partial eta square value of 0.044 showed that interaction effect of treatment and years of work experience had a combined contribution of 4.4% to participants' e-waste management practice.

Table 4.8c: Estimated marginal means of participants'practice of e-waste management by treatment and years of work experience

Dependent Variable	Treatment Group	Years of Work Experience	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Practice	Environmental Health Education	1 -5 years	22.373	3.066	16.725	28.470
		6 -10 years	25.766	2.893	20.013	31.519
		11 years and above	22.538	1.166	20.220	24.856
	Control	1 -5 years	20.167	2.012	16.167	24.168
		6 -10 years	14.481	1.694	11.113	17.850
		11 years and above	20.624	1.238	18.163	23.086

Table 4.8c indicated that participants in the treatment group with 6-10 years of work experience had the highest posttest mean score of 25.766 in practice of e-waste management, over participants with over 11 years of work experience with a mean score of 22.538 and those that had 1-5 years of work experience with a mean score of 22.373. This showed that participants in treatment group with 6-10 years of work experience had the best performance in practice of e-waste management than the participants that had over 11 years of work experience and those with 1-5 years respectively.

In the control group, the participants with over 11 years of work experience obtained the highest mean score of 20.624 over participants with 1-5 years of work experience with a mean score of 20.167; and those that had over 6-10 years of work experience with a mean score of 14.481. The overall comparison showed that participants with 6-10 years of work experience in treatment group had the highest mean, followed by participants with 11 years and above in the same group. This meant that participants with 6-10 years of work experience had the best performance in practice of e-waste management over their counterparts with diverse years of work experience and the participants in control group.

Hypothesis 5(a): There is no significant interaction effect of treatment and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 showed that there was no significant interaction effect of treatment and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$= 1.767, p>0.05, partial η^2=0.021); hence, hypothesis 5(a) was not rejected. This implied that interaction effect of treatment and educational background had no significant effect on participants' scores on knowledge of e-waste management. The partial eta square value of 0.021 showed that interaction effect of treatment and educational background had a combined contribution of 2.1% to participants' knowledge of e-waste management.

Table 4.9a: Estimated marginal means of participants' knowledge of e-waste management by treatment and educational background

Dependent Variable	Treatment Group	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Knowledge	Environmental Health Education	Primary School Leaving Cert.	18.047	.916	16.225	19.869
		SSCE/NECO	22.062	1.854	18.376	25.749
		OND	22.053	.820	20.422	23.685
	Control	Primary School Leaving Cert.	13.708	2.769	.820	19.215
		SSCE/NECO	14.942	.890	13.173	16.712
		OND	-	-	-	-

Table 4.9a showed that participants that obtained SSCE/NECO in the treatment group had highest post test mean score of 22.062 in knowledge of e-waste management, over participants that possessed OND with a mean score of 22.053; as well as those that had Primary School Leaving Certificate with a mean score of 18.047. This showed that participants in treatment group with SSCE/NECO had a better performance in knowledge of e-waste management than the participants with OND and Primary School Leaving Certificate.

In the control group, the participants that obtained SSCE/NECO had a higher mean score of 13.708 over participants that had SSCE/NECO with a mean score of 14.942. The overall comparison showed that participants who obtained SSCE/NECO had the highest mean, followed by participants with Primary School Leaving Certificate in the same group. This meant that participants with SSCE/NECO in treatment group had the best performance in knowledge of e-waste management than their counterparts with other educational qualifications and the participants in control group.

Hypothesis 5(b): There is no significant interaction effect of treatment and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that, there was no significant interaction effect of treatment and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$=1.702, p>0.05, partial η^2=0.020); hence,

hypothesis 5(b) was not rejected. This implied that interaction effect of treatment and educational background had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.020 showed that interaction effect of treatment and educational background had a combined contribution of about 2.0% to participants' attitude towards e-waste management.

Table 4.9b: Estimated marginal means of participants' attitude towards e-waste management by treatment and educational background

Dependent Variable	Treatment Group	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Attitude	Environmental Health Education	Primary School Leaving Cert.	26.954	1.576	23.820	30.089
		SSCE/NECO	30.467	3.561	23.386	37.549
		OND	24.542	1.760	21.042	28.043
	Control	Primary School Leaving Cert.	14.204	5.320	3.625	24.784
		SSCE/NECO	22.185	1.710	18.785	25.584
		OND	-	-	-	-

Table 4.9b showed that participants that obtained SSCE/NECO in the treatment group had the highest post test mean score of 30.467 in attitude towards e-waste management, over participants that had Primary School Leaving Certificate with a mean score of 26.954; and those that had OND. This showed that participants in treatment group with SSCE/NECO had the best attitude towards e-waste management than the participants with Primary School Leaving Certificate and OND respectively.

In the control group, the participants that obtained SSCE/NECO had a higher mean score of 22.185 over participants that had Primary School Leaving Certificate with a mean score of 14.202. The overall comparison showed that participants that obtained SSCE/NECO in treatment group had the highest mean, followed by participants with Primary School Leaving Certificate in the same group. This implied that participants that obtained SSCE/NECO in treatment group had a better attitude towards e-waste management than their counterparts with other educational qualifications and the participants in control group.

Hypothesis 5(c): There is no significant interaction effect of treatment and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was no significant interaction effect of treatment and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(1,84)}$=2.238, p>0.05, partial η^2=0.026); hence, the hypothesis was not rejected. This implied that interaction effect of treatment and educational background had no significant effect on participants' scores on practice of e-waste management. The partial eta square value of 0.026 showed that interaction effect of treatment and years of work experience had a combined contribution of 2.6% to participants' e-waste management practice.

Table 4.9c: Estimated marginal means of participants' practice of e-waste management by treatment and educational background

Dependent Variable	Treatment Group	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Practice	Environmental Health Education	Primary School Leaving Cert.	21.908	1.188	19.545	24.271
		SSCE/NECO	25.210	2.685	19.871	30.548
		OND	20.120	1.327	17.481	22.759
	Control	Primary School Leaving Cert.	9.633	4.011	1.657	17.608
		SSCE/NECO	18.345	1.289	15.782	20.908
		OND	-	-	-	-

Table 4.9c showed that, participants that obtained SSCE/NECO in the treatment group had a higher posttest mean score of 25.210 in practice of e-waste management, over participants that possessed Primary School Leaving Certificate with a mean score of 21.908; as well as those that obtained OND with a mean score of 20.120. This showed that participants in treatment group with SSCE/NECO had a better performance in practice of e-waste management than the participants with Primary School Leaving Certificate and OND respectively.

In the control group, the participants that obtained SSCE/NECO had the higher mean score of 18.345 over participants that had Primary School Leaving Certificate with

a mean score of 9.633. The overall comparison showed that participants that obtained SSCE/NECO in experimental group had the highest mean, followed by participants with Primary School Leaving Certificate in the same group. This meant that participants with SSCE/NECO in treatment group had the best performance in knowledge of e-waste management than their counterparts with other educational qualification and the participants in control group.

Hypothesis 6(a): There is no significant interaction effect of years of work experience and educational background on knowledge of e-waste management.

As indicated in table 4.4, there was no significant interaction effect of years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=0.110, p>0.05,partial η^2=0.003); hence, hypothesis 6(a) was not rejected. This implies that interaction effect of years of work experience and educational background had no significant effect on participants' scores on knowledge of e-waste management. The partial eta square value of 0.003 showed that interaction effect of years of work experience and educational qualification had a combined contribution of 0.3% to participants' knowledge of e-waste management.

Table 4.10a: Estimated marginal means of participants' knowledge of e-waste management by years of work experience and educational background

Dependent Variable	Years Work of Experience	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Knowledge	1 -5 years	Primary School Leaving Cert.	19.433	2.059	15.338	23.528
		SSCE/NECO	20.309	1.475	17.376	23.241
		OND	-	-	-	-
	6 -10 years	Primary School Leaving Cert.	19.262	2.091	15.105	23.420
		SSCE/NECO	20.911	.846	19.229	22.593
		OND	13.708	2.769	8.202	19.215
	11 years and above	Primary School Leaving Cert.	16.811	.889	15.043	18.580
		SSCE/NECO	18.931	.624	17.690	20.171
		OND	-	-	-	-

Table 4.10a showed that participants who had 1-5 years of work experience and SSCE/NECO had a higher mean score ($\bar{x}$ =20.309) than participants with 1-5 years of work experience and Primary School Leaving Certificate with a mean score of 19.433. This meant that participants who had 1-5 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants that had 1-5 years of work experience with Primary School Leaving Certificate. In addition, the participants who had 6-10 years of work experience and SSCE/NECO had the highest posttest mean score ($\bar{x}$ =20.911) than participants with 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 19.262; as well as those that had 6-10 years of work experience and OND with a mean score of 13.708. This meant that participants who had 6-10 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants that had 6-10 years of work experience with Primary School Leaving Certificate and OND respectively.

The table further revealed that the participants who had over 11 years of work experience and SSCE/NECO had a higher posttest mean score ($\bar{x}$ =18.931) than participants that had over 11 years of work experience and Primary School Leaving Certificate with a mean score of 16.811. This means that participants who had over 11 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants with Primary School Leaving Certificate. The overall comparison showed that participants that obtained 6-10 years of work experience and SSCE/NECO had the highest mean, followed by participants with 1-5 years and WASC/SSCE. This meant that participants who obtained 6-10 years of work experience and SSCE/NECO had better knowledge of e-waste management than other participants with diverse years of work experience and educational background.

Hypothesis 6(b): There will be no significant interaction effect of years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 showed that there was no significant interaction effect of years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=1.102, p>0.05, partial η^2=0.026);

hence, hypothesis 6(b) was not rejected. This implied that interaction effect of years of work experience and educational background had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.026 showed that interaction effect of years of work experience and educational background had a combined contribution of 2.6% to participants' attitude towards e-waste management.

Table 4.10b: Estimated marginal means of participants' attitude towards e-waste management by years of work experience and educational background

Dependent Variable	Years of Work Experience	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Attitude	1 -5 years	Primary School Leaving Cert.	28.318	3.956	20.450	36.185
		SSCE/NECO	23.891	2.833	18.257	29.525
		OND	-	-	-	-
	6 -10 years	Primary School Leaving Cert.	21.964	4.017	13.976	29.952
		SSCE/NECO	26.440	1.625	23.209	29.671
		OND	14.204	5.320	3.625	24.784
	11 years and above	Primary School Leaving Cert.	28.696	1.709	25.298	32.094
		SSCE/NECO	26.914	1.198	24.531	29.297
		OND	-	-	-	-

Table 4.10b showed that participants who had 1-5 years of work experience and SSCE/NECO had a higher mean score of 23.891 than participants with 1-5 years of work experience and Primary School Leaving Certificate with a mean score of 23.891. This means that participants who had 1-5 years of work experience and OND had the better performance in attitude towards e-waste management than other participants that had 1-5 years of work experience with Primary School Leaving Certificate. In the same vein, the participants who had 6-10 years of work experience and SSCE/NECO had the highest posttest mean score of 26.440 than participants with 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 22.964; as well as those that

had 6-10 years of work experience and OND with a mean score of 14.204. This means that participants who had 6-10 years of work experience and SSCE/NECO had the best performance in attitude towards e-waste management than other participants that had 6-10 years of work experience with Primary School Leaving Certificate and OND respectively.

Table 4.10b further revealed that the participants who had over 11 years of work experience and Primary School Leaving Certificate had higher posttest mean score of 28.696 than participants that had over 11 years of work experience and SSCE/NECO with a mean score of 26.914. This meant that participants who had over 11 years of work experience and Primary School Leaving Certificate performed better in attitude towards e-waste management than other participants with over 11 years of work experience and SSCE/NECO. The overall comparison showed that participants that had over 11 years of work experience and Primary School Leaving Certificate had the highest mean, followed by participants with 1-5 years and Primary School Leaving Certificate. This meant that participants who had over 11 years of work experience and SSCE/NECO had the best performance in attitude towards e-waste management than other participants with diverse years of work experience and educational qualifications.

Hypothesis 6(c): There is no significant interaction effect of years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 showed that there was no significant interaction effect of years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=.690, p>0.05, partial η^2=0.016); hence, hypothesis 6(c) was not rejected. This implied that interaction effect of years of work experience and educational background had no significant effect on participants' scores on practice of e-waste management. The partial eta square value of 0.016 showed that interaction effect of years of work experience and educational background had a combined contribution of 1.6% to participants' e-waste management practice.

Table 4.10c: Estimated marginal means of participants' practice of e-waste management by years of work experience and educational background

Dependent Variable	Years of Work Experience	Educational Background	Mean	Std. Error	95% confidence interval	
					Lower Bound	Upper Bound
Practice	1 -5 years	Primary School Leaving Cert.	23.032	2.982	17.101	28.963
		SSCE/NECO	19.508	2.136	15.260	23.755
		OND	-	-	-	-
	6 -10 years	Primary School Leaving Cert.	20.246	3.028	14.225	26.268
		SSCE/NECO	22.425	1.225	19.989	24.861
		OND	9.633	4.011	1.657	17.608
	11 years and above	Primary School Leaving Cert.	22.053	1.288	19.491	24.615
		SSCE/NECO	21.109	.903	19.313	22.906
		OND	-	-	-	-

Table 4.10c showed that participants who had 1-5 years of work experience and Primary School Leaving Certificate had a higher mean score of 23.032 than participants with 1-5 years of work experience and SSCE/NECO with a mean score of 19.508. This meant that participants who had 1-5 years of work experience and Primary School Leaving Certificate had a better performance in practice of e-waste management than other participants that had 1-5 years of work experience with SSCE/NECO. Furthermore, the participants who had 6-10 years of work experience and SSCE/NECO had the highest posttest mean score of 22.425 than participants with 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 20.246; as well as those that had 6-10 years of work experience and OND with mean score of 9.633. This meant that participants who had 6-10 years of work experience and SSCE/NECO had the best performance in practice of e-waste management than other participants that had 6-10 years of work experience with Primary School Leaving Certificate and OND respectively.

The table further revealed that the participants who had over 11 years of work experience and Primary School Leaving Certificate had higher posttest mean score of 22.053 than participants that had over 11 years of work experience and SSCE/NECO

with a mean score of 21.109. This meant that participants who had over 11 years of work experience and Primary School Leaving Certificate performed better in practice of e-waste management than other participants with over 11 years of work experience and SSCE/NECO. The overall comparison showed that participants that had 1-5 years of work experience and Primary School Leaving Certificate had the highest mean, followed by participants with 6-10 years and SSCE/NECO. This meant that participants who had 1-5 years of work experience and Primary School Leaving Certificate had the better performance in practice of e-waste management than other participants with diverse years of experience and educational qualifications.

Hypothesis 7(a): There is no significant interaction effect of treatment, years of work experience and educational background on knowledge of e-waste management.

As indicated in table 4.4, there was a significant interaction effect of treatment, years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}=3.744$, $p<0.05$, partial $\eta^2=0.082$); hence, the hypothesis was rejected. This implied that interaction effect of treatment, years of work experience and educational background had significant contribution to the variation in participants' scores on knowledge of e-waste management. The partial eta square value of 0.082 showed that interaction effect of treatment, years of work experience and educational background had a combined contribution of about 8.2% to participants' knowledge of e-waste management.

Table 4.11a: Estimated marginal means of participants' knowledge of e-waste management by treatment, years of work experience and educational background

Dependent Variable	Treatment	Years of Work Experience	Educational Background	Mean	Std. Error	95% confidence interval	
						Lower Bound	Upper Bound
Knowledge	Environmental Health Educ.	1 -5 years	Primary School Leaving Cert.	23.017	1.898	19.243	29.790
			SSCE/NECO	23.518	3.771	16.020	31.016
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	19.632	1.349	16.950	22.315
			SSCE/NECO	22.190	1.134	19.935	24.445
			OND	25.482	3.789	17.948	33.106
		11 years and above	Primary School Leaving Cert.	17.601	2.207	13.212	21.989
			SSCE/NECO	20.954	.843	19.277	22.630
			OND	-	-	-	-
	Control	1 -5 years	Primary School Leaving Cert.	15.349	1.690	11.988	18.709
			SSCE/NECO	17.187	1.346	14.511	19.864
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	13.043	1.702	9.657	16.428
			SSCE/NECO	13.708	2.769	8.202	19.215
			OND	-	-	-	-
		11 years and above	Primary School Leaving Cert.	16.436	1.210	14.029	18.843
			SSCE/NECO	16.908	1.067	14.786	19.029
			OND	-	-	-	-

Table 4.11a showed that participants in the treatment group who had 1-5 years of work experience and SSCE/NECO, had a higher mean score of 23.518 than participants that had the same years of work experience, but obtained Primary School Leaving Certificate with a mean score of 23.017. This meant that participants who had 1-5 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants with 1-5 years of work experience with Primary School Leaving Certificate. In addition, the participants in the treatment group who had 6-10 years of work experience and OND had the highest mean ($\bar{x}$) score of 25.482 over other participants with 6-10 years of work experience and SSCE/NECO with a mean score of 22.190; as well as those who had 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 19.632. This meant that participants who

had 6-10 years of work experience and OND had the best performance in knowledge of e-waste management than other participants of the same years of work experience but with diverse educational background.

Table 4.11a further revealed that participants in the treatment group who had over 11 years of work experience and SSCE/NECO had a higher mean score of 20.954 than participants with the same years of work experience, but obtained Primary School Leaving Certificate with a mean score of 17.601. This meant that participants who had over 11 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants with over 11 years of work experience and Primary School Leaving Certificate. In the control group, the participant who had 1-5 years of work experience and SSCE/NECO had a higher mean score of 17.187 over the participants that had the same years of work experience but had Primary School Leaving Certificate with a mean school 15.349. This meant that participants who had 1-5 years of work experience and SSCE/NECO performed better in knowledge of e-waste management than other participants with 1-5 years and Primary School Leaving.

Participants in the control group who had 6-10 years of work experience and SSCE/NECO had a higher mean score (13.708) than those that had 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 13.043. This meant that participants who had 6-10 years of work experience and SSCE/NECO had best performance in knowledge of e-waste management than other participants with 1-6 years of work experience and obtained Primary School Leaving Certificate. It was further showed in the table that participants in the treatment group who had over 11 years of work experience and SSCE/NECO had a higher mean score (16.908) than participants with the same years of work experience but obtained Primary School Leaving Certificate with a mean score of 16.434. The overall comparison showed that participants in the treatment group that had 6-10 years of work experience with OND had the highest mean, followed by participants that had 1-5 years with SSCE/NECO. This meant that participants who had 6-10 years of work experience and OND had better performance in knowledge of e-waste management than their counterparts with diverse years of work experience and educational background in both treatment and control group.

Hypothesis 7(b): There is no significant interaction effect of treatment, years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 showed that there was no significant interaction effect of treatment, years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$=1.343, p>0.05, partial η^2=0.031); hence, the hypothesis was not rejected. This implied that interaction effect of treatment, years of work experience and educational background had no significant effect on participants' scores on attitude towards e-waste management. The partial eta square value of 0.031 showed that interaction effect of treatment, years of work experience and educational qualification had a combined contribution of 3.1% to participants' attitude towards e-waste management.

Table 4.11b: Estimated marginal means of participants' attitude towards e-waste management by treatment, years of work experience and educational background

Dependent Variable	Treatment	Years Of Work Experience	Educational Background	Mean	Std. Error	95% confidence interval	
						Lower Bound	Upper Bound
Attitude	Environmental Health Educ.	1 -5 years	Primary School Leaving Cert.	31.019	7.244	16.613	45.424
			SSCE/NECO	26.690	3.646	19.441	33.940
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	29.106	7.279	14.632	43.581
			SSCE/NECO	26.115	2.325	21.491	30.739
			OND	27.523	2.591	22.370	32.676
		11 years and above	Primary School Leaving Cert.	31.277	2.586	26.135	36.419
			SSCE/NECO	28.815	1.619	25.595	32.025
			OND	-	-	-	-
	Control	1 -5 years	Primary School Leaving Cert.	25.617	3.247	19.160	32.074
			SSCE/NECO	21.091	4.240	12.660	29.523
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	14.822	3.270	8.318	21.326
			SSCE/NECO	25.357	2.179	21.025	29.690
			OND	-	-	-	-
		11 years and above	Primary School Leaving Cert.	14.204	5.320	3.625	24.784
			SSCE/NECO	25.013	2.049	20.938	29.089
			OND	-	-	-	-

Table 4.11b showed that participants in the treatment group who had 1-5 years of work experience and Primary School Leaving Certificate had a higher mean score (31.019) had a higher mean score than participants that had the same years of work experience but obtained SSCE/NECO with a mean score of 26.690. This meant that participants who had 1-5 years of work experience and Primary School Leaving Certificate performed better in attitude towards e-waste management than other participants with 1-5 years of work experience and SSCE/NECO. This might be attributed to the fact that the participants who had 1-5 years of work experience and Primary School Leaving Certificate are being careful by exhibiting positive attitude towards e-waste management. In addition, the participants in the treatment group who had 6-10 years of work experience and Primary School Leaving Certificate had the highest posttest mean score (29.106) than other participants with 6-10 years of work experience and OND with a mean score of 27.523; as well as those who had 6-10 years of work experience and SSCE/NECO with a mean score of 26.115. This meant that participants who had 6-10 years of work experience and Primary School Leaving Certificate had better performance in attitude towards e-waste management than other participants of the same years of work experience but with SSCE/NECO and OND respectively.

Table 4.11b further revealed that participants in the treatment group who had over 11 years of work experience and Primary School Leaving Certificate had a higher mean score (31.277) than participants with the same years of work experience but obtained SSCE/NECO with a mean score of 28.815. This meant that participants who had over 11 years of work experience and Primary School Leaving Certificate performed better in attitude towards e-waste management than other participants with over 11 years of work experience and SSCE/NECO.

In the control group, the participants who had 1-5 years of work experience and Primary School Leaving Certificate had a higher mean score of 25.617 over participants that had 1-5 years of work experience and SSCE/NECO with a mean score of 21.091. This meant that participants who had 1-5 years of work experience and Primary School Leaving Certificate performed better in attitude towards e-waste management than other participants with the same years of work experience, but with SSCE/NECO. Participants

in the control group who had 6-10 years of work experience and SSCE/NECO had the higher mean score (25.357) than participants that had 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 14.822. This meant that participants who had 6-10 years of work experience and SSCE/NECO had a better performance in attitude towards e-waste management than other participants with 6-10 years of work experience and obtained Primary School Leaving Certificate.

It was further shown in table 4.11b that, participants in the control group who had over 11 years of work experience and SSCE/NECO had a higher mean score (25.013) than participants with the same years of work experience but obtained Primary School Leaving Certificate with a mean score of 14.204. The overall comparison showed that participants in the treatment group that had over 11 years of work experience and Primary School Leaving Certificate had the highest mean, followed by participants with 1-5 years of work experience and Primary School Leaving Certificate. This meant that participants who had over 11 years of work experience and Primary School Leaving Certificate had the best performance in attitude towards e-waste management than their counterparts with diverse years of work experience and educational background in treatment and control group.

Hypothesis 7(c): There is no significant interaction effect of treatment, years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis.

Table 4.4 revealed that there was a significant interaction effect of treatment, years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis ($F_{(2,84)}$= 3.818, p<0.05, partial η^2=0.083); hence, the hypothesis was rejected. This implied that interaction effect of treatment, years of work experience and educational background had significant contribution to the variation in participants' scores on practice of e-waste management. The partial eta square value of 0.083 showed that interaction effect of treatment, years of work experience and educational background had a combined contribution of 8.3% to participants' e-waste management practice.

Table 4.11c:Estimated marginal means of participants'practice of e-waste management by treatment, years of work experience and educational background

Dependent Variable	Treatment	Years Of Work Experience	Educational Background	Mean	Std. Error	95% confidence interval	
						Lower Bound	Upper Bound
Practice	Environmental Health Educ.	1 -5 years	Primary School Leaving Cert.	24.840	5.461	13.980	35.699
			SSCE/NECO	22.006	1.753	18.520	25.492
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	22.007	1.954	18.123	25.892
			SSCE/NECO	22.100	1.949	18.224	25.976
			OND	22.843	1.642	19.577	26.109
		11 years and above	Primary School Leaving Cert.	28.689	5.487	17.777	39.600
			SSCE/NECO	22.976	1.221	20.548	25.404
			OND	-	-	-	-
	Control	1 -5 years	Primary School Leaving Cert.	21.225	2.448	16.358	26.092
			SSCE/NECO	19.109	3.196	12.753	25.466
			OND	-	-	-	-
		6 -10 years	Primary School Leaving Cert.	11.084	2.465	6.901	16.707
			SSCE/NECO	19.906	2.748	14.441	25.371
			OND	-	-	-	-
		11 years and above	Primary School Leaving Cert.	9.633	4.011	1.657	17.608
			SSCE/NECO	19.242	1.545	16.170	22.315
			OND	-	-	-	-

Table 4.11c shows that participants in the treatment group who had 1-5 years of work experience and Primary School Leaving Certificate had a higher mean score (24.840) than participants that had the same years of work experience but obtained SSCE/NECO with a mean score of 22.006. This meant that participants who had 1-5 years of work experience and Primary School Leaving Certificate performed better in practice of e-waste management than other participants with 1-5 years of work experience with SSCE/NECO. In addition, the participants in the treatment group who had 6-10 years of work experience and OND had the highest posttest mean score (22.843) than other participants with 6-10 years of work experience and SSCE/NECO with a mean score of 22.100; as well as those who had 6-10 years of work experience and

Primary School Leaving Certificate with a mean score of 22.007. This meant that participants who had 1-6 years of work experience and OND had better performance in practice of e-waste management than other participants of the same years of work experience but with diverse educational background in treatment group.

Table 4.11c further revealed that participants in the treatment group who had over 11 years of work experience and Primary School Leaving Certificate had a higher mean score (28.689) than participants with the same years of work experience but obtained SSCE/NECO with a mean score of 22.976. This means that participants who had over 11 years of work experience and Primary School Leaving Certificate performed better in practice of e-waste management than other participants with over 11 years of work experience and SSCE/NECO.

In the control group, the participant who had 1-5 years of work experience and Primary School Leaving Certificate had a higher mean score of (21.225) over the participants who had 1-5 years of work experience and SSCE/NECO with a mean score of 19.109. This meant that participants who had 1-5 years of work experience with Primary School Leaving Certificate had a better performance in practice of e-waste management than other participants with 1-5 years of work experience and SSCE/NECO.

It was further shown in table 4.11c that the participants who had 6-10 years of work experience and SSCE/NECO had a higher mean score of 19.906 over the participants who had 6-10 years of work experience and Primary School Leaving Certificate with a mean score of 11.084. This means that participants who had 6-10 years of work experience with SSCE/NECO had better performance in practice of e-waste management than other participants with 6-10 years of work experience and Primary School Leaving Certificate. It was also shown that participants in the control group who had over 11 years of work experience and SSCE/NECO had a higher mean score (19.242) than participants with the same years of work experience but obtained Primary School Leaving Certificate with a mean score of 9.633. The overall comparison showed that participants in the treatment group that had over 11 years in experience and Primary School Leaving Certificate had the highest mean, followed by participants with 1-5 years of work experience and Primary School Leaving Certificate. This means that participants who had over 11 years of work experience and Primary School Leaving Certificate had

the best performance in practice of e-waste management than their counterparts with diverse years of work experience and educational qualifications in both treatment and control group.

Summary of Findings

Hypothesis 1(a): Treatment had significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis. The participants exposed to environmental health education (treatment group) had higher post-test mean score on knowledge of e-waste management than the participants in the control group. In addition, 18.9 % of the total variance in participants' knowledge of e-waste management was attributable to the influence of treatment.

Hypothesis 1(b): Treatment had significant effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. The participants exposed to environmental health education (treatment group) had higher post-test mean score on attitude towards e-waste management than the participants in the control group. Similarly, 5.5 % of the total variance in participants' attitude towards e-waste management was attributable to the influence of treatment.

Hypothesis 1(c): Treatment had significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. The participants exposed to environmental health education (treatment group) had higher post-test mean score on practice of e-waste management than the participants in the control group. Furthermore, 6.3% of the total variance in participants' practice of e-waste management was attributable to the influence of treatment.

Hypothesis 2(a): Years of work experience had no significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis. However, participants with 1-5 years of work experience had better knowledge of e-waste management than other groups. In addition, 4.9% of the total variance in participants' knowledge of e-waste management was attributable to the influence of years of work experience.

Hypothesis 2(b): Years of work experience had no significant effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. Nevertheless, participants with over 11 years of work experience had better attitude towards e-waste management than other groups. Also, 2.7% of the total variance in participants' attitude towards e-waste management was attributable to the influence of years of work experience.

Hypothesis 2(c): Years of work experience had no significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. Conversely, participants with over 11 years of work experience had better practice of e-waste management than other groups. Also, 0.1% of the total variance in how participants' practiced e-waste management was attributable to the influence of years of work experience.

Hypothesis 3(a): Educational background had no significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis. However, participants that obtained OND had better knowledge of e-waste management than other educational groups. In addition, 3.0% of the total variance in participants' knowledge of e-waste management was attributable to the influence of educational background.

Hypothesis 3(b): Educational background had no significant effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. Nevertheless, participants that possessed OND had better attitude towards e-waste management than other educational groups. Also, 1.8% of the total variance in participants' attitude towards e-waste management was attributable to the influence of educational background.

Hypothesis 3(c): Educational background had significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. In the same vein, participants that possessed OND had better practice of e-waste management than other educational groups. Also, 3.4% of the total variance in participants' practice of e-waste management was attributable to the influence of educational background.

Hypothesis 4(a): The interaction effect of treatment and years of work experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants with 6-10 years of work experience in

treatment group had better knowledge on e-waste management than their counterparts with diverse years of work experience and the participants in control group. Also, 6.5% of the total variance in participants' knowledge of e-waste management was attributable to the influence of treatment and years of work experience.

Hypothesis 4(b): The interaction effect of treatment and years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants with over 11 years of work experience in treatment group had better attitude towards e-waste management than their counterparts with diverse years of work experience and the participants in control group. Also, 0.2% of the total variance in participants' knowledge of e-waste management was attributable to the influence of treatment and years of work experience.

Hypothesis 4(c): The interaction effect of treatment and years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants with 6-10 years of work experience in treatment group had better attitude towards e-waste management than their counterparts with diverse years of work experience and the participants in control group. Also, 4.4% of the total variance in participants' knowledge of e-waste management was attributable to the influence of treatment and years of work experience.

Hypothesis 5(a): The interaction effect of treatment and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants that obtained SSCE/NECO in treatment group had better knowledge on e-waste management than their counterparts with other educational qualifications and the participants in control group. Also, 2.1% of the total variance in participants' knowledge of e-waste management was attributable to the influence of treatment and educational background.

Hypothesis 5(b): The interaction effect of treatment and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants that obtained SSCE/NECO in treatment group had better attitude towards e-waste management than their counterparts with other educational background and the participants in control group. Also, 2.0% of the total

variance in participants' attitude towards e-waste management was attributable to the influence of treatment and educational background.

Hypothesis 5(c): The interaction effect of treatment and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants that obtained SSCE/NECO in treatment group had better practice of e-waste management than their counterparts with other educational background and the participants in control group. Also, 2.6% of the total variance in participants' e-waste management practice was attributable to treatment and educational background.

Hypothesis 6(a): The interaction effect of years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants who had 6-10 years of work experience and SSCE/NECO had better knowledge of e-waste management than participants with diverse years of work experience and educational background. Also, 0.3% of the total variance in participants' knowledge of e-waste management was attributable to the combined effect of years of work experience and educational background.

Hypothesis 6(b): The interaction effect of years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants who had over 11 years of work experience and SSCE/NECO had better attitude towards e-waste management than other participants with diverse years of work experience and educational background. Also, 2.6% of the total variance in participants' knowledge of e-waste management was attributable to the combined effect of years of work experience and educational background.

Hypothesis 6(c): The interaction effect of years of work experience and educational background on practice of EM among electronic technicians in Ibadan Metropolis was not significant. However, participants who had 1-5 years of work experience and Primary School Leaving Certificate had better practice of e-waste management than other participants with diverse years of work experience and educational background. Also, 1.6% of the total variance in participants' practice of e-waste management was

attributable to the combined effects of years of work experience and educational background.

Hypothesis 7(a): The interaction effect of treatment, years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was significant. The participants who were exposed to environmental health education with 6-10 years of work experience and OND had better knowledge of e-waste management than their counterparts with diverse years of work experience and educational background in both treatment and control group. Also, 8.2% of the total variance in participants' knowledge of e-waste management was attributable to the combined effect of treatment, years of work experience and educational background.

Hypothesis 7(b): The interaction effect of treatment, years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants who were exposed to environmental health education with over 11 years of work experience and Primary School Leaving Certificate had better attitude towards e-waste management than their counterparts with diverse years of work experience and educational background in both treatment and control group. Also, 3.1% of the total variance in participants' attitude towards e-waste management was attributable to the combined effect of treatment, years of work experience and educational background.

Hypothesis 7(c): The interaction effect of treatment, years of experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis was significant. The participants who were exposed to environmental health education with over 11 years of work experience and Primary School Leaving Certificate had better practice of e-waste management than their counterparts with diverse years of work experience and educational background; in both treatment and control group. Also, 8.3% of the total variance in participants' attitude towards e-waste management was attributable to the combined effect of treatment, years of work experience and educational background.

Discussion of Findings:

The finding of the study revealed that treatment had significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis. This implied that the environmental health education which was used as treatment for the experimental group was essentially effective on knowledge of e-waste management. That is, the exposure of the treatment group to environmental health education brought about difference in knowledge of e-waste management between the two groups. This was also supported with the post-test mean score of treatment group that is higher than the participants in the control group on knowledge of e-waste management. The outcome of this study on knowledge of e-waste management was in agreement with the finding of Orhan and Kadir (2014), that absence of environmental awareness and the extent of environmental damage were caused by absence of environmental health education.

It was further established that treatment had significant effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. The implication of this was the environmental health education which was used as treatment for the experimental group was effective. This meant that the exposure of the treatment to environmental health education brought about difference in participants attitude towards e-waste management between treatment and control groups. The higher post-test mean score of the members exposed to environmental health education (treatment) over those in the control group was attributable to the effect of treatment.

The finding further revealed that treatment had significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. This implied that the environmental health education used as treatment for the experimental group essentially brought about difference in practice of e-waste management. It meant that, the exposure of the treatment group to environmental health education brought about difference in practice of e-waste management between the treatment and control groups. This was also supported with the higher post-test mean score of treatment group that is higher than the participants in the control group on practice of e-waste management.

This finding also established that years of work experience had no significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis. This implied there was no significant variation in knowledge of e-waste

management among the electronic technicians in spite of their diverse experiences. However, members who had 1-5 years of work experience had better knowledge of e-waste management than other groups based on experience. The better knowledge of e-waste management of participants with 1-5 years of work experience might be due to the way that the group was likely to be younger and perhaps exposed than other groups. It was further established that years of work experience had no significant effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. The implication was that there was no significant variation in attitude of the participants to e-waste management based on years of work experience. Nevertheless, participants with over 11 years of work experience had better attitude towards e-waste management than other groups. The variance in the attitude of members with above 11 years of work experience towards e-waste management over others might be attributable to their work experience over the years.

It was also established that, years of work experience had no significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. This implied there was no significant variation in practice of e-waste management among the participants based on years of work experience. Conversely, participants with over 11 years of work experience had better practice of e-waste management than other groups. The variance in the practice of e-waste management among participants with above 11 years of work experience over others might be attributable to their work experience over the years. The finding of the study showed that educational establishment had no significant effect on knowledge of e-waste management among electronic technicians in Ibadan Metropolis.

This implied there was no significant variation in the knowledge of e-waste management among the respondents despite their diverse academic differences. However, participants that obtained tertiary education had better knowledge of e-waste management than other educational groups. The better knowledge of e-waste management that those with tertiary education had might be attributable to their academic exposure over those with Primary School Leaving Certificate and SSCE/NECO. The outcome of this study corroborates the finding of Audu (2013), that level of education had significant effect on knowledge of waste management. However, it was further

revealed that respondents with OND had correct level of knowledge on the effect of poor waste management on health than those with lower level of education.

It was also ascertained that educational background had no effect on attitude towards e-waste management among electronic technicians in Ibadan Metropolis. This implied that there was no significant variation in the attitude towards e-waste management among the participants despite their diverse academic differences. Nevertheless, members that possessed SSCE/NECO had better attitude towards e-waste management than other educational groups. It was discovered that educational qualification had significant effect on practice of e-waste management among electronic technicians in Ibadan Metropolis. This implied that educational qualification of the participants contributed to the way participants manage e-waste. This finding further revealed that members that possessed SSCE/NECO had better practice of e-waste management than other educational achievement. The outcome of this research corroborates the finding of Audu (2013), that status of education had significant effect on practices associated with waste.

The finding of this study revealed that the interaction effect of treatment and years of experience on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. This implied that the interaction effect of treatment and years of work experience had no significant effect on differences in knowledge of e-waste management among the members. However, members with 1-5 years of work experience in treatment group had better knowledge of e-waste management than their counterparts with diverse years of work experience and the members in control group. It was discovered that the interaction effect of treatment and years of work experience on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. This implied that the interaction effect of treatment and years of work experience had no significant effect on differences in attitude towards e-waste management among the participants. However, participants with over 11 years of work experience in treatment group had better attitude towards e-waste management than their counterparts with diverse years of work experience and the participants in control group.

The finding further revealed that the interaction effect of treatment and years of work experience on practice of e-waste management among electronic technicians in Ibadan Metropolis was not significant. This implied that the interaction effect of treatment and years of work experience had no significant impact on differences in practice of e-waste management among the participants. However, members with 6-10 years of work experience in treatment group had better attitude towards e-waste management than their counterparts with diverse years of work experience and the members in control group. It was further established that the interaction effect of treatment and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. The implication was that the interaction effect of treatment and educational establishment had no significant effect on variation in knowledge of e-waste management among the participants. However, participants that obtained tertiary education in treatment group had better knowledge on e-waste management than their counterparts with other educational background and the participants in control group.

The finding also revealed that the interaction effect of treatment and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. Nevertheless, participants that obtained SSCE/NECO in treatment group had better attitude towards e-waste management than their counterparts with other educational background and the participants in control group. The interaction effect of treatment and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants that obtained Primary School Leaving Certificate in treatment group had better practice of e-waste management than their counterparts with other educational background and the participants in control group.

The outcome of this study showed that interaction effect of years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was not significant. This implied the interaction effect of years of work experience and educational background had no significant effect on the variation in knowledge of e-waste among the participants. However, participants who had 1-5 years of work experience and tertiary education had

better knowledge of e-waste management than other participants with diverse years of work experience and educational background. The finding of years of work experience and educational background on knowledge of e-waste management was in congruent with the finding of Komolafe (2012), that higher rate of illiteracy, ignorance, uncivilized culture indiscriminate waste littering and infringement of town arranging regulations were identified as factors responsible for improper dumping of waste in the previous five decades in Ibadan Municipality.

The interaction effect of years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants who had 6-10 years of work experience and SSCE/NECO had better attitude towards e-waste management than other participants with diverse years of work experience and educational background. The outcome of this study corroborates the finding of Lauren and Louise (2005), that stakeholders and policy makers have to become proactive in their approach in managing e-waste as a result of the disposal and management problem, which was attributed to attitude.

The finding also revealed that interaction effect of years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants who had 6-10 years of work experience and Primary School Leaving Certificate had better practice of e-waste management than other participants with diverse years of work experience and educational background.

It was found out that interaction effect of treatment, years of work experience and educational background on knowledge of e-waste management among electronic technicians in Ibadan Metropolis was significant. However, participants with 1-5 years of work experience and tertiary education who were exposed to environmental health education had better knowledge of e-waste management than their counterparts with diverse years of work experience and educational background in both treatment and control group. The finding also showed the interaction effect of treatment, years of work experience and educational background on attitude towards e-waste management among electronic technicians in Ibadan Metropolis was not significant. However, participants

exposed to environmental health education with over 11 years of work experience and SSCE/NECO had better attitude towards e-waste management than their counterparts with diverse years of work experience and educational background treatment and control group.

Also, the interaction effect of treatment, years of work experience and educational background on practice of e-waste management among electronic technicians in Ibadan Metropolis was significant. This implied that combine effect of treatment, years of work experience and educational background brought about significant difference in practice of e-waste management among electronic technicians in Ibadan Metropolis. However, participants who were exposed to environmental health education with 6-10 years of work experience and Primary School Leaving Certificate had better practice of e-waste management than their counterparts with diverse years of work experience and educational background in both treatment and control group.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

This study investigated environmental health education and e-waste management among electronic technicians in Ibadan Metropolis, Nigeria. Consequently, independent and moderating variables were tested in relation to dependent variable. The tested independent variable was environmental health education, while knowledge, attitude and practice of e-waste management were examined as the dependent variables. Meanwhile, the years of work experience and educational background were used as the moderating variables. Three research questions were raised and answered, while twenty one hypotheses were formulated and tested.

In order to have a guide for the study, a conceptual frame work was therefore developed. Also, Sustainable E-waste Supply Chain Model was adapted so as to give a strong theoretical base for the study. Furthermore, relevant concepts in relation to the tested variables were reviewed under various sub-headings. Such concepts included e-waste management health and environmental impact on e-waste management, and socio-economic impact on e-waste management. Other concepts included flow of e-waste and problems of e-waste in Nigeria, policy and legislation on e-waste as well as concept of environmental health education. Also, relevant literature were empirically reviewed on knowledge, attitude and practice of e-waste management in relation to environmental health education.

The population for the study comprised electronic technicians in Ibadan Metropolis. The purposive and systematic sampling techniques were used in selecting the participants for the study. A total of one hundred (100) participants were used for the study. A self developed manual on e-waste management and questionnaire were used as instruments. The descriptive statistics of frequency counts, percentages, mean and standard deviation were used to answer the research questions. Bar and pie charts were used to analyse the demographic data, while inferential statistics of Analysis of Variance (ANOVA) was used to test the hypotheses at 0.05 level of significance.

This study provided answers to three research questions, while seven hypotheses were tested with three sub variables each; making a total of twenty one variables. The

findings of the study revealed that environmental health education had significant effect on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis. The results also revealed that there was a significant main effect of educational background on practice of e-waste management; while years of work experience had no significant effect on knowledge, attitude and practice of e-waste management. It was also shown that interaction effects of treatment and years of work experience, treatment and educational background as well as treatment, years of work experience and educational background were not significant.

Conclusion

Based on the findings of this study, it was concluded that environmental health education was effective on knowledge, attitude and practice of e-waste management among the electronic technicians. Years of work experience had no significant effect on knowledge, attitude and practice of e-waste management. It was further concluded that educational background had no significant effect on knowledge, attitude and practice of e-waste management. Interaction effect of treatment and years of work experience as well as treatment and educational background were not significant on knowledge, attitude and practice of e-waste management. The interaction effect of treatment, years of work experience and educational background on knowledge, attitude and practice of e-waste management were not significant. Also, it was concluded that the interaction effect of treatment, years of work experience and educational background was significant on knowledge and practice of e-waste management, but not significant on attitude.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Environmental health education should be encouraged and used by health and safety educators, environmental health officers and other stakeholders to educate the public on e-waste management as well as other environmental-related issues. This is to ensure that the general public's knowledge, attitude and practice are improved regarding environmental health issues.

2. Health and safety educators and environmental health officers should make conscious efforts to ensure that environmental health education is organised in such a way that the experience of the participants is taken into consideration. This is to ensure that both experienced and inexperienced participants are adequately considered in the course of conducting the intervention.
3. Health and safety educators, environmental health officers as well as other stakeholders should ensure that they are sensitive to educational qualifications of participants in the course of conducting in programmes. This is to ensure that each educational group is given equal opportunity and attention irrespective of their educational attainments level.
4. Public health education and sensitization on e-waste management should be carried out periodically by government (both state and local) as well as non-governmental organizations in Ibadan Metropolis and possibly in other towns in Oyo State.
5. Non-governmental organisations should improve on the quality of their environmental health awareness programme in Oyo State to ensure its effectiveness.
6. Related government ministries and agencies should implement environmental sanitation law in the state, particularly on e-waste management. This is to prevent indiscriminate disposal of e-waste in the state.
7. The weekly (Thursdays) environmental sanitation period in Oyo State should be used by Ibadan Solid Waste Management Authority and relevant agencies to monitor electronic technicians in particular and other artisans in general in order to ensure that standard waste management is maintained.
8. Oyo State Ministries of Health and Environment and other relevant agencies should ensure that adequate e-waste disposal facilities are provided for the use by the populace, particularly, the electronic technicians in Ibadan Metropolis.

Contributions to Knowledge

The study contributed to knowledge in the following ways:

1. Environmental health education was an effective programme in the improvement of technicians' knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis.
2. The study confirmed that interaction effect of treatment on years of work experience and educational background had impact on knowledge and practice of e-waste management among electronic technicians in Ibadan Metropolis.
3. The study established that electronic technicians in Ibadan Metropolis had better disposition towards e-waste management and took appropriate precautions to prevent potential hazards on their health.
4. It was deduced that electronic technicians in Ibadan Metropolis did not have appropriate knowledge of e-waste management, attitude towards it; as well as good practice before they were exposed to environmental health education.

Suggestion for Further Studies

The following suggestions were made:

1. The study of this kind can be replicated among electronic technicians at the other political zones in Oyo State, and other states in Nigeria.
2. This study can be replicated on general waste management process in other locations in Oyo State and other states in Nigeria.
3. Other variables such as social interaction, socio-economic status and psychological factors, that the present study did not include can be studied in the future.
4. Multidisciplinary and collaborative approaches on e-waste management can be carried out by other researchers for holistic impact on the environment and people.

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APPENDIX I

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION, UNIVERSITY OF IBADAN, IBADAN, NIGERIA

QUESTIONNAIRE ON EFFECTS OF ENVIRONMENTAL HEALTH EDUCATION ON KNOWLEDGE, ATTITUDE AND PRACTICE OF E-WASTE MANAGEMENT AMONG ELECTRONIC TECHNICIANS IN IBADAN METROPOLIS,

OYO STATE, NIGERIA

Dear Participant,

This questionnaire is developed to examine the effects of environmental health education on knowledge, attitude and practice of e-waste management among electronic technicians in Ibadan Metropolis, Oyo State, Nigeria. Your responses to the questions below shall be appreciated and treated confidentially. Please fill them as appropriate. Thank you.

Yours Sincerely,

Omeboh Nwankaego. E.

(The Researcher)

SECTION A: DEMOGRAPHIC INFORMATION

Instruction: please tick (✓) in the column as it applies to you in each of the following items

1. Sex: Male ( ) Female ( )
2. Age: 18years- 25years ( ) 26years-33years ( ) 34years-41years ( ) 42years-49years ( ) 50 years and above ( )
3. Marital status: Single ( ) Married ( ) Divorced ( ) Separated ( ) Widow ( ) Widower ( )
4. Tribe: Hausa ( ) Igbo ( ) Yoruba ( ) Others ( )
5. Years of work experience: 1years- 5 years ( ) 6years- 10 years ( ) 11 years and above ( )
6. Educational qualification: Primary School Leaving Certificate ( ) NECO /SSCE ( ) OND ( ) NCE ( ) HND ( ) First degree ( ) Postgraduate ( )

SECTION B

KNWOLEDGE OF E-WASTE MANAGEMENT SC ALE (KEWMS)

Please tick (✓) in the appropriate column to indicate the extent of your understanding about the statements below:

S/N	ITEMS	YES	NO
1.	Electronic waste (e-waste) includes scraps from all electronics and electrical appliances.		
2.	E-waste include used electronic gadgets that are discarded for reuse, resale, salvage and recycling or disposing		
3.	Scraps from computers, radio and television are examples of e-waste.		
4.	Hazardous components that are found in e-waste could be injurious to the environment .		
5.	Hazardous components found in e-waste are unsafe for human consumption .		
6.	E-waste management involves all activities and actions required to manage electronic wastes from its site to final state of disposal		
7.	The process of e-waste management includes sorting out storage, collection, recycling and disposal.		
8.	The use of personal protective equipment such as hand glove and nose mask are essentials at some stage of managing e- waste		
9.	Handling of hazardous component from other electrical garget parts requires the use of hand gloves		
10.	The resultant effects of improper storage and disposal of e-waste include damage to the central nervous system, skin disorders and cancer.		
11.	Burning of e-waste constitutes harmful contents into the atmosphere, which are injurious to animals and human being.		
12.	Discharge of harmful contents from e-waste burning can dissolve in rainwater and assimilated by plants.		

SECTION C

ATTITUDE TOWARDS E-WASTE MANAGEMENT SCALE (ATEWMS)

Please tick (✓) in the appropriate column to indicate the extent to which you agree or disagree with the statements below:

Strongly agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD)

S/N	ITEMS	SA	A	D	SD
1	I prefer to use my bare hand while recycling e-wastes				
2.	Use of hand glove is not necessary while sorting e-wastes				
3.	I am indifferent to separation of hazardous e-waste from other components before storage				
4.	I am less concern with the health effects of improper management of e-waste				
5	People show unnecessary concern about safety in e-waste management				
.6	I can burn e-waste to dispose them off my shop/facility				
7	Using protective devices often while handling e-waste is a sign of lack of faith in God				
8.	I safeguard through use of necessary protective gadget myself while collecting e-waste anytime I feel like				
9.	I support environmental safeguards and protection of again e-waste.				
10	I am ready to join group on proper e-waste management in my area				

SECTION D

PRACTICE OF E-WASTE MANAGEMENT SCALE (PEMS)

Please tick (✓) in the appropriate column to indicate the extent to which you agree or disagree with the statements below:

Often (O) – Every day
Regularly (RE) – Twice/three times in a week
Rarely (RA) – At least twice in a month
Never (N) – Not at all

S/N	ITEMS	O	RE	RA	N
1.	I sort e-wastes separately before storing or disposing them				
2.	I use hand gloves and nose mask while sorting e-waste				
3.	Gloves that are grossly contaminated during storing and parking are disposed off along with e-waste by me				
4.	I ensure that e-wastes are properly identified and packed before collection				
5.	I store e-wastes in a container with air-tight closure within the store room or workshop				
6.	I place residues of e-waste in an unbreakable labelled container before collection by refuse collectors				
7.	I sell discarded e-waste materials to those who will convert them to useful materials				
8.	I follow safety procedures while transporting wastes from where they are stored to the point of disposal				
9.	I disinfect e-waste container after disposal				
10.	I do not burn electronic wastes				

APPENDIX II (ÀSOMỌ́ II)
ẸKA ÌMỌ ẸKỌ́ KÀÌNẸ́TÍÌKÌ ATI ẸKỌ AJẸMỌ́LERA, YUNIFÁSÍTÌ ÌBÀDÀN, ÌBÀDÀN, NÀÌJÍRÍÀ
ÀTÒJỌ ÌBÉÈRÈ AFIṢÈWÁDÌÍ LÓRÍ IPA ẸKỌ́ ÌMỌ̀ ÌLERA LÓRÍ ÌMỌ̀, ÌWÙWÀSÍ ÀTI ÌṢIṢẸ́ ÌṢÀKÓSO ÌDỌ̀TÍ AJẸMỌ́ LẸ́ŃTÍRÍKÌ LÁÀRÍN ÀWỌN ÒṢÌṢẸ́ ONÍMỌ̀-IṢẸ́-ỌWỌ́ NÍ AGBÈGBÈ ÌBÀDÀN

Akópa mi Ọ̀won,

A ṣe àkójọpọ̀ Àtòjọ ìbéèrè afiṣèwádìí yìí, láti le è ṣe àgbéyẹ̀wò ipa ti ẹ̀kọ́ ìmọ̀ ìlera, ìwùwàsi àti ìṣiṣẹ̀ ìṣàkóso e-waste ń kó láàárin àwọn òṣìṣẹ́ onímọ̀ iṣẹ́-ọwọ́ ní agbègbè Ìbàdàn, tí ìpínlẹ̀ Ọ̀yọ́, ní orílẹ̀ èdè Nàìjíríà.Ìdáhùn yin sí àwọn ìbéère ìsàlẹ̀ wọ̀nyìí yóò dùn mọ́ wa nínú púpọ̀, bákan náà, a kò ní jeh kí ó hàn sí ẹnikẹ́ni. Ẹ jọ̀wọ́, ẹ ri dájú pẹ ẹ dáhùn bí ó ti yẹ. Ẹ ṣeun púpọ̀.

Tiyín Tòótọ́

Omeboh Nwankaego. E.

(Aṣèwádìí)

ÌPÍN A: ÌFITÓNILÉTÍ AJẸMỌ́ ÌMỌ̀ ÌṢỌWỌ́PỌ̀-ÈNÌYÀN LÁWÙJỌ

Àlàyé pàtàkì: jọ̀wọ́ ṣàmì () sí inú àkámọ́ kọ̀ọ̀kan bí o ti bá ọ mu si

1. Akọnbábo: Akọ( ) Abo ( )
2. Iye Ọdún: ọdún méjìdínlógun si márùndínlọ́gbọ̀n ( ) Ọdún mẹ́rìndínlọgbọ̀n sí mẹ́tàlẹ́lọ́gbọ̀ ( ) Ọdún mẹrìnlélọ́gbọ̀n sí mọ́kànlẹ́lógójì ( ) Ọdún méjìlẹlógóji sí mọ́kàndínláadọ́ta ( ) Àádọ́ta ọdún síwájú ( )
3. Ipò igbéyàwó: Àpọ́n ( ) Abilékọ ( ) Ìkọ̀sílẹ̀ ( ) Idagbé ( ) Opóbìnrin( ) Opókùnrin ( )
4. Ẹ̀yà: Hausa ( ) Ìgbò ( ) Yorùbá ( ) Ẹ̀yà Mìíràn ( )
5. Iyẹ ọdún lẹ́nu iṣé : Ọdún kan sí márùn-ún ( ) Ọdún mẹ́fà sí mẹ́wàá ( ) Ọdún mọ́kànlá sókè ( )
6. Ìwé Ẹ̀rí tí o ní lọ́wọ́: Ìwé ẹ̀ri ilẹ ìwé alákọ̀ọ́bẹ̀rẹ̀ ( ) Ìwé ẹ̀ri ilẹ ìwé Girama ( ) OND () NCE ( ) HND ( ) Ìwé ẹ̀ri Yunifásíti ( ) Ìwé ẹ̀ri onípò gíga Yunifásíti ( )

ÌPÍN B
ÌGBÉLÉWỌ̀N IMỌ ÌṢÀKOSO E-WESTE (KEWMS)

jọ̀wọ́ ṣàmì ( ) sí inú àkámọ́ kọ̀ọ̀kan bí o ti tọ́ láti ṣeàfihàn bí àwọn òrọ̀ ìsàlẹ̀ wọ̀nyìí ti yẹ ọ sí:

Òǹkà	Ọ̀kọ̀ọ̀kan	Bẹ́ẹ̀ni	Bẹ́ẹ̀kọ́
1.	Àwọn irin àkọ̀ti láti ara gbogbo àwọn ẹ̀rọ alòlẹ́ńtírílìkì wà lára ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì		
2.	Àwọn ẹ̀rọ tó ń lo lẹ́ńtírílìkì gbogbo ti wọ́n ti di àlọ̀patì fuhn igbà pípẹ́ wà lára ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì		
3.	Àwọn eyẹeyọ alòpatì ẹ̀rọ Kọ̀ǹpútà, Rédíò àti Tẹlifisàn wà lára ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì		
4.	Àwọn èròjà tí o léwu tí a ri fàyọ lati ara ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì yìí lè mú ìpalára wá fún àyíká		
5.	Àwọn èròjà tí o léwu tí a ri fàyọ lati ara ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì yìí lèwu fún agọ́ ara ènìyàn		
6.	Ikọ̀ tó ń ṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtírílìkì yìí maa ń ní ṣe pẹ̀lú		

	gbogbo ìgbésẹ̀ tí ó wà fún ṣíṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì, láti kikó wọn kúrò ni ibi tí wọ́n dàwọ́n si títí di kikó de ibi ilò wọn		
7.	Títo ibi iko nǹkan pamọ́ si, gbí gba wọlé, títúnlò àti kíkó dànu wà lára ìgbésẹ̀ Ìṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì yìí		
8.	Lílo àwọn ohun èlò ìdáàbòbò bíI ìbọ̀wọ́ àti ìbòmú ṣe pàtàkì ní ìpele kan ninú ìṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì		
9.	Ó ṣe pàtàki láti lo ìbọ̀wọ́ nígbà tí a bá ń ṣe ètò àwọn èròjà tí o léwu tí a ri fàyọ lati ara ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì		
10.	Ìkópamọ́ àti dádànù àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì lọ́nà àìtọ́ máa ń fa àìdápe fun gbogbo ẹ̀yà ara, àìsàn àwọ̀ àti jẹjẹrẹ		
11.	Jíjó àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì máa ń ṣokùnfa oríṣìírìṣìí ohun ìjànbá sínú afẹ́fẹ́, ní èyí tí ó lé ṣe àkóbá fún àgọ́ ara ènìyàn àti ẹranko		
12.	Àwọn ohun ìjànba láti ara ìsísun ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì lè yòrò sínú omi òjò tí àwọn ohun ọ̀gbìn lè fàsára		

ÌPÍN C

ÒṢÙWỌ̀N ÌHÀ TÍ A KỌ SÍ ÌṢÀKÓSO ÌDỌ̀TÍ AJẸMỌ́ LẸ́ŃTÍRÍKÌ

jọ̀wọ́ ṣàmì ( ) sí inú àkámọ́ kọ̀ọ̀kan bí o ti tọ́ láti ṣeàfihàn bóyá o gbà tàbí o lòdì sí àwọn gbólóhùn ìsàlẹ̀ yìí:

Mo faramọ́ dáadáa (MFD), Mo faramọ́ (MF), N kò faramọ́ (NKF) àti N kò faramọ́ rárá (NKFR)

Ònkà	Ọ̀kọ̀ọ̀kan	MFD	MF	NKF	NKFR
1.	Ọwọ́ lásán ni o máa ń wù mi láti lò ní ṣíṣe ètò àyípadà àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì				
2.	Lílo ibọ̀wọ́ kìí ṣe dandan nígbà tí a ba ń ṣe ìṣàsọ́tọ̀ àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì				
3.	Mí ò bìkítà nípa yíya àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì apanilára sọtọ̀ kúrò lara àwọn ìdọ̀tí mìíràn kí a tó kó wọn pamọ́				
4.	Mi ò bìkítà sí ipa ti ìṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì tí kò péyé ń kó lorí ìlera				
5.	Àwọn èniyàn máa ń ṣe àpọ́n ààbo ìṣàkóso ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì jù				
6.	Mo lè dáná sun ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì tí n kò fẹ́ ri agbègbè mi				
7.	Lilo àwọn ohun ìdáàbòbò ní gbogbo igba tí a ba ń ṣètò ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì túnmọ̀ si àìnígbàgbó nínú ọlọ́run				
8.	Nigbatí mo bá ń sètò àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì, moo máa ń lo àwọn ohun idáàbòbo ara tí bá wù mi				
9.	Mo faramọ́ ìdáàbò àyíká lọ́wọ́ ẹwu ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì				

10.	Mo ti ṣetán láti darapọ̀ mọ́ ẹgbẹ́ ìsàkóso tó péyé lorí ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì ní agbègbè mi				

ÌPÍN D

DÍDÁN ÒṢÙWỌ̀N ÌṢÀKÓSO ÌDỌ̀TÍ AJẸMỌ́ LẸ́ŃTÍRÍKÌ WÒ

jọ̀wọ́ ṣàmì ( ) sí inú àkámọ́ kọ̀ọ̀kan bí o ti tọ́ láti ṣeàfihàn bóyá o gbà tàbí o lòdì sí àwọn gbólóhùn ìsàlẹ̀ yìí:

Lẹmọ́lemọ́ (LE) - Ojoojúmọ́
Lẹ́ẹ̀kọ̀kọ̀kan (LEK) - ẹ̀ẹ̀mejì/ẹ̀ẹ̀mẹ́ta ní ọ̀ṣẹ̀
Kò wọ́pọ̀ (KW) - Ó kẹ́rẹ́ tán ẹ̀ẹ̀mejì lóṣù
Lailai (LA) - kì í ṣelẹ̀ rárá

Òǹkà	Ọ̀kọ̀ọ̀kan	LE	LEK	KW	LA
1.	Mo máa n ya àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì sọ́tọ̀ kí n tó dà wọ́n nù				
2.	Mo máa ń lo ìbọ̀wọ́ àti ìbòmú tí mo bá ń kó àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì jọ				
3.	Mo máa n da àwọn ìbọwọ́ tí wọn ba ti ni alébu nù pẹlú àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì ní àsì kò tih mo bá lò wọ́ láti ṣiṣẹ́				
4.	Mo máa ń rí I dáju pé a ṣa àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyí sọ́tọ̀ dáadáa kí wọn to wá kó wọn				
5.	Mo máa n ri dájú pé mo kó àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí si inú ibi tí afẹ́fé kò lè wọ̀ láàrín ibi – iṣẹ́ mi				
6.	Mo máa n gbe àwọn àlòku ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí si inú ibi ti kò lè fọ́, pẹ̀lú orukọ́ lara rẹ̀ láàrín ibi – iṣẹ́ mi, kí àwọn akódọ̀ti tó wá kó o				
7.	Mo máa ń ta àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí fún àwọn tí yóò tún un rọ sí nǹkan mìíran				
8.	Mo máa ń tèlé ilànà tí ó tọ́ lati gbé àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí lati ibi ikowọnpamọ́sí, sih ibi ìdànu wọn				
9.	Mo máa ń fọ àwọn nǹkan tí mo fi ko ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí kúrò dáadá lẹyin ti mo ba dà wọ́n nù				
10.	N kìí sun àwọn ìdọ̀ti ajẹmọ́- lẹ́ńtíríìkì wọ̀nyìí nina				

APPENDIX III

ENVIRONMENTAL HEALTH EDUCATION MANUAL

Purpose of the Intervention

The purpose of the environmental health education is to bring about improvement in knowledge, attitude and practice towards e-waste management among electronic technicians in Ibadan Metropolis, Oyo State, Nigeria.

Objective of the Intervention

By the end of the eight week of environmental health education, it was expected that electronic technicians in Ibadan Metropolis would be able to:

1. Have better understanding of e-waste management
2. Have better attitude towards e-waste management
3. Have better practice of e-waste management

Modality of the Intervention

The intervention programme covered:

1. A period of eight weeks
2. Electronic technicians in Ibadan Metropolis, Oyo State
3. 2 hour (once a week)

Outline of the Programme

1. Pretest on participants' knowledge, attitude and practice towards e-waste management.
2. Environmental health education sessions for a period of eight weeks for the treatment group.
3. Conventional lecture sessions for a period of eight weeks for the control group.
4. Posttest on participants' knowledge, attitude and practice towards e-waste management.

Topics to be considered for the environmental health education

1. Concept of e-waste
2. Hazardous components in e-waste
3. Concept and method of e-waste management
4. Health and environmental impact of e-waste management
5. Preventive measures on e-waste management
6. Promotion of positive attitude and practice of e-waste management

APPENDIX IV

ENVIRONMENTAL HEALTH EDUCATION ON E-WASTE MANAGEMENT TRAINING PACKAGE

Week 1 Topic: General Orientation and Administration of Pre-test instrument.

Objectives of the session:

1. To state the purpose of the meetings
2. To explain the procedures that would be followed by the trainers as well as participants
3. To administer the pre-test instrument on the participants.

Step 1: The researcher welcomed the participants. Solicit for their co-operation, punctuality, regular attendance and allow them to interact for few minutes to ensure familiarization among the participants.

Step 2: The researcher would state and explain the purpose, objectives and benefits of the training. Day, duration, contact hours as well as other relevant information would be discussed with the participants.

Step 3: The researcher later administered the pre-test instruments on the participants with the help of trained Research Assistants. The instruments were collected on the spot.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week II Topic: E-waste (Concept, categories and main sources of e-waste)

Objectives: At the end of this session, the participants were able to:

1. Define e-waste
2. State the categories of e-waste with their typical examples
3. Mention the main sources of e-wastes

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week were introduced and explained

Concept of e-waste

Electronic waste (e-waste) or Waste Electrical and Electronic equipment (WEE) is described as unwanted electrical and electronic equipment that are obsolete at the end of their lives; or that have been discarded by their original users. E-waste broadly covers waste from all electronic and electrical appliances and comprises of items such as computers, mobile phones, digital music recorders/players, refrigerators, washing machines, televisions (TVs) and many other household consumer items that are perceived no longer useful. It also includes all components, subassemblies and consumables, which are part of the product at the time of discarding.

Categories of e-waste

E-waste covers waste from all electronic and electrical appliances. These are categorized as follows; with their typical examples:

Categories of Electrical and Electronics Waste

S/N	Category	Typical examples
1	Large Household Appliances	Refrigerators, freezers, washing machines, clothe dryers, microwaves, heating appliances, radiators, fanning/exhaust ventilation/conditioning equipment
2	Small Household Appliances	Vacuum cleaners, other cleaners, sewing/knitting/ weaving textile appliances, toasters, fryers, pressing iron, grinders, opening/sealing/packaging appliances, knives, hair cutting/drying/shaving devices, clocks, watches
3	IT and Telecommunication Equipment	Mainframes, microcomputers, printers, PC (desktop, notebooks, laptops), photocopiers, typewriters, fax/telex equipment, telephones
4	Consumer Equipment	Radio and TV sets, video cameras/decoders, Hi-fi recorder, audio amplifiers, musical instruments
5	Lighting Equipment	Luminaires for fluorescent lamps, low pressure sodium lamps
6	Electrical and Electronic Tools (excluding large-scale industrial tools)	Drills, saws, sewing machines, turning/milling/sanding/sawing/cutting/shearing/drilling/punching/folding/bending equipment, riveting/nailing/screwing tools, welding/soldering tools, spraying/spreading/dispersing tools,
7	Toys, Leisure and Sports Equipment	Electric trains, car racing sets, video games, sports equipment, coin slot machines, biking/diving/running/ rowing computers
8	Medical Devices	Devices for radiotherapy/cardiology/dialysis, ventilators, analyzers, freezers, fertilization tests, detecting/preventing/monitoring/treating/alleviating illness, injury or disability
9	Monitoring and Control Instruments	Smoke detectors, heating regulators, thermostats, measuring/weighing/adjusting appliances for household or laboratory use, other industrial monitoring and control instruments
10	Automatic Dispensers	for hot drinks, hot or cold bottles/cans, solid, products, money, and all kinds of products

Main sources of e-waste

There are five major sources of e-waste. These include;

i. Waste electronic products from household;
ii. Waste electronic products from governments, institutions and enterprises;
iv. Defective electronic products (Defective Imports);
iv. Used EEE (e-waste and near end of the life EEE);
v. Illegal imports

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week III: Hazardous components in e-waste and their effect on human

Objectives: At the end of the session, the participants were able to:

1. List the hazardous components in e-waste
2. State the effects of the hazardous components on human

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week were introduced and explained.

Hazardous components in e-waste

Most of the components in e-waste are hazardous and toxic, hence unsafe to human and the environment. The cathode ray tube (CRT) of a TV or computer monitor, for example, contains lead, antimony, phosphorous and so on. In some proportions, the circuit boards in different electric products contain lead, beryllium, antimony and brominated flame retardant (BFR). Other toxic substances contained in various electronic items include selenium, antimony trioxide, cadmium, cobalt, manganese, brome and barium, amongst many others. The major components are therefore explained as follows:

Hazardous components in e-waste items

S/n	Hazardous components	Typical sources	Effects on humans
1	Mercury	Fluorescent lamps, LCD monitor, switches, flat panel screens	Impairment of neurological development in fetuses and small children, tremours, emotional changes, cognition, motor function, insomnia, headaches, changes in nervous response, kidney effects, respiratory failures, death
2	Lead	CRT of TV, computer monitor, circuit boards	Probable human carcinogen, damage to brain and nervous systems, slow growth in children, hearing problems, blindness, diarrhea, cognition, behavioural changes (For instance, delinquent), physical disorder.
3	Chromium	Untreated and galvanized steel plates, decorator or hardener for steel housings	Asthmatic bronchitis, skin irritation, ulceration, respiratory irritation, perforated eardrums, kidney damage, liver damage, pulmonary congestion, oedema, epigastric pain, erosion and discolouration of the teeth, motor function
4	Brominated Flame Retardant (BFR)	Plastic casings, circuit boards	May increase cancer risk to digestive and lymph systems, endocrine disorder
5	Cadmium	Light-sensitive resistors, as corrosion retardant, Ni-Cd battery	Inhalation due to proximity to hazardous dump can cause severe damage to the lungs, kidney damage, cognition

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week IV: Concept and method of e-waste management

Objectives: At the end of the session the participants were able to:

1. Define e-waste management
2. List the methods of e-waste management
3. Explain the method of e-waste management

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week were introduced and explained

Concept of e-waste management

E-waste management is a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of e-waste in a sanitary, aesthetically, acceptable and economic manner. The term waste management in this context is conceptualized as the care in manipulation, treatment, use or control of e-waste in an acceptable, aesthetically and economic manner.

Method of e-waste management

In waste management, waste materials are collected, transported, disposed or possibly processed and recycled with the view to reducing their negative impacts on health, the environment or aesthetics. It is also carried out in order to recover resources from it. Some of the methods used in managing e-waste include the following:

i. Disposal to Landfill

This is one of the most widely used methods of waste disposal in which e-waste is buried. Mining voids or borrow pits can be used in land filling.

iii. Incineration

With this method, the waste materials are burnt in incinerators at high temperatures. When e-waste is incinerated, there is a reduction in the waste volume and the energy content of combustible materials can be utilized. However, this method results in pollution, more so because most e-wastes contain some quantities of lead-tin solders and therefore should not be encouraged.

iii. Re-use Method

In this method the original equipment is put into second hand use or use after modifications. This method equally has an advantage of reducing the volume of e-waste generation.

iv. Avoidance and Reduction Methods

Waste reduction or prevention involves the prevention of e-waste from being created. This method is good in waste management because it is only when waste is generated

that it has associated waste management costs. In addition, it helps in resources conservation.

v. Extended Producer Responsibility (EPC)

Usually producers push the responsibility for the end-of-life product management to the general public. However, this method places it appropriately on the shoulders of the producers and all entities involved in the product chain. With this in mind, product designers are challenged to ensure that at every stage of products lifecycle, there is minimization of impact on human health and the environment.

vi. Legislation

The issue of e-waste has sparked off a number of initiatives around the world with the aim of promoting the reuse of electronic devices and mandating manufacturers to use safer substances in their products. For instance, in some states in the USA developed policies banning cathode ray tubes from landfills due to the fear that the heavy metals contained in them would contaminate ground water. Also in Europe, legislation has been drafted to deal with the problem.

vii. Export to Developing Countries

Some developed countries have adopted a method of exporting e-waste to developing countries like India and Nigeria under the guise of sale or donation of second hand electronics. These countries have gradually become their e-waste dump sites extensions. The exporting countries carry out their illegal business because they see it as less expensive than normal disposal.

viii. Recycling

The best method of e-waste management is to recycle the equipment. Recycling is the process of extracting resources of value from e-waste. Here the equipment is disassembled and the valuable components are recovered and are used for manufacturing new products.

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week V: Health and environmental impact of e-waste management

Objectives: At the end of the session the participants were able to:

1. Explain the health impact of e-waste management
2. Explain the environmental impact of e-waste management

Activity

Step 1: The researcher welcomed the participants

Step 2: The topic for the week were introduced and explained.

Health impact of e-waste management

Electronic waste has many toxic and hazardous elements/materials that are sources of environmental pollution. The risk from e-waste affects the entire ecosystems and it is a major environmental health risk to wildlife and humans. E-wastes contain over 1000 different substances many of which are toxic and potentially hazardous to environment and human health.

It is made up of multiple components some of which contain toxic substances that have an adverse impact on human health and environment if not handled properly. Often, these problems arise out of improper recycling and disposal methods.

Long term exposure to the toxic substances affects;

- the nervous system, reproductive and endocrine systems
- kidneys, bones,
- altered cellular expression
- decreased lung function

Environmental impact of e-waste management

- The act of using landfill and burning as a disposal management methods contributes immensely to environmental and public health problems.
- Burning can also leak harmful contents into the atmosphere, which can be inhaled by livestock and humans, or can dissolve in rainwater and is assimilated by plants

- Uncontrolled and poorly managed dumping in the landfill can result to poisonous substances being leached into the soil and water bodies, thus contaminating the soil and water bodies.

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week VI Topic: Management of e-waste and its hazardous substances

Objectives: At the end of the session the participants were able to:

1. Explain how e-waste and its hazardous substances could be managed without risk for human health
2. Explain plans on how to minimize the negative impact of e-waste

Activity

Step 1: The researcher welcomed the participants.

Step 2: The topic for the week were introduced and explained

Plans on how to minimize the negative impact of e-waste

1. All stakeholders (government, industry, environmental groups, and citizens) must work in cooperative collaboration with NESREA to effectively manage and mitigate the problems of e-waste in Nigeria.
2. Producer companies should use non-toxic raw materials in the manufacture of EEE to reduce the production of e-waste.
3. Increase the tempo of the awareness campaigns in local and indigenous languages on the dangers of e-waste to human and environmental health.
4. Develop local capacity for the recovery of copper, steel, lead, silver, gold, platinum group metals, plastics, etc. from e-waste.
5. Develop national e-waste collection centers and e-waste management infrastructure in Nigeria.

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week VII Topic: Promotion of positive attitude towards e-waste management

Objectives: At the end of the session the participants were able to:

1. Describe attitudes that could enhance e-waste management in the workplace.
2. Provide education on the need for attitudinal change that will bring about source separation and improved e-waste disposal habits

Activity

Step 1: The researcher welcomed the participants.

Step 2: The topic for the week were introduced and explained

Promotion of positive attitude towards e-waste management

- The attitude of cleaning the workplace environment regularly will promote good health of Electrical and electronic workers and their customers.
- Burning of electrical/electronic wastes in an open place should be avoided because of pollution and contamination in the environment
- Dumping of e-waste at the appropriate dumping sites or facilities is necessary
- E-waste residuals from workshop should not just be packed together without considering the forms or nature of such wastes.
- The attitude of free dumping of e-waste in and around the workplace will lead to dirty surrounding, flies breeding and foul odour, which can cause diseases or disorders.
- Always showing concern for workplace environment
- Cleaning and sweeping of shop and its surroundings regularly will prevent flies and rats from gaining access

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.

2. The participants were reminded of the time and venue for the next session.

Week VIII Topic: Review of Previous Sessions and Administration of Post-test Instrument

Objectives: At the end of the session participants were able to:

1. Summarize what the participants have learnt from the training programme
2. Express their willingness to continue to improve on attitude towards e-waste management

Activity

Step 1: The participants were welcomed

Step 2: Questions were asked on all topics taught to know how participants have internalized the training.

Step 3: Post-test instrument were administered on the participants. The instruments were collected on the spot with the help of trained Research Assistants.

Step 4: Participants were appreciated for their co-operation. Refreshment was served. Participants were later dismissed.

APPENDIX V

NUTRITION EDUCATION TRAINING PACKAGE

Week 1 Topic: General Orientation and Administration of Pre-test instrument.

Objectives of the session:

1. To state the purpose of the meetings
2. To explain the procedures that will be followed by the trainers as well as participants

Step 1: The researcher welcomed the participants. Solicit for their co-operation, punctuality, regular attendance and allow them to interact for few minutes to ensure familiarization among the participants.

Step 2: The researcher stated and explained the purpose, objectives and benefits of the training. Day, duration, contact hours and other relevant information were discussed with the participants.

Step 3: The researcher later administered the pre-test instrument on the participants with the help of trained Research Assistants. The instruments were collected on the spot.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week II Topic: Concept of nutrition and nutrients

Objectives: At the end of this session, the participants were able to:

1. Define nutrition
2. State the six classification of nutrient

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week were introduced and explained

Definition of nutrition

Nutrition is the process of absorbing nutrients from food and processing them in the body in order to keep healthy or to grow. It also deals with interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. Nutrition includes food intakes, absorption, assimilation, biosynthesis, catabolism and excretion.

Classification of nutrients

Nutrients are classified as essential or non- essential. That is, there are macro and micro nutrients. Macro nutrients are needed in relatively large amount; these include carbohydrates, fats, protein and water. Micro nutrients are needed in smaller quantities, these include minerals and vitamins. This implies that nutrients are majorly classified into six.

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week III: Concept of adequate/balance diet and importance of diet in the body

Objectives: At the end of the session, the participants were able to:

1. Define adequate diet
2. Define balance diet
3. Mention three importance of adequate diet in the body

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week was introduced and explained

Definition of adequate and balance diet

Adequate diet includes sufficient energy for a person's needs, through the energy in the diet, which may be in any form. For example it can be in form of carbohydrate, protein, fat and so on.

Balance diet not only includes sufficient energy for the person's needs, but the person's entire dietary requirement in the correct proportion. In other words, a balanced diet is

food intakes that include all of the dietary needs of the organism in the correct proportions.

Importance of adequate diet in the body

1. It provides the body with essential nutrients
2. It promotes growth
3. It helps the organs of the body to function well

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week IV Topic: Concept of Protein and Carbohydrate

Objectives: At the end of the session, participants were able to**:**

1. List two examples of protein
2. Mention two importance of protein in the body
3. List two examples of carbohydrate
4. Mention two importance of carbohydrate in the body

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week was introduced and explained

Concept of Protein

Protein is a macro nutrient that primarily helps to build and maintain cells in the body. It could be derived from foods like beans, milk, egg, meat, fish and so on.

Importance of protein in the body

i. It builds and maintains cells in the body

ii. It responsible for muscle contraction

iii Its chemical breakdown provides energy for the body

Concept of carbohydrate

Carbohydrate is a biological compound containing carbon, hydrogen and oxygen that is an important source of food and energy. It is an example of macro nutrient which primarily provides energy. It could be derived from foods like bread, yam, cocoyam and so on.

Importance of protein in the body

i. It provides energy for the body

ii. It helps the body organs to function well

iii. It helps to protect the body from diseases

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week V Topic: Concept of fats and oil as well as vitamins
Objectives: At the end of the session, participants were able to**:**

1. List two examples of fats and oil
2. Mention two importance of fats and oil in the body
3. List two examples of vitamins
4. Mention two importance of vitamins in the body

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week was introduced and explained

Concept of fats and oil

Fats and oil are group of naturally occurring compounds called triglycerides. They comprised of three molecules of fatty acids and one molecule of the glycerol. They are oily, greasy or waxy substances that in their pure state are normally tasteless, colourless and odourless. Fats and oil could be derived from palm oil or vegetable oil.

Importance of fats and oil

i. It helps to maintain cells in the body

ii. It helps in the maintenance of body structure

Concept of vitamin

Vitamin includes any of the organic carbon-containing compounds that the body requires in small amounts to maintain health and function properly. Vitamins can be classified into two, namely, fat soluble and water soluble. Fat soluble include vitamins A, D, E and K, while water soluble include vitamins C, B1, B2, B3, B6, B12 and folic acid. The body gets most of its vitamins from the food we eat. Vitamins could be derived from fruits and vegetables.

Importance of vitamin

i. It helps to protect the body from diseases

ii. It helps in the formation of blood cells

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week VI Topic: Concept of minerals and water

Objectives: At the end of the session, participants were able to:

1. List two examples of minerals
2. Mention two importance of minerals in the body
3. Mention two importance of water in the body

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week was introduced and explained

Concept of minerals

Minerals are minute amounts of metallic elements that are vital for the healthy growth of teeth and bones. They are classified as major and trace elements. Major elements involve calcium, chlorine, magnesium, potassium, phosphorus and so on. Trace elements include iron, zinc, copper and so on. Minerals could be derived from fruits and vegetables.

Importance of minerals in the body

i. It helps in building and maintaining strong bones

ii. It helps in prevention of onset of many disorders

Concept of water

Water is an essential nutrient that is essential in the body. It is usually colourless, odorless and tasteless when pure. It circulates through blood and lymphatic system; transporting oxygen and nutrient to cells and removing wastes through urine and sweat. It also maintains the natural balance between dissolved salts and water inside and outside of cells. The human body is 65% water, and it takes an average of 8 to 10 cups to replenish the water that the body lose each day.

Importance of water in the body

i. It helps to transport oxygen and nutrient to cells

ii. It helps in digestion and absorption of foods.

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week VII Topic: Effect of unhealthy diet in the body

Objectives: At the end of the session, participants were able to:

1. Mention four effects of unhealthy diet

Activity

Step 1: The researcher welcomed the participants and made them interact for few minutes

Step 2: The topic for the week was introduced and explained

Effect of unhealthy diet in the body

Unhealthy diet can lead to the following;

i. Malnutrition (e.g. kwashiorkor)
ii. Disease
iii. Poor maintenance of body structure
iv. Weakness of the body
v. Nutritional problem (e.g obesity)

Step 3: The researcher asked questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks

1. The participants were appreciated for sparing their time for the training.
2. The participants were reminded of the time and venue for the next session.

Week VIII Topic: Review of Previous Sessions and Administration of Post-test Instrument

Objectives: At the end of the session participants were able to:

1. Summarize what the participants have learnt from the training programme
2. Express their willingness to continue to improve on good nutrition

Activity

Step 1: The participants were welcomed

Step 2: Questions were asked on all topics taught to know how participants have internalized the training.

Step 3: Post-test instruments were administered on the participants. The instruments were collected on the spot with the help of trained Research Assistants.

Step 4: Participants were appreciated for their co-operation. Refreshment was served. Participants were later dismissed.

APPENDIX VI

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION

Head of Department
Professor Michael Adeniyi Ajayi
NCE (Ife), B.Ed. (Benin), M.Ed., Ph.D. (Ibadan)
Sports Psychology & Leisure Studies.

E-mail: michaelajayi952@ymail.com
michaelajayi604@gmail.com
Tel.: 08023424905

Our Ref:_____

Date 02/11/2016

Your Ref:_____

The Chairmen
Electrical & Electronic Technical
Association, Ibadan
IBNE L-G & IBSW L-G

Dear Sir,

Permission to collect data/information/carryexperiment

The bearer Omeleke, H- Eunice with Matric. No. 105743 is a Ph.D student in the Department of Human Kinetics and Health Education, University of Ibadan, Ibadan.

He/She needs to collect data/information/carry out experiment in your Department/Unit for his/her/ Project/Course work.

Kindly allow him/her all necessary assistance required.

Thank you.

PROF. M.A. AJAYI
Head of Department

HEAD OF DEPT. HUMAN KINETICS & HEALTH EDUCATION
FACULTY OF EDUCATION
SIGN
03 NOV 2016
UNIVERSITY OF IBADAN

OTHER PROFESSORS

1. Prof. B. O. Ogundele (Health Education/Promotion)
2. Prof. O. A. Moronkola (Health Education/Promotion & Curriculum Studies)
3. Prof. B. O. Asagba (Organization & Administration of Sports)
4. Prof. E. O. Morakinyo (Organization & Administration of Sports)
5. Prof. J. F. Babalola (Exercise Physiology)
6. Prof. A. O. Abass (Exercise Physiology)
7. Prod. O. A. Adegbesan (Sports Pyschology)
8. Prof. A. O. Fadoju (Sports Pyschology)

READERS

1. Dr. Francisca Anyanwu (Health Education)
2. Dr. K. O. Omolawon (Organisation & Administration of Sports)

SOCIAL SCIENCES AND HUMANITIES RESEARCH ETHICS COMMITTEE (SSHEC)
UNIVERSITY OF IBADAN
Chairman: Prof. A. S. Jegede, B.Sc, M.Sc (Ife), MHSc (Toronto), Ph.d (Ibadan)
Tel: +234-8055282418
E-mail: sayjegede@yahoo.com
sayjegede@gmail.com
as.jegede@mail.ui.edu.ng

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Effect of environmental health education on knowledge and attitude towards e-waste management among electrical and electronic technicians in Ibadan metropolis, Oyo State, Nigeria.

UI/Social Sciences Ethics Committee assigned number: UI/SSHEC/2016/0002

Name of Principal Investigator: **Nwakaego Eunice OMOBOH**
Address of Principal Investigator: Dept. of Human Kinetics & Health Education,
Faculty of Education,
University of Ibadan.

Date of receipt of valid application: 18/04/2016
Date of meeting when final determination on ethical approval was made: 14**th June, 2016.**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and given full approval by the SSHE Committee.

This approval dates from 14/06/2016 to 13/06/2017. If there is delay in starting the research, please inform the SSHE Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry the SSHE Committee assigned number and duration of SSHE Committee approval of the study. It is expected that you submit your annual report as well as an annual request for the project renewal to the SSHE Committee early in order to obtain renewal of your approval to avoid disruption of your research.

Note: the National code for health research ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the SSHEC. No changes are permitted in the research without prior approval by the SSHEC except in circumstances outlined in the Code. The SSHE reserves the right to conduct compliance visit to your research site without previous notification.

Prof. A.S. Jegede

APPENDIX VII

Fig. 1: Researcher and facilitators while addressing the participants during one of the sessions at Ibadan North Local Government Area Secretariat, Agodi-Gate

Fig. 2: Researcher and research assistants at Ibadan North Local Government Area Secretariat, Agodi-Gate.

Fig. 3: A cross session of participants listening to the facilitator in one of the sessions

Fig. 4: The researcher facilitating in one of the sessions

Fig 5: Group photograph at the end of the training at Ibadan North Local Government Area Secretariat, Agodi-Gate