AWARENESS AND READINESS TO ADOPT GREEN COMPUTING PRACTICES AMONG EDUCATIONAL TECHNOLOGY STAKEHOLDERS

IN NORTH-CENTRAL NIGERIA

BY

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DEPARTMENT OF EDUCATIONAL FOUNDATION AND CURRICULUM

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF INSTRUCTIONAL TECHNOLOGY

DEPARTMENT OF EDUCATIONAL FOUNDATION AND CURRICULUM
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DECLARATION

I declare that the work in this dissertation entitled "Awareness and Readiness to Green Computing Adoption among Educational Technology stakeholders in North Central Nigeria" was conducted by me in the Department of Educational Foundations and Curriculum Ahmadu Bello University, Zaria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other institution.

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Yero, SHEHU **Signature Date**

CERTIFICATION

This dissertation entitled "AWARENESS AND READINESS TO GREEN COMPUTING ADOPTION AMONG EDUCATIONAL TECHNOLOGY STAKEHOLDERS IN NORTH-CENTRAL NIGERIA, by Yero SHEHU P13EDFC8013 meets part of the regulations governing the award of degree of Masters in Instructional Technology of the Ahmadu Bello University Zaria, and is approved for its contribution to knowledge and literary presentation.

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Dr. S.A. Zubairu
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Dean, School of Postgraduate Studies -------------------------------- ----------------------
Signature Date

DEDICATION

This dissertation is dedicated to the entire family of late Alhaji Shehu Halliru Ruma, especially my late sister Aisha. May Almighty Allah continue to protect and bless them all, Ameen.

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ABSTRACT

The use of computer and its accessories in our daily activities, in spite of its usefulness have caused a lot of hazards to humans and the environment. Green computing aimed at reducing energy consumption and carbon emission, prevent wastage, cut cost and protect the environment. This study investigates educational technology stakeholders' awareness and readiness to green computing adoption in North central Nigeria. A cross sectional Survey research design was adapted to the conduct of the study. Nine research questions and six hypotheses were drawn to guide the study. Related literatures were reviewed after the conceptual framework based on the major variables of the study. The population of the study comprises of all the educational technology stakeholders in north central Nigeria. Purposive sampling was used to select two universities in north central Nigeria. Six hundred and six (606) educational technology stakeholders were selected using Krejcie and Morgan's tables. Stratified random sampling technique was used to select male and female stakeholders from each stratum. A questionnaire tagged stakeholders' awareness, readiness and adoption of green computing (SARAGC) was used for data collection. It was designed under three (3) different sections and harmonized in one single questionnaire. The instrument was pilot tested using 33 students, lecturers and technical staff in Ahmadu Bello University Zaria. A reliability coefficient of 0.92, 0.79 and 0.81 were obtained for section B, C and D respectively, was obtained using cronbatch Alpha. Percentage was used to interpret the demographic data of the study. Data collected on the basis of the research questions set in chapter one were analyzed using mean and standard deviation. The limit for decision rule: An average mean of 2.50 and above was considered as agreed, while an average mean of 2.49 and below was considered disagreed with respect to research questions. Kruskal-wallis test was used to answer hypotheses one, three and five while Mann-Whitney

Independent test was used to analyse hypotheses two, four and six. The null hypotheses one, two and four were rejected while null hypotheses three and five and six were not rejected. Specifically, the findings of this study revealed that there is a significant difference in Green Computing Awareness among students, lecturers and technologist in North Central Nigeria with no significant difference in their readiness and adoption of Green Computing. The study also found that age has significance influence on educational technology stakeholders' awareness and readiness to green computing adoption with no significant influence on their green computing adoption. This study recommends, among others, that green technology policy should be formulated and implemented and encourages stakeholders towards attitudinal change in their daily usage of computer.

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ABBREVIATIONS

GC: Green Computing

ICT: Information and communication Technology

I T: Information Technology

P C: Personal Computer

PEB: Pro Environmental Behavior

TOE: Technology Organization Environmental Framework

DOI: Diffusion of Innovation

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Information technology has changed our society remarkably over the past years. Although its effects on our everyday lives are obvious, the effect that it has on the environment has been ignored in the past years (Piccirillo, 2011). Computer use in education sector is an important aspect of everyday life; however, their impact is not entirely realized or mainly considered (Murugesan, 2008).As the debate on climate change and its associated effects continues, society is becoming more aware of the negative effects use of computers can have on the environment.

A Computer is now a most important instrument for everyone in educational, commercial, corporate, banks and government sectors. It improves efficiency, reduce the time and energy spend to carry out a specific job. The optimum knowledge and skill of using computer is very vital. (Shittu, Gambari & Alabi, 2016).Computer users should know the benefit of shutting down the computer when not in use or power-down the CPU and all peripherals during an extended period of inactivity. A user should also learn how to make use of the defective and outdated parts of the machine by recycling them instead of disposing them as wastage. Hence, such knowledge must be incorporated into each individual so as to maintain eco-friendliness.

Green computing (GC) according to Murugesan (2008), refers to energy-efficient computing practices and environmentally responsible use of the computer and its associated subsystems. It is both a field of study and a set of eco-friendly computing practices. Murugesan (2008) suggests that the concept is multifaceted and multidimensional, covering a broad scope of energy-efficient and hazard-free computing activities involving myriad systems, devices, hardware and software. The green computing concept advanced by Murugesan (2008) includes the dimensions of e-waste disposal and management, as well as design and manufacturing of computing systems and resources.

There is much discussion centering upon how to reduce energy consumption and carbon emissions, prevent wastage, cut costs and protect the environment through green ideas, green initiatives, green buildings and green policies (Bello, 2015).Going green is fundamental and a major concern of the modern world today. The global society as a whole is going through a phase where individuals, groups, organizations, industries and governments are becoming more environmentally conscious at home and the workplace, as well as at university campuses. The internet literature and academic journals are awash with discussions on these issues and with solutions on how to go green, ranging from simple tips such as printing on both sides of the paper using small fonts and printing only when necessary to physical acts of greening the environment by planting more trees to offset carbon emissions to big ideas such as green buildings (Omer, 2008).

Recent statistics reveal that a lack of green computing awareness and education is affecting the world in negative ways. Financially, about $ 212.5 billion about N95625 trillion a year is wasted on powering idle computers (Aggarwal, Garg, & Kumar, 2012). Wasteful computer use releases unnecessary carbon emissions into the air, thereby increasing global warming. These carbon emissions, also called carbon footprint, combine with other greenhouse gases to cause increased global temperatures, smog, and acid rain, droughts in some countries and floods in others. Jenkin, Webster and McShane (2011) attributed half of the world's energy wastage to end users' wasteful habits resulting from their lack of awareness about sustainable computing.

Laroche, Tomiuk, Bergeron, and Barbaro-Forleo (2002) explain that, awareness is vital to the formation of environmentally proactive attitudes, while Thapa, Graefe, and Meyer (2005) opined that environmental awareness is a major factor in predicting pro-environmental behaviors. Bamberg and Moser (2006) found that awareness indirectly determines an individual's intention to act pro-environmentally through perceived behavioral control. Authors underscore the role of awareness in influencing decision-making that results in pro-environmental behavior (PEB), which in this case means behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world (e.g. minimize resource and energy consumption, use of non-toxic substances, reduce waste production) (Kollmuss& Agyeman, 2002).

Readiness for green computing is an assessment of the ability, capability and capacity of individuals and institutions to take advantage of green computing (Shittu et.al, 2016). The government initiative and policies would provide a basis for evaluation of green computing on one hand, while on the other hand, there is the need also to measure the perception and attitude of students, faculty and technologists. Green Computing readiness is considered to be an organization's capability to embed sustainability in the beliefs and attitudes in the development, deployment and disposal of ICT technical assets and in their ICT processes, practices and policies and in the governance systems to ensure compliance with internal and external sustainability expectations (Molla, Cooper & pittayachawan, 2009).

Existing evidence shows that although end-users feel it is desirable to go green, many do not know much about what it really is and what is going on, nor do they understand why there is a need to go green. Consequently, we now see innumerable efforts in the forms of pro-environmental regulations, programs, and campaigns being rigorously carried out in many parts of the world to improve users' knowledge of energy-efficient computing practices; as well as experimentations and innovations within the Information and Communication Technology (ICT) industry to enhance the energy efficiency of computers and reduce their toxicity (Murugesan, 2008). These are done with the aims of reducing the hazardous impact of computers on the environment and increasing users' green computing knowledge, hence the likelihood of their engaging in green compliant behaviors.

Across the globe, there is an increasing interest in and demand for the teaching of green computing knowledge following assertions that it is fundamental to sustaining a healthy, green environment (McDougall, 1993). Many educational technologists in developed nations have long started their green education efforts. This is an important first step towards the adoption of green computing practices among university populations in accordance with the proposition that knowledge is the first step in the adoption process (Rogers, 2003). Ideally and logically, an individual cannot begin to adopt an idea, system or device if he or she knows little or nothing about it thus, awareness is the key drive to readiness and virtually adoption.

Gender has been identified as one of the factors influencing the adoption of green computing. Gender is a range of characteristics used to distinguish between male and female, particularly in the case of men and women and the masculine and feminine attributes assigned to them (Wikipedia, 2012). In order to ascertain the level of green computing adoption of educational technology stakeholders, an understanding of the two sexes (male and female) is very essential. Gender has significant influence in green computing adoption among university students with female students having a more positive attitude toward green environment than their male counterpart (Bello, 2015).

Research in Green Computing is vast and multi-faced, but it is extremely limited in looking at an important group of people at the receiving end who makes a huge difference in reducing global energy consumption and, it has almost overlooked the importance and role of students as agents of Carbon dioxide reduction (Bournay, 2008). Male and female students, lecturers and technologist are vast users of ICTs, and hence, vast contributors of carbon emission. Assessing educational technology stakeholders' awareness and readiness toward adopting green computing adoption and getting them to act in green compliant ways is very essential.

It is in this light that students, lecturers and technical staff of educational technology department in north central Nigerian universities who are expected to drive forward green computing practices in education, is brought in to the limelight. However, this depends on the awareness and readiness of the stakeholders. A major gap in most universities in the world in the onset of the 21st century is the gap in the awareness, readiness and adoption of green computing practices.

1.2 Statement of the Problem

Over the years, the use of computer and its accessories in every aspect of daily activities have caused a lot of hazards to humans and the environment. Tackling environmental issues and adopting environmentally sound practices related to computer have been a challenge to Organizations, governments and societies at large. Factors such as environmental legislation, the rising cost of waste disposal, corporate images, and public perception give further impetus to the green computing initiative. The purpose of Green Computing is to improve energy efficiency, lowering greenhouse gas emissions, from harmful materials, and encouraging reuse and recycling (Harris, 2008).

Computers and other IT resources are the largest sources of growth in electricity demand in commercial and government buildings. A typical medium-sized personal computer consumes about 150 Watts of electricity per hour. This pushes the electricity usage high, especially in a situation where computers are not switched off after use. Unlike privately-owned PCs, workstations and network servers in the offices are often left idling these have negatively affected the life span of the computers as well as increase its carbon footprint (Bournay, 2008).

The number of computers used in the education sector is increasing due to their frequent replacement. This has brought a lot of challenges especially in terms of massive energy requirements to power and cool them. This issue makes the environmental impact of IT a major concern. Forrest, William, James, Kaplan and Kindler (2008) posit that the total electrical energy consumption by servers, computers, monitors, data communications equipment, and cooling systems for data centers is steadily increasing which poses a great challenge, especially in a country with a power vacuum of about 8,800 megawatts (MW). Adoption of energy saving practices among educational technology stakeholders' computers and home appliances will certainly reduce energy demand and its consumption in Nigeria.

Some of the electronic components used in producing computers and other electrical appliances are toxic and harmful to the consumers and their environment. It is necessary therefore Individuals and educational technology stakeholders should be aware of these toxic elements and their impact before purchasing them as individuals and the education sector replace their computers, educational technology equipment, home and industrial appliances with newer ones thereby discarding and throwing away the spoilt or obsolete ones. The disposing of equipment becomes a threat to the environment. Adoption of green computing can help in the reduction of this containment process that harms the ecosystem (Shittu, Gambari & Alabi 2016).

It is obvious that there are very few studies on green computing in Nigerian and the world at large. Most of these studies were undertaken in companies, data centers, and other private organizations. Therefore, there is a need for a study on the awareness and readiness of educational technology stakeholders on green computing practices in Nigeria. The term green computing is still a mirage even among educational technologist in Nigeria; hence there is need to gain insight on the concept, practices and the benefits of its adoption by lecturers, students and the technical staff of educational technology in north-central Nigeria.

1.3Objectives of the Study

This study seeks to investigate awareness and readiness of adopting green computing practices among educational technology stakeholders in north-central Nigeria. Specifically, the study will:

i. Investigate the level of awareness on green computing practices among educational technology stakeholders in North-Central Nigeria.
ii. Find out whether educational technologists in North-Central Nigeria are ready to adopt green computing practice.
iii. Investigate the level of educational technology stakeholders' green computing adoption in North-Central Nigeria
iv. find out the differences among students, lecturers, and educational technologists are aware of Green Computing Practices in North-Central Nigeria;
v. investigate the difference between male and female students, lecturers and educational technologists' awareness on Green Computing practices in north central Nigeria;

vi. examine the differences in the readiness of students, lecturers and educational technologists' towards adopting green computing practices in North-Central Nigeria;

vii. investigate the difference between male and female students, lecturers and educational technologists' readiness on adopting green computing practices in North-Central Nigeria;

viii. ascertain the extent of Green Computing Adoption of students, lecturers and educational technologist in North-Central Nigeria; and

ix. examine whether the gender of the educational technology stakeholders has aninfluence on the adoption of Green Computing Practices.

1.4 Research Questions

The following research questions were raised to guide the study:

i. What is the level of educational technology stakeholders' awareness on green computing practices in North-Central Nigeria?

ii. What is the level of educational technology stakeholders' readiness to green computing adoption in North-Central Nigeria?

iii. What is the level of educational technology stakeholders' green computing adoption in North-Central Nigeria?

iv. What is the level of green computing awareness of students, lecturers and educational technologist in North-Central Nigeria?

v. What is the difference between male and female educational technology stakeholders' green computing awareness in North-Central Nigeria?

vi. What is the level of green computing readiness of students, lecturers and educational technologist towards green computing adoption in North-Central Nigeria?

vii. What is the difference between male and female educational technology stakeholders’ readiness for green computing adoption in North-Central Nigeria?

viii. What is the extent of green computing adoption of students, lecturers and educational technologist in North-Central Nigeria?

ix. What is the difference between male and female educational technology stakeholders green computing adoption in North-Central Nigeria?

1.5 Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 levels of significance:

i. There is no significant difference in awareness of green computing practices among students, lecturers, and technologist in North-Central Nigeria.

ii. There is no significant difference between male and female educational technology stakeholders’ green computing awareness in North-Central Nigeria.

iii. There is no significant difference in the extent of readiness of green computing adoption among students, lecturers and technologist in North-Central Nigeria.

iv. There is no significant difference between male and female educational technology stakeholders’ readiness for green computing adoptions in North-central Nigeria.

v. There is no significant difference in the level of green computing adoption among educational students, lecturers, and technologist in North-Central Nigeria.

vi. There is no significant difference between male and female educational technology stakeholders’ green computing adoption in North-Central Nigeria.

1.6 Basic Assumptions

For the purpose of this study, it is assumed that:

i) Students, lecturers and educational technologist in North-Central Nigeria are fully aware of green computing and conscious in selecting, purchasing and utilization of media equipment.

ii) Students, lecturers and educational technologist in North-Central Nigeria are ready to adopt green computing practices in their daily use of computer and its sub-systems.

iii) Educational technology stakeholders in North-Central Nigeria are fully Adopting green computing practices.

1.7 Significance of the Study

This study may be of immense benefit to the educational technology stakeholders such as students, lecturers, technologists, institutions` policymakers and administrators. This study will provide useful information to guide educational technology stakeholders in understanding how green computing practices can influence the use of computers and develop sustainable Information Technology solutions.

Additionally, as the digital natives (especially educational technology students) use computer with more frequency and intensity in their daily routines, this study may inform the students of the pros and cons of green computing practices, its adoption and the benefits it offers thereby informing the stakeholders through interactive session via online social networks, comments and the incorporation of green computing awareness in to their curricula.

Meanwhile, Lecturers from educational technology department are at the forefront in computer usage, thus the study may no doubt awaken their consciousness on efficient computing practices. Lecturers` readiness and adoption of environmentally sound computing practices will provide gaps and solutions to daily problems of energy, generation, transmission and distribution in the Nigerian context thereby reducing the energy demand and consumption as well as the adoption of environmentally sound practices among educational technology stakeholders.

The study may also be of immense benefit to the technologist who uses the computers and its subsystems to teach students on their practical use of computers the energy efficient use of the equipment. The technologist will also be guided by the study on their recommendations to the university management of the type of computer equipment to be procured. The heads of departments, deans and directors will also be part of the beneficiaries. The study will serve as a guide for the administrators in approving the recommendations from the technologist. It will help them in approving the type of media equipment to be procured for the departments and for their use as well.

Findings from this study might also benefit researchers by adding to the pool of information that already exists in this new area of study. Researchers can therefore, fall back on information gathered here by replicating this study in another setting. It is also hoped that this study may bring new ideas and practical action among students and lecturers in both the policy realm and in higher education research environment. The recommendations arising from the findings may guide the National Universities Commission (NUC) management in setting priority for strategic planning and incorporating green computing awareness initiatives in its curriculum. Professional associations like EMTAN, AITIE, CPAN, STAN etc may benefit from the findings of the study.

1.8 Scope of the Study

The study focused on the investigation of awareness and readiness in the adoption of green computing practices among educational technology stakeholders in North-Central Nigeria. The stakeholders are limited to educational technology students, lecturers and technologist in the universities within North-central Nigeria. The states in North-central Nigeria are Kogi, Niger, Benue, Kwara, Plateau, Nasarawa and the Federal Capital Territory.

In addition, the study would be limited to green computing practices such as reuse, recycling, and efficient power management system. The study also focused on the dependent variable of awareness, readiness and adoption, and independent variable stakeholders as well as the moderating variables gender and designation.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents a review of related literature based on the conceptual framework, green computing definitions, awareness, readiness as well as adoption. It examines green computing practices like virtualization, managing energy consumption, E-waste, and recycling as well as Telecommunicating. It also reviews some Green computing initiators, benefits of Green Computing adoption, hazardous chemicals available in computers, Barriers to Green Computing adoption, as well as using IT to create Green Awareness. The theoretical framework of the study was based on Rogers Diffusion of innovation, The Technology-organization-Environment framework, Technology acceptance model. Empirical studies on Green computing awareness, readiness, adoption and the influence of gender on green computing adoption were reviewed.

2.2 Conceptual Framework

Knowledge and practices of environmental sustainability is a very recent study across the globe. Studies looking specifically at students' green computing knowledge are extremely rare. There is an acute lack of research in this area although students represent a substantial portion of ICT users worldwide and can play a significant role as agents of global CO2 reduction. Research in green computing has mainly focused on solutions and practices for the IT industry and businesses, and has largely neglected the importance of examining what end users, especially students in universities and colleges, know about green computing and whether they practice green compliant behaviors (Afroz, Masud, Akhtar & Duasa, 2013).

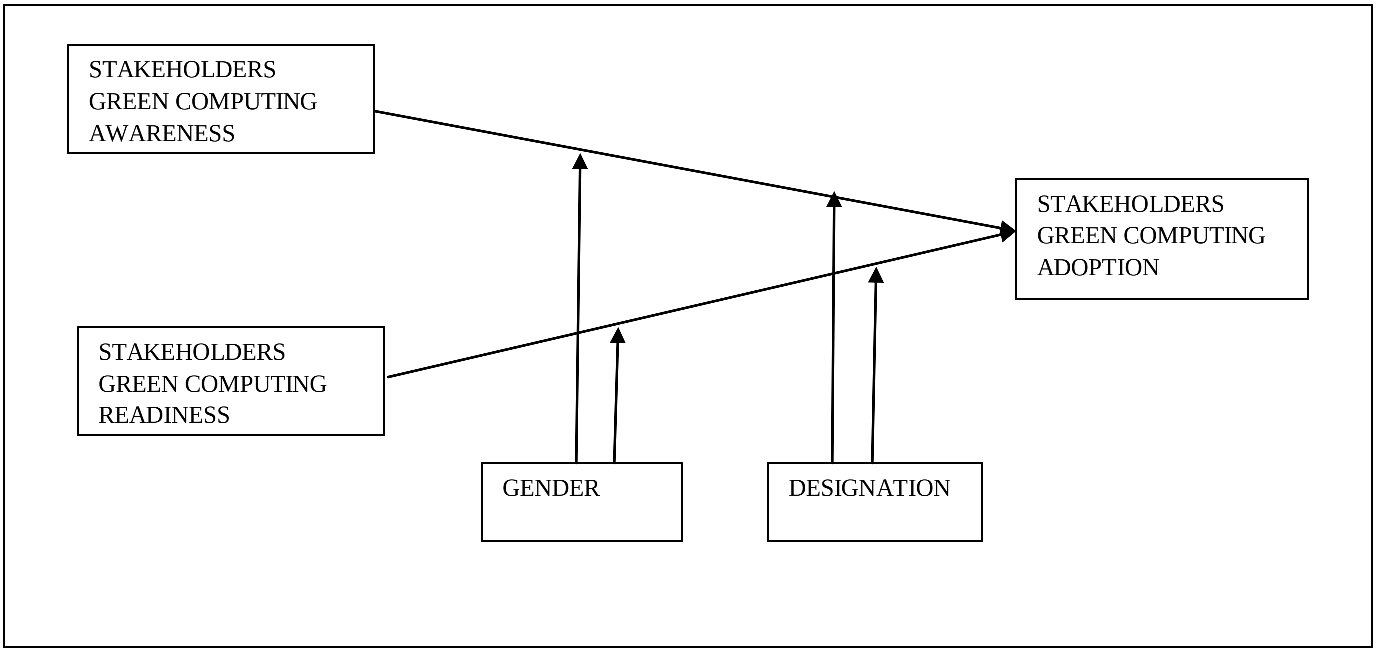

Fig. 1: Educational Technology Stakeholders' Green Computing Awareness

A number of surveys show that lack of awareness is the biggest barrier to the adoption of green computing practices and solutions in the information technology (IT) industry and that this state of ignorance is a cause for worry as it impacts a country's economic recovery via reduced energy consumption and prevention of wasteful spending. Courtney (2008) asserted that a lack of knowledge in green computing is preventing Information Technology managers from going green.

Raza, Patle, and Arya (2012) proposed the idea of teaching users to understand how power consumption impacts the "greenness" of any technology, believing it to be an essential step toward reducing wasteful energy consumption. Efforts to educate the young generation through educational programs in schools and universities are already underway in the U.S., Hong Kong, India, parts of Europe, and the U.K. (Murugesan, 2013). Educational institutions – from elementary schools to universities – in Hong Kong, Macao, and mainland China have incorporated environmental protection and green concepts into their course syllabi, focusing on fundamental green issues such as nonrenewable energy sources and materials, and climate change among other things.

Pearce (2001) reported that the majority of students at an American university never shut down their computers and were ignorant of the implications of their energy waste, while Creighton (2002) discovered a shocking 80% to be engaged in this habit of leaving their computers on all the time.

Green Computing Readiness

Green Computing readiness captures a dynamic assessment of an organization's own and environment preparation to accept Green Computing. It captures the perceptual characteristics of the adoption context. Kuan and Chau (2001) argue that as many characteristics of innovation turn out to be secondary, many organizational characteristics turn out to be secondary as well. And arguably, characteristics of the external environment also turn out to be secondary. Molla and Molla (2010) concurred with this view and further argue that even if two organizations have the same level of organizational resources and operate in the same context; they are likely to have different perceptions of the level of readiness and might make different adoption decisions. Therefore, based on Molla and Licker's (2005), three dimensions of Green Computing readiness can be identified organizational, value network and institutional.

The main objectives of Green Computing Readiness were a guideline for organizations to measure the preparedness of Green Computing implementation in their institution. Five drivers elements (attitude, practice, policy, Governance, and technology) were needed to measure the preparedness of Green Computing implementation and all the elements were tangible which can be counted and measured (Molla, 2009).

Adopting Green Computing Practices

The adoption of Green Computing, although to some extent could be similar to the adoption of other technologies, but it has a number of differences. The adoption of Green Computing necessitates that ICT users are informed about the various facets of the notion, i.e. what it is that constitutes environmentally sustainable computing, what features and characteristics make a computer a green PC, and what computing practices are compliant with the green movement (Olson, 2008).

As purported by Rogers (2003), knowledge is the first step in the adoption process. An individual cannot begin the adoption process without knowing about the idea, the practice or the device to be adopted. Therefore, the importance of knowledge in embracing green computing ideas cannot be overstated. A lack of knowledge in energy-efficient computing has in fact already led to much energy wastage and financial loss around the globe. According to Jenkin et al. (2011), half of the world's energy wastage is attributable to uninformed behaviors of users and consumers. No information system (IS) can produce positive outcomes unless it is effectively adopted and used (Sasovoca & Leenders, 2008).

Providing a means to enhance growth and increase innovation abilities is the common reason for IT initiatives adoption in many firms (Bruque and Moyano, 2007). Corrales and Westhoff (2006) state that adoption theory examines the choices an individual makes to accept or deny a particular innovation and the extent to which that innovation is integrated into the appropriate context. Rogers (1995) defines adoption as:

The process through which an individual or other decision-making association passes from first knowledge of innovation to forming an attitude towards innovation, to a decision to adopt or reject, to implementation of then ew idea, and to confirmation of this decision.

The adoption of green technologies, although to some extent could be similar to the adoption of other technologies, it has a number of differences (Molla, 2008). Distinction between green initiatives and other innovation and technology adoption has been made. He suggested that green practices take a longer period to break-even and affected more by softer benefits such as employee morale and good corporate citizenship than by hard dollar investments. (Olson, 2008).

The tension between the environmental and social case on the one hand and the business case for “top-line revenue and bottom-line costs” on the other hand can influence the pace of green technology adoption. These features imply that in seeking to explain the adoption of Green IT, effort should be exerted to cover all the domains of adoption. Although many firms recognize the importance of Green IT, its adoption has been selective (Molla, 2009). Molla (2008) proposes two measures of Green Computing adoption breadth and depth. Breadth refers to the coverage of Green Computing different areas. It gauges whether Green Computing is permeating a business’s IT activity chain. On the other hand, depth refers to the extent of Green Computing adoption in one particular category, such as sourcing.

2.3 Overview of Green Computing

There are many definitions of green computing with many focusing on technological solutions whereas, some focus on soft business practices depending on the researchers’ perspectives. However, most of Green IT definitions focus on hardware side or tangible aspects of Information Technology. For instance, Murugesan (2008) suggests that “Green Computing is the study and practice of designing, manufacturing, and using computers, servers, monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal impact on the environment”.

Sayeed and Gill (2008) provide a more general definition: “Green IT initiatives are organizational activities that aim to engender environmentally sustainable consequences in the conduct of information processing tasks of an enterprise”. Eastwood (2009) considers the green IT not only as a study or practice but also as the strategy and tactic for the organizations. He mentions that “Green IT is a collection of strategic and tactical initiatives that directly reduce the carbon footprint of an organization’s computing operation”.

Gartner (2007) provides a comprehensive definition considered for this research: "Green IT is theoptimal use of information and communication technology (ICT) for managing the environmental sustainability of enterprise operations and the supply chain, as well as that of its products, services,and resources, throughout their life cycles."

Justification for Green Computing Adoption in Nigeria

Population growth in Nigerian is triggering the increasing demand for electricity supply. The World Bank in its 2014 annual report project that Nigeria`s electricity demand will grow from 15,730 megawatts (MW) in 2014 ( with 4,306 megawatts supplied) to 41,133 megawatts (MW) and 88,282 megawatts (MW) by year ends2015 and 2020 respectively. Moreover, Nigeria`s electricity consumption per capita as measured by the World Bank stood at 149 kilowatt per hour per below that of Brazil at 438.8 kilowatt per hour and South Africa at 240.3 kilowatt per hour as a result 81 percent (or 130 million Nigerians) generates electricity through alternative sources to compensate for irregular power supply (World Bank, 2014).

Considering the wide electricity demand gap, steady increase in electrical energy by computers, monitors, servers, data communication equipment, cooling systems and the inevitable need for computer in education, as well as the meager power supplied from the national grid, it is suffice to say that we need an energy efficient and eco-friendly computing practice. Green computing will no doubt supplement Nigeria`s energy generation, distribution, and transmission.

Due to the constant changes in the information technology industry, new advanced devices and computers are being produced continuously. The manufacturing of these products becomes a problem to the environment due to different chemicals and materials used. Most of these materials are a hazard to the environment. Some elements used in the manufacturing process are toxic and harmful to the environment too. This necessitates an innovation that proposes reuse, recycling and efficient usage of computer products for sustainable development (Bournay, 2008).

Information technology (IT) investors and consumers measure the carbon footprint of an information technology(IT) company and its products by looking at the total greenhouse emissions that are caused by individual organizations' operations or products directly or indirectly (Gartner, 2008). Organisations must be aware of all these toxic elements before purchasing computers. The environmental information must be made available by these manufacturers to their buyers.

In the information technology (IT) space, the disposal of equipment is a major environmental problem because of the toxic products in computers and displays (Winston 2010). However, according to Junglas and Watson (2006) information technology (IT) has been the major contributor to productivity growth in many countries over the last half-century. Green computing has been seen as a solution to most of the challenges that have been mentioned.

Vreeswijk (2008) revealed that every three to five years, organizations replace their computers with newer ones. The older computers are discarded and thrown away at landfills and this becomes a significant problem to the environment (McCabe 2008). However, Vreeswijk (2008) hinted that there are measures of prevention that can help in the reduction of this contaminant process that harms the environment.

According to McCabe (2008), users of computers increase every year as companies, organizations including education, hire more staff. This results in an increase in information technology (IT) infrastructure capacity because customer demands increases (Harris 2008). McCabe further emphasizes that energy is not a concern for most information technology (IT) departments since the energy bill is being paid by someone else. The main concern of these departments is to ensure that information technology (IT) infrastructure runs, not that it is energy-efficient (Williams et al, 2010).

Barriers to Green Computing Adoption

Despite the numerous benefits of green computing practices, there are barriers that the world must overcome in order to successfully implement green computing. First is the natural psychological resistance to change on the part of any individual or organization. The larger the organization, the more difficult it is to justify and manage change (Molla, 2008). Green computing can justify some significant cost savings and increased profits, but there are also "soft benefits," such as environmental awareness, that is more difficult to recognize and quantify. Cloud computing is difficult for any organization to embrace as they apparently still feel the need to "own" the infrastructure and resources, rather than "rent" them from a third-party provider (Brocade, 2008).

Another overwhelming barrier can be that of cost. Most organizations and individuals particularly in times of a weaker economy, find it hard to justify expenditures on information technology. It can be very challenging to construct a cost-benefit analysis that adequately demonstrates how information technology contributes to the bottom line (Molla, 2008).Certainly, a comprehensive return-on-investment analysis that shows how, for example, reduced energy or travel costs can increase the profit margin, is imperative. Internal recycling, or re-purposing of computer equipment, can also contribute to cost reductions and thus improved profit margins.

Green computing is still relatively new and it is not easy for organizations to understand and articulate their requirements. Although it is desirable to purchase computer equipment from suppliers and vendors that are ecologically mindful in their manufacturing processes, this can be challenging to accomplish as many manufacturers lack environmental awareness (Barnhart, 2011).

Green Computing Practices

a) Virtualization

Virtualization, the ability to run multiple clients and programs from a single energy-efficient hub, has quickly become the next big thing on many IT pros' horizons. A range of solutions is quickly entering the market to virtualize every aspect of IT, from the biggest green data centers to individual machines. As it turns out, it has a great deal to do with the subject. One of the primary goals of almost all forms of virtualization is making the most efficient use of available system resources. Storage virtualization uses hardware and software to break the link between an application, application component, system service or whole stack of software and the storage subsystem. This allows the storage to be located just about anywhere, on just about any type of device, replicated for performance reasons, replicated for reliability reasons or for any combination of the above (Molla, 2008).

i. Consolidation — in the past, it was necessary for each computer system to have its own storage to function. Storage virtualization makes it possible for systems to access a shared storage subsystem that is somewhere out on the net. It also means that copies of data that used to be stored on every computer's disks can now be stored once in the shared storage subsystem. It's clear that this approach would reduce the number of storage devices needed, the amount of power required, the heat produced and, as a wonderful side effect, would reduce the operational and administrative costs of back up, archival storage and the like (Murugesan, 2008).

ii. Appropriate Devices — since the link between the application and the actual storage device is broken by storage virtualization software, the device can be selected based on what's most appropriate. Applications and data that are accessed frequently can be stored at high speed, expensive devices that consume more power. Applications and data that are accessed less frequently can be stored on lower speed, less expensive devices that consume less power. Rarely accessed applications and data can be migrated to archival storage devices that result in the lowest cost and require the lowest power consumption (Kuznetzky, 2007). The commonly encountered example in the market is VMW virtualization software.

b) Managing Energy Consumption

It's one of the most important components in the computer. Nothing will work without it, and yet it doesn't receive a fraction of the attention it deserves. It's the power supply. Why is the power supply so important? The reason is simple: every other component in the PC depends on stable power for trouble-free operation. Even relatively slight deviations in voltage can lead to crashes and component failures, a fact many users are still unaware of. When a PC is unstable, the first things they suspect as the cause are overly-aggressive memory timings, an overheated graphics card or an overlocked CPU (Schuhmann, 2004). Very rarely does the power supply unit come under scrutiny, despite its being one of the most problem-prone components.

The Advanced Configuration and Power Interface (ACPI), an open industry standard, allows an operating system to directly control the power saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity (Schuhmann, 2004). In addition, a system may hibernate, where most components (including the CPU and the system RAM) are turned off. ACPI is a successor to an earlier Intel-Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions.

Some programs allow the user to manually adjust the voltages supplied to the CPU, which reduces both the amount of heat produced and electricity consumed. This process is called undervolting. Some CPUs can automatically undervolt the processor depending on the workload; this technology is called "SpeedStep" on Intel processors, "PowerNow!"/"Cool'n'Quiet" on AMD chips, Long Haulon VIA CPUs, and Long Run with Transmeta processors (Eastwood, 2009).

c) E-waste and Recycling

E-waste is a popular, informal name for electronic products nearing the end of their "useful life." Computers, televisions, VCRs, stereos, copiers, and fax machines are common electronic products. Many of these products can be reused, refurbished, or recycled. Unfortunately, electronic discards are one of the fastest growing segments of our nation's waste stream.

In addition, most of the old electronics are in storage, in part because of the uncertainty of how to manage the materials. Combine this with increasing advances in technology and new products headed towards the market and it is no wonder that "e-waste" is a popular topic. These days, responsible computing means more than not spreading viruses and not hacking into someone else's system. The waste that results from disposing of electronics such as computers and mobile phones, called e-waste, can be highly toxic (Sorrel, 2007). The United Nations Environmental Program estimates that each year, 20 million to 50 million tons of e-waste is dumped into landfills around the world. That works out to about 4,000 tons per hour.

Almost every component is built with some kind of toxin. Computer circuit boards hold lead and cadmium. Monitors' cathode-ray tubes have lead, cadmium, phosphorus, and barium. In fact, a large CRT may contain as much as 4 to 8 pounds of lead (Dubey & Hefley, 2011). Even cables are bad for the environment, as they are sprayed with brominated flame retardants. Such chemicals can leach into the soil and groundwater.

Recycling is another approach in the right direction. Dell recently initiated a program in which it will recycle anyone's PC, regardless of manufacturer. Simply go to the Dell Web site and fill out a form; a Dell representative will come to your house or place of business to collect the old PC. HP will recycle any manufacturer's hardware for a charge ranging from $13 to $34 that is N3900 to N10200 (Sorell, 2007). It has also set up battery recycling programs in many computer stores. Gateway gives you cash for your old technology with proof of purchase of a new Gateway machine. Such companies are taking a great step forward for the industry when launching these programs.

The problem of e-waste isn't limited to PCs. Mobile phones, PDAs, and batteries all pose problems for the environment. Most wireless carriers will recycle mobile phones. Below are shown list of companies that recycle (Sorell, 2007).

Table 2.1: **Companies that Recycle Computer and its Sub-systems**

Manufacturers	**Service Providers**	**Retailers**
Apple	Cellular One	Best Buy
Canon	Ingram Micro	Circuit City
Dell	Palm	Office Depot
Epson	RIM (BlackBerry)	Staples
Gateway	Sprint/Nextel	
Hewlett-Packard	T-Mobile	
IBM	Verizon Wireless	
Intel		
Lexmark		

d) Telecommuting

Telecommuting means a working arrangement in which an employee works from a remote site that is located in place that reduces the employee's regular commute to the principal place of business, including working at home, at a satellite office, or at a telework center, and communicating electronically between the remote site and employers' principal place of business. Telecommuting can be a beneficial tool for the employee, the employer, and the community. The employee benefits by reducing the time spent commuting, reduced commuting costs, and reduced level of stress. The community benefits by reducing the number of cars on the road, reduction in gas consumption, and increased air quality (The Climate Group, 2008).

Case Study of Green Computing Practices in Universities

Green computing initiatives are already shaping the lives and practices of the world university campus populations as the highest users of ICT. A number of universities in the U.S., Canada, Australia, Europe and the U.K. have for some time been creating awareness among students through green plans and sustainability campaigns. Some are very serious about energy reduction and have gone as far as erecting carbon-neutral buildings. A case in point is the University of Copenhagen (UCPH) in Denmark which in 2009 successfully built an energy-efficient center for its student services. The building is completely carbon free and powered by a combination of solar energy, heating pumps, and a district heating. The UCPH also has a Green Action plan in which it employs green ambassadors to promote good energy conservation habits among students and staff. The plan helped the university to reduce its energy consumption and carbon footprint by 2.5% in 2012 (Harris, 2011).

The University of Utah in Salt Lake City, U.S. also maintains a sustainability website that educates its students and staff on the ways to reduce paper and electronic waste. It has a green policy that provides guidelines for e-waste management and hardware retirement. It also implements free e-waste collections and provides a calendar specifying dates on which e-waste will be collected. In Australia, green ICT is offered as an online course by the Australian National University and the University of New South Wales as part of an effort to increase awareness in green computing, in line with the plan that green ICT education be integrated into the tertiary curriculum (Harris, 2011). The universities' move to offer the courses completely online is also an act of compliant with green computing as e-learning options are hailed as a viable way of reducing energy consumption and CO2 emissions by a substantial percentage (Akaslan & Law, 2010).

Green Computing Initiators

1. United State Environmental Protection Agency and Energy Star

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy-efficient products and practices.

In 1992 the US Environmental Protection Agency (EPA) introduced ENERGY STAR as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. Through 1995, EPA expanded the label to additional office equipment products and residential heating and cooling equipment.

In 1996, EPA partnered with the US Department of Energy for particular product categories. The ENERGY STAR label is now on major appliances, office equipment, lighting, home electronics, and more. EPA has also extended the label to cover new homes and commercial and industrial buildings. Through its partnerships with more than 12,000 private and public sector organizations, ENERGY STAR delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices. ENERGY STAR has successfully delivered energy and cost saving across the country, saving businesses, organizations, and consumers about $16 billion in 2007 alone. Over the past decade, ENERGY STAR has been a driving force behind the more widespread use of such technological innovations as efficient fluorescent lighting, power management systems for office equipment, and low standby energy use (Energy Star, 2012).

2. The Swedish Organization TCO

Development and TCO Certification TCO is a quality and environmental labeling system, the purpose of which is to influence the development of products to ensure optimum user-friendliness and minimum impact on the environment. The TCO labeling system makes it easy to choose IT and office equipment which is beneficial to both the user and the environment. It is set by TCO Development, owned by the Swedish Confederation of Professional Employees. The Certifications are named after years (TCO Development, 2012).

TCO labeling introduced energy-saving requirements in 1992 and recycling requirements in 1995. With regard to IT products, material and energy consumption are the two single factors with the greatest impact on climate change. The TCO labeling system has always focused on the technical front with regard to emitted radiation, picture quality, the environment and energy. In future, it will be essential for computers to operate using significantly less energy than they do today while providing users worldwide with a genuinely healthy working environment (TCO Development, 2012) .

3. Climate Savers Computing Initiative (CSCI)

CSCI was started on 12 of June in 2007. CSCI is an approach to decrease the electric power consumption by PC. The member organizations of CSCI in the scope of CSCI are offering a catalog of green products. Also, CSCI provides information for reducing PC power consumption and product longevity (climatesavers, 2012).

4) Green Computing Impact Organization, Inc. (GCIO)

GCIO is a non-profit organization that guides users of computing products to be environmentally conscious. GCIO is organized educational meetings, gathering programs, and financed auditing services. Key persons consist in GCIO Cooperative. They are a community of IT leaders who care about the environment. These cooperative members use own recourses for buying power to educate, widen the usefulness and effectiveness of green computing products and services. Through using group negotiated power, keeping a community which accounts generated savings for effectiveness and understanding of measurable savings GCIO Cooperative members want to increase the ROI of green computing (GCO, 2013).

5. Green Electronics Council (GEC)

The Electronic Products Environmental Assessment Tool (EPEAT) was provided by Green Electronics Council. The EPEAT is used to assist in the purchase of "green" computing systems. GEC Inspire and support the effective design, manufacture, use, and recovery of electronic products to contribute to a healthy, fair and prosperous world. The Green Council in 2012 **t**hrough partnerships with the electronics industry and other interested stakeholders to implement market-driven systems to recognize and reward environmentally preferable electronic products as well as build the capacity of individuals and organizations to design and manage the lifecycle of electronic products to improve their environmental and social performance.

6. The Green Grid

The Green Grid is a global consortium dedicated to advancing energy efficiency in data centers and business computing ecosystems. It was founded in February 2007 by several key companies in the industry – AMD, APC, Dell, HP, IBM, Intel, Microsoft, Rackable Systems, Spray Cool, Sun Microsystems and VMware. The Green Grid has since grown to hundreds of members, including end users and government organizations, all focused on improving data center efficiency (Green Grid, 2012).

Benefits of Green Computing Practices

The overall goals of green computing are similar to that of any other ecologically-friendly endeavor: chiefly, to maximize energy efficiency, reduce the use of hazardous materials, and promote the recycling of obsolete products and waste. Various practices that deliver useful benefits have become popular.

Energy management is often the starting point in the implementation of green computing. In line with new ecological awareness, many companies have also come to accept that reduced energy consumption translates not only to reduced greenhouse gas emissions, but reduced operational costs for the users as well. Fortunately, there are steps that can be taken to manage and reduce energy consumption. Servers and entire data centers can be consolidated. The datacenter can upgrade to energy-efficient servers and high-efficiency power supplies and can employ power management processes and controls that automatically turn off systems after set periods of inactivity. User computers are also high energy consumers. Fifteen PCs can generate as much carbon emissions as a mid-size car each year. The average PC consumes 588 kilowatt-hours of electricity per year and wastes almost 400 kWh of that by running at fullpower when not in use. Using power management controls on PCs during periods of inactivity can cut energy use on average 60-70 percent (Klustner, 2008).

Virtualization, of both computer resources and the employee experience, has started to generate significant benefits for green computing. Computer virtualization refers to an abstraction of computer resources, for example, running two or more logical computer systems on one set of physical hardware. With virtualization, hardware infrastructure is reduced, resulting in reduced energy and cooling consumption. Cloud computing services, relating to the location and ownership of infrastructure, can be purchased from a third-party provider, resulting in economies of scale and significant cost savings. In addition to virtualization of computer resources, virtualization of the employee experience can also drive benefits for the environment and the users.

The daily energy consumption is on the rise, with computers accounting for a significant percentage. According to the Environmental Protection Agency, the average annual energy consumption for U.S. office buildings is over 23-kilowatthours per square foot, with heat, air conditioning, and lighting accounting for 70% of all energy consumed (U.S. EPA, Office of Air and Radiation, 2008). Certainly one of the basics of green computing involves recycling. The EPA estimates that as of 2007, some 66 million PCs, 42 million monitors, and 25 million printers/faxes/scanners were in storage. The EPA further estimates that only about 18% of these would be recycled, with the rest disposed of in landfills (Tucci, 2008).

Recycling computer equipment can keep toxic materials such as lead and mercury out of landfills, and can also replace equipment that otherwise would need to be manufactured, thus reducing further energy requirements. Computer systems that have aged or become obsolete can have their lifecycles extended or re-purposed. For example, older servers can be kept powered off or in standby and used only during periods of high demand. Older desktops can be used as terminal servers or can be provided to employees whose jobs do not require high-end computing power. Older computer equipment can also be donated to various charities and non-profit organizations.

Moreover, within the realm of green computing, there are many practices and work habits that can be encouraged, or mandated, among employees. Most computer equipment now comes with power management features and they should be activated. Computers, printers, and monitors should be turned off when not in use. Printers and hardcopy print output can be especially hard on the environment. Users should review documents on screen, rather than printing documents unnecessarily, especially draft versions. Many printers can print double-sided documents, which is also environmentally friendly. Ink-jet printers, though a little slower than laser printers, use 80 to 90 percent less energy (Go green, save green, 2010). Many organizations mandate the recycling of paper, which is an excellent practice. Companies should carefully consider the size of computer monitors provided to employees. A large display device, such as a 17-inch monitor, uses 40 percent more energy than a 14-inch monitor. Also, if a monitor is set to display higher resolution, it requires more energy (Go green, save green, 2010).

Hazardous Chemicals available in Computers

There are many hazardous chemicals in computers which causes numerous ailments when not properly disposed of. Claiborne, (2009) identified lead, mercury, cadmium, and plastics as some of the most hazardous chemicals in computers. Lead is one of the chemicals found in computers that can cause damage to the central and peripheral nervous systems, blood system, kidneys, endocrine system and causes negative effects on child brain development. Lead accumulates in the environment and has toxic effects on plants, animals and microorganisms Electronics contribute 40% of the total amount of lead found in landfills and can make its way from landfills into the water supplies. Another hazardous chemical available in computers is Mercury which spreads out in water transforming into methylated mercury which easily accumulates in living organisms. It enters the food chain through fish that swim in polluted waters methylated mercury can cause chronic brain damage.

Cadmium is another chemical classified as toxic; these compounds accumulate in the human body, particularly the kidneys. It is absorbed through respiration and also food intake. Cadmium has a half-life of 30 years so that cadmium can poison a human body slowly through the human's life. There are plastics in computers, which are often treated with flame retardant chemicals, particularly brominate flame retardant these chemicals can act as endocrine disrupters and increase the risk of several forms of cancer. They have been found entering the food chain.

Using IT to Create Green Awareness

In addition to moving itself in a greener direction and leveraging other environmental initiatives, IT could help create green awareness among IT professionals, businesses, and the general public by assisting in building communities, engaging groups in participatory decisions, and supporting education and green advocacy campaigns. Along these lines, tools such as environmental Web portals, blogs, wikis, and interactive simulations of the environmental impact of an activity could offer assistance. IT is part of the environmental problem, and it can be part of the solution (Fuchs, 2008). Green IT is an economic, as well as an environmental, imperative. Greening IT is and will continue to be a necessity, not an option. Green IT represents a dramatic change in priority in the IT industry. So far, the industry has been focusing on IT equipment processing power and associated equipment spending. It's not been concerned with other requirements such as power, cooling, and data center space (Eastwood, 2009).

However, going forward, the IT industry will need to deal with all of the infrastructure requirements and the environmental impact of IT and its use. The challenges of green IT is immense; however, recent developments indicate that the IT industry has the will and conviction to tackle our environmental issues. Companies can benefit by taking these challenges as strategic opportunities. The IT sector and users must develop a positive attitude toward addressing environmental concerns and adopt forward-looking, green-friendly policies and practices (Fuchs, 2008).

2.4 Theoretical Framework

The organizational adoption of novel information technologies is one of the classical issues in information systems, operations, and technology management research (Thiesse, stake, Schmitt & Fleisch, 2011). The majority of existing IT adoption studies follows a “factor approach” which assumes that a number of predicting variables identified at a particular time determine adoption decisions of an organization (Thiesse et al., 2011). When it comes to variables that influence IT adoption firms tend to ignore the significance of many factors that directly or indirectly affect the process (Nguyen, 2009).

Therefore, many researchers attempted to provide a comprehensive and general framework to identify the significant factors influencing new technologies and innovations adoption. Tornatzky and Fleischer (1990) believe that the most used theories of technology adoption are theory of planned behavior (TPB), the technology acceptance model (TAM), unified theory of acceptance and use of technology (UTAUT), Diffusion of Innovation (DOI) (Rogers 1995), and the Technology-Organization-Environment (TOE) framework. These models have differences in term of their focus and are designed to examine different aspects of technology adoption (Alam, 2009). For the purpose of this study, Rogers Diffusion of Innovation (DOI) and Technology-Organization-Environment (TOE) framework is to be adopted.

2.4.1 Rogers Diffusion of Innovation (DOI)

Roger (2003) suggests that five characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption. Five attributes of innovations are: relative advantage, compatibility, complexity, trial ability, and observability.

Relative advantage: is the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage is often expressed in economic profitability, in status giving, or in other ways (Rogers, 2003).

Compatibility: is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter (Rogers, 2003).

Complexity: is the degree to which an innovation is perceived as relatively difficult to understand and use. Any new idea may be classified on the complexity-simplicity continuum. Some innovations are clear in their meaning to potential adopters while others are not(Rogers, 2003).

Trialability: is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the installment plan will generally be adopted more rapidly than innovations that are not divisible (Rogers, 2003). Trialability is positively correlated with the rate of adoption. The more an innovation is tried, the faster its adoption will be (Laratta, 2010).

Observability: is the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others.

In summary, Rogers argued that innovations offering more relative advantage, compatibility, simplicity, trialability, and observability will be adopted faster than other innovations (Laratta, 2010). According to Roger (2003) when the innovation is being diffused there are four attributes that affect the rate of adoption for the innovation:

(1) The type of innovation-decision: Rogers (2003) believes that innovations can be adopted or rejected by individual members of a system, or by the entire social system, which can decide to adopt an innovation by a collective or an authority decision. There are three types of innovation decision:

Optional innovation-decisions are choices to adopt or reject an innovation that are made by an individual independent of the decisions of other members of the system.

Collective innovation-decisions are choices to adopt or reject an innovation that are made by consensus among the members of a System. All of the units in the system usually must conform to the system's decision once it is made.

Authority innovation-decisions are choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise.

(2) The nature of communication channels: Two types of communication channels have been influential in diffusing technology: mass media channels and interpersonal channels. Mass media defined by Rogers (1995) as all those means of transmitting messages that involve a mass medium, such as radio, television, newspapers, and so on, which enable a source of one or a few individuals to reach an audience of many.

Interpersonal channels are defined as: face-to-face; telephone; personal memo. In his review of innovation diffusion, Rogers (1995) reported mass media channels were most influential in introducing potential adopters to an innovation, whereas interpersonal channels were more influential in subsequent stages (Pollar, 2003).

(3) The nature of the social system: The social system is the environment (individual, organizational and environmental) within which an innovation is diffused (Pollar, 2003). This system is likely to have opinion leaders, norms of its own, and a social structure that may be more or less cumbersome (Philliber, 2008). Different roles individuals play, such as change agent and opinion leader within that social system influence diffusion (Pollar, 2003).

(4) The extent of change agents' promotion efforts: Change agents promote concrete change in groups or organization. For instance, they foster the diffusion of innovations by influencing chosen group members towards innovation adoption (Maienhofer & Finholt, 2002). There is a powerful influential role to be played by opinion leaders and change agents in diffusing innovation in a community through their social networks (Carrigan, Moraes & Leck, 2011).

Figure one shows Roger's DOI model.

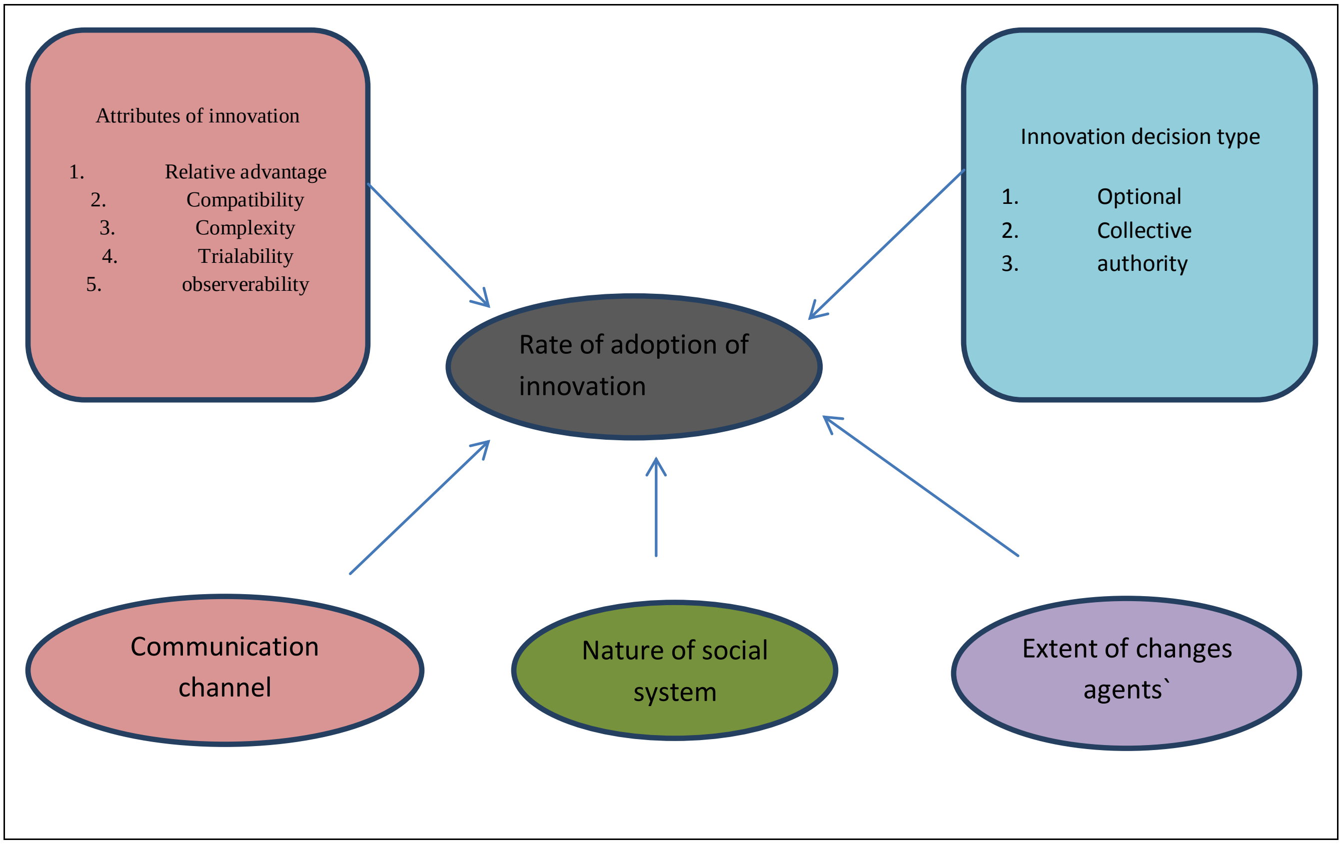

Figure 2: Roger's DOI Model (Roger, 2003)

DOI model considers adoption decisions from the rationalistic perspective of strategic choice, aiming at improving organizational efficiency and performance (Midgley & Dowling, 1993). This model is a theory of how, why, and at what rate new ideas and technology spread through cultures, operating at the individual and firm level (Oliveira & Martins, 2011). Roger model is based on examination of thousands of studies which span a large number of fields of human endeavor, and has quite rightly had a profound role in shaping the basic concepts, terminology, and scope of the field (Fichman, 2000).

Although Rogers' model has been implemented extensively to describe new technologies or innovation adoptions, there are some criticisms about it. For instant, Azadegan and Teich (2010) note that DOI model falls short in detailing the role of other influential factors. For example, how motivated or capable the adopting organization in applying the technology is a secondary consideration in the model. Also, while Rogers' model underlines the effects of network-related factors, it falls short in capturing the dynamics of inter-organizational relationships between the trading partners.

As Azadegan and Teich (2010) describe Rogers' model underlines the effects of network-related factors; but it falls short in capturing the dynamics of inter-organizational relationships between the trading partners. In a critique of DOI model, Lundblad (2003) provides details on the importance of inter-organizational and systems-related factors and how their exclusion may limit the applicability of the model (Assimakopoulos & Wu, 2010).

2.4.2 The Technology-Organization-Environment (TOE) Framework

The early TOE theoretical model was proposed by Tornatzky and Fleischer for new technology adoption back in 1990 (Assimakopoulos & Wu, 2010). The TOE framework as originally presented, and later adapted in IT adoption studies, provides a useful analytical framework that can be used for studying the adoption and assimilation of different types of IT innovation (Oliveira and Martins, 2011). The TOE framework is a method for ascertaining the features that form technology adoption (Miscione & Johnston, 2010).

A criticism of classical diffusion theories is that they tend to neglect market and industry characteristics as important factors in the adoption decision. It seems that TOE model is an exception (Azadegan & Teich, 2010). The TOE framework identifies three features of a firm's context that may influence adoption of technological innovation (Oliveira & Martins, 2010):

The Technological Context: describes existing technologies in use and technical skills in the organization and new technologies relevant to the firm (Thiesse et al., 2011). The nature of a technology can influence its adoption. For example, Rogers (1995) makes the distinction between hardware and software; software is the understanding about what the technological hardware can achieve. Rogers contends that the software diffuses faster than the hardware (Meade & Islam, 2006).

The Organizational Context: These factors are related to companies' characteristics, such as the availability of financial resources, the management emphasis put on adoption, the availability of human resources, and the competitive attitude of the company (Matopoulos, Vlachopoulou & Manthou, 2009). Teo, Lin and Lai, (2009) suggest a few descriptive measures for the organizational context: firm size and scope, informal electronic linkage and communication, amount of slack resources that are internally available as well as the centralization, formalization, and complexity of the firm's managerial structure.

According to Camara, Fonseca, Onsrud, and Monteiro, (2004) some organizational factors might explain the differences in the extent and the speed of IT adoption. Among these are fluid (or not) communication between departments and business units of the organization, low (or high) levels of conflict, the explicit support of top management towards IT adoption, and learning and creative skills of staff (Assimakopoulos & Wu, 2010). Dembla et al. (2007) in their research identified the following organizational factors: centralization, formalization, IS budget, and organizational slack. Centralization, referring to the concentration of decision-making activity, increases the predictability of outcomes of decisions. Formalization represents the use of rules in an organization. A higher IS budget allows the organization the flexibility to adopt new innovations. Finally, Organizational slack refers to the extra resources available in excess of what is required for the normal operation of an organization.

The Environmental Context: is the arena in which a firm conducts its business, referring to its industry, competitors, and dealings with the government (Oliveira & Martins, 2010). Environmental context refers to influences from external factors surrounding the firm (Sophonthummapharn, 2009). Environmental factors influence the diffusion of new technology and its applications across organizational and institutional contexts (Assimakopoulos and Wu, 2010). These factors encompass a variety of influences from the outside of the organization on its adoption decisions, which have different origins (Thiesse et al. 2011). An organization is influenced by the industry it operates in and by its competitors (Miscione & Johnston, 2010). The environment context presents both constraints and opportunities for technological innovation (Oliveira & Martins, 2011).

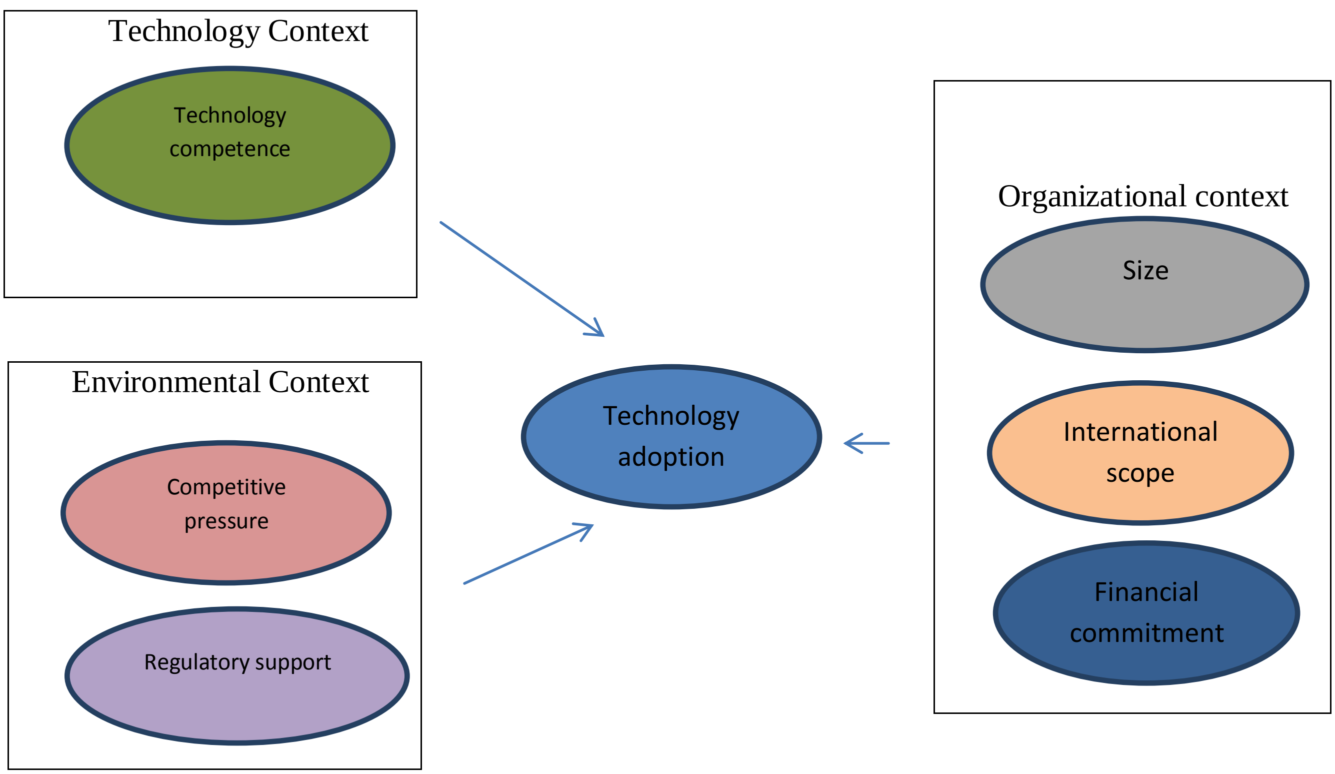

Figure 3: Technology-Organization-Environment Framework (Assimakopoulos & Wu, 2010)

There are a number of studies on the adoption of IT-based new technologies suggests that TOE framework is a popular foundational model in examining the adoption, implementation, and usage of IT innovations (Zhu, Kraemer, Xu, & Dedrick, 2004). Today, the TOE framework has become a widespread theoretical perspective on IT adoption and has been tested for a variety of technologies in the literature (Zhu et al., 2004). A number of empirical studies on various information system domains have proposed the TOE framework.

Despite of its wide usage in IT adoption researches, there are some critics against TOE framework effectiveness in assessing the role of key factors affecting the process of innovation adoption. For example, Dedrick & West (2003) believe that the TOE framework is just Taxonomy for classifying factors and does not provide an integrated conceptual framework or a well-developed theory.

2.4 Review of Empirical Studies

(i) Stakeholders' Green Computing Awareness

Shittu, Gambari and Alabi (2016) in a survey investigate the knowledge of green computing possessed by university students in Nigeria. The study involved students from three departments (Computer Science, Engineering, and Education). Purposive sampling method was used to draw 300 respondents that volunteer to answer the questionnaire administered. Out of the three hundred questionnaires distributed, 276 were used for data analysis. In all, 167 respondents were male, while 109 were female. The reliability of the instrument showed a 0.75 Cronbach's alpha level. The three research questions of the study were answered with descriptive statistic (percentage), t-test and Analysis of Variance. The findings showed that the students do not possess adequate knowledge on conscious use of green computing system.

Batlegang (2012) assessed Botswana students' awareness of green ICT vocabulary, i.e. terms associated with green computing, and the compliance of their computing practices with sustainable computing. He found that the majority of students had limited or no knowledge of green environmental issues, and frequently engaged in practices that led to unnecessary high consumption of electricity. Although the college made efforts to create energy conservation awareness via posting green ICT messages and power saving tips in all classes and computer labs, students' levels of green environmental awareness remained low and discouraging. Despite the efforts, students remained oblivious to the need to use energy efficiently. The author concluded that green environmental knowledge and education was lacking at the college, and extensive work needed to be done to sensitize its campus population ongoing green.

Dookhitram, Sunhaloo, Sukhoo and Soobron (2012) found slightly higher levels of awareness among Mauritian students, but discovered a gap between their awareness levels and practices. Although students reported having moderate knowledge and awareness of green ICT, their daily practices were inconsistent with their self-report. Only 18% turned off their computers and other electrical appliance when not in use, and most had misconceptions about power saving practices. The authors emphasized the importance of university-led initiatives in increasing students' awareness on the need to keep the environment green, recommending a sustainability website to be put in place and the implementation of a green technology policy. In both studies, students were reported as heavy users of electrical/electronic and the internet with high degrees of computer literacy.

Courtney (2008) in a survey of 120 Information Technology decision-makers carried out in the UK revealed that only18% of the managers evaluated the carbon footprint of a new Information Technology system prior to its purchase, and nearly half did not consider the environmental impact of Information Technology equipment. Many did not even know what the requirements were for purchasing green systems for their companies and had completely no knowledge of green computing by which to judge the green products promoted in the market.

Another UK survey conducted by Nlyte.Software (2010) revealed the following statistics: 63% of businesses accused consumers of being unaware of the hefty carbon footprint associated with the use of Internet services, from Hotmail to Amazon and Facebook, yet 53% of these businesses themselves had no inkling of the environmental impact of their own data centers; only 25% of ICT users aged 16 to 64 claimed to understand the vast environmental impact of their carbon footprint, while just a fraction (2%) of heavy users aged 16 to 24 would consider paying for online services to offset their carbon emissions; a staggering 83% of Facebook and email users had no idea where their thousands of photos and multiple accounts are stored (Nlyte. Software, 2010).

In Australia, a readers' poll conducted by the Government, (2011). disclosed an apparent lack of knowledge in green IT among organizations, with 25% admitting having no knowledge of what it means and 22% claiming that their organization did not know enough about green technologies to adopt green computing. The statistics suggest that although a lot of users feel it is desirable to go green, many do not know much about what it really is and what is going on, nor do they understand why there is a need to go green. We have reasons to suspect that the same situation afflicts students in universities, looking at how uncaring they are and have been with energy consumption.

(ii) Stakeholders' Green Computing Readiness

In a study conducted by Gregory (2013) based on green ICT readiness in Kenya on the relationship between ICT personnel's gender, age and training with the G-readiness variables as proposed in Molla's G- readiness model. The study surveyed ICT personnel in four cases using a questionnaire on a seven likert scale. It established that there exists a significant relationship between the ICT personnel related variables and the G-readiness variables. Based on the findings on the relationship, the study extended Molla's G-readiness model to include a sixth dimension of personnel readiness.

In his study Bello, (2015) explored university students' attitude toward green computing and sought to ascertain whether they were influenced by gender (Male versus Female). A total of 700 students were randomly sampled from six faculties of a Nigerian public university and participated in the survey. Descriptive statistics, independent- samples t-test and Principal Components Analysis (PCA) were used to analyze the data. The PCA analysis extracted one factor, named attitude that could be used to explain students' likely intention to adopt green computing practices through their behavior. Results show that a majority (80.2%) of students were in agreement on the issue of going green.

Miswan and Abdulrahman (2013) in a survey investigating end users` green IT readiness in university technology Malaysia involving students, academic staff and admin staff using questionnaire as the instrument, found that users are ready for green IT implementation only that they have some slack in adopting the practices.

In the United States, study conducted by Seitz et al. (2011) discovered students' attitudes toward green ICT and their intention to adopt it to be significantly influenced by their awareness.

The respondents demonstrated positively compliant behaviors following initiatives that increased their awareness of green behavior.

(iii) Stakeholders' Green Computing Adoption

Chen and chang (2014) in their study examine the leading factors of Green IT adoption decisions. More specifically, the study was interested in the issue of whether government support plays a key factor on determining Green IT adoption in developing countries. Based upon a survey of 64 organizations in Taiwan, the results indicated that environmental compliance (i.e., responding to the environmental regulation changes and citizenships), instead of economic consideration, was the driving force for organizations to adopt Green IT. Furthermore, government support, indeed, played an important role for leading organizations to pursuit their social responsibilities. Technological resources and governance toward green IT were also important factors for organizations to be ready to exercise their social responsibilities.

Ping (2012) in his survey investigates the factors influencing green IT adoption by manufacturing firms in Penang, Malaysia. In attaining the study objectives, a quantitative approach was used by distributing survey questionnaire to randomly sampled manufacturing firms in Penang state. The collected data was then tested with Smart PL Sversion 2.0.M3. The outcomes indicated that there exist a significant and positive relationship between technological, organizational and environmental factors and green IT adoption. However, there is no significant moderating effect found on the organizations size to the relationship between the three factors and green IT adoption.

Lay, Dahui, Wang and Hutchinson (2006) presents a comprehensive look on the key factors that may hinder higher education adopting green technology in a survey "barriers to adoption of green technology by higher education institutions in Malaysia" Though the study is conceptual in nature, its findings can be used as the foundation for future research to identify the most significant factors that promote green technology adoption in order to assess the readiness of higher education in Malaysia to implement green initiatives and practices. Key barriers identified include high adoption cost, lack of environment knowledge and green awareness, lack of trust, adoption skepticism, institution adoption rate and switching barrier issues.

(iv) Gender influence in Green Computing Adoption

Bello (2015) in a survey on university students' attitude toward green computing practices; ascertain the influence of gender (Male versus Female) on green computing attitude. A total of 700 students were randomly sampled from six faculties of a Nigerian public university and participated in the survey. Descriptive statistics, independent- samples t-test and Principal Components Analysis (PCA) were used to analyze the data. However, the result of the t-test shows that female university students were more concern and have a significant difference positive attitude toward green environment compared to their male counterpart.

Ahmad et al. (2013) in their study seek to ascertain the influence of gender and field of study on the two types of green computing knowledge, and whether they were positively and significantly correlated. A total of 208 students from ICT- and non-ICT study programmes of a Malaysian public university took the survey. Data were collected using a self-developed green computing questionnaire. Descriptive statistics, independent-samples t-tests and bicariate correlation were employed to analyze the data. The findings shows that, Gender influenced perceived knowledge – with female students reporting significantly higher knowledge levels – but not objective knowledge, while field of study influenced both in favor of students pursuing ICT-related degree programmes.

Shittu, Gambari and Alabi (2016) in a survey investigate the knowledge of green computing possessed by university students (male and females) in Nigeria. Purposive sampling method was used to draw three hundred (300) respondents that volunteer to answer the questionnaire administered. Out of the three hundred questionnaires distributed, two hundred and seventy-six (276) were used for data analysis. In all, one hundred and sixty seven (167) respondents were male, while one hundred and nine (109) were female. t-test and Analysis of Variance was used in the analysis. The findings showed that the students do not possess adequate knowledge on conscious use of green computing system. Also, the study showed that there is no significant difference in the green computing knowledge possesses among male and female.

2.6 Summary

In this chapter, issues like Green Computing Practices, students, lecturers and educational Technologists` awareness and readiness towards adopting green computing practices were discussed. Thus, the literature review provides information on the awareness level of green computing among computer users across the glove as well as their readiness to adopting green computing practices. Barriers to green computing adoption and benefits of its adoption were discussed.

Most of the empirical studies reviewed share the conviction that students do not possess adequate knowledge on conscious use of green computing and that no innovation can be adopted without its awareness (Gambari, Shittu & Alabi, 2016). According to Batlegang (2012) majority of students in Botswana had limited or no knowledge of green environmental issues, and frequently engaged in practices that led to unnecessary high consumption of electricity. Seitz et al. (2011) discovered students’ attitudes toward green ICT and their intention to adopt it to be significantly influenced by their awareness. Therefore, by virtue of the relevance of green computing among educational technology stakeholders as the highest computer users, it becomes necessary to raise green computing awareness as a prerequisite to readiness and its adoption. From the review of literature, it is clear that several studies found that green computing awareness level is very low, which in turn lead to poor attitude towards going green and adoption of environmental sound practices.

However, very few of the literature reviewed sought to find out educational technology stakeholders` awareness and readiness towards green computing adoption in Universities. This study is designed to fill this gap in the literature so as to provide useful information in such area.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the method, procedures and techniques used in the conduct of the study under the following sub-headings: research design, population of the study, sample and sampling technique, instrumentation, validity of the instrument, pilot testing, reliability of the instrument, procedure for data collection, as well as procedure for data analysis.

3.2 Research Design

This study adopted a cross sectional survey research design. A survey is used in studies that have individuals as units of analysis (Babbie, 2001). This is also what Nworgu (1991) described as allowing a group of people or items to be studied by collecting and analyzing data from only a few people or items to be considered as representative of the entire group.

This design allows the researcher to gather information about a target population without undertaking a complete enumeration. It is a research method that is good for both small and large population and it is a common research method in Social Science (Hale, 2011). The choice of this design was to allow the researcher to gain an insight of the awareness and readiness of students, lecturers in adopting Green Computing practices.

3.3 Population

The population of the study covers all the educational technology students, lecturers and technologist in the two universities under study in north central Nigeria.

Table 3.1: The Distribution of Educational Technology Stakeholders in North central Nigeria

S/N	University	No. of educational technology stakeholders						
		Students		Lecturers		Technologists		Total
		M	F	M	F	M	F	
1	UNIVERSITY A	617	297	19	5	9	1	948
2	UNIVERSITY B	160	40	11	3	9	1	224

From the Table 3.1 above, university A has 948 educational technology stakeholders of which 914 are students; 24 are lecturers while 10 are technologist. The population of university B is 200 students, 14 lecturers and 10 technologists making a total of 224 educational technology stakeholders. The total population of the two universities is 1172 educational technology stakeholders.

3.4 Sample and Sampling Techniques

There are twenty (20) universities in north central Nigeria as at 2015 according to National University Commission. The researcher uses purposive sampling technique in sampling the two universities. The universities are: University A and University B as the only universities with Educational technology departments in North-Central Nigeria. Stratified random sampling technique was used in selecting male and female educational technology stakeholders.

The researcher use Krejcie & Morgan (1970) and Sambo (2008) in determining the sample size from the sample frame. According to Asuzu (2015) sample is a portion of a study population of interest selected in such a way that it is complete representative of that study population and so, inference data obtained from the sample will be as true as if the entire population has been studied.

Table 3.2: The Distribution of sample from the population of Educational Technology Stakeholders in North central Nigeria

S/N	University	No. of Educational Technology Stakeholders						
		Students		Lectures		Technologists		Total
		M	F	M	F	M	F	
1	UNIVERSITY A	234	165	19	5	9	1	433
2	UNIVERSITY B	113	36	11	3	9	1	173

Using Krejcie and Morgan`s table, six hundred and six (606) educational technology stakeholders was used as the sample of the study. Three hundred and forty seven (347) was drawn as sample from 777 male students and 201 female students from the two universities under study. As the population of lecturers and technologists is only 58, the researcher decides to use all the 58 as a sample size.

3.5 Instrumentation

The instrument used in the research work is questionnaire, which allows for the collection of large number of data in a short period of time as well as getting the required information from the respondents. The instrument is a researcher-made questionnaire tagged Stakeholders Awareness, Readiness and Adoption of Green Computing (SARAGC). It contains four sections harmonized in one questionnaire; Section A required the respondents' demographic information that includes: Sex, stakeholders Designation: student, lecturer or educational technologist, and the definition of Green Computing.

Section B contains ten (10) items purposely meant to collect information on the Educational Technology Stakeholders` Awareness on Green Computing with four rating scale: FA (fully aware) A (aware) NFA (not fully aware) NA (not aware)

Section C contains fifteen (15) items designed to collect information on the educational technology stakeholders` readiness to green computing adoption. Four (4) rating scale included in this section is: FR (fully ready) PR (partially ready) R (ready) NR (not ready) Section D is designed to collect information on the educational technology stakeholders` level of green computing adoption with four (4) rating scales: A (always) S (sometimes) R (rarely) N (never).The Respondents were required to respond to the items by a tick (√) against the appropriate option that reflect or show their personal opinion as seen in appendix I.

3.5.1 Validity of the Instrument

The instrument was subjected to face content and construct validity. Two lecturers from Instructional Technology section, two lecturers from computer science department and two senior lecturers from English language department from Ahmadu Bello University Zaria validated the instrument. After receiving the validation assessment forms from validation, comments were made on the appropriateness of the instrument, language used as well as the suitability of the instrument to respondents and some were considered and affected.

3.5.2 Pilot Testing

The instrument was pilot tested using thirty three (33) students, lecturers and technologists from Educational Technology unit of Ahmadu Bello University Zaria. The institutions are not part of the real study but share similar characteristics with the sampled institutions in terms of gender, designation and their discipline. The purpose of pilot testing is to ascertain the reliability coefficient. The data collected was analyzed using statistical package for social sciences.

3.5.3 Reliability of the Instrument

Reliability coefficient index of 0.92, 0.79 and 0.82 from section B, C and D respectively, was obtained using cronbatch Alpha from the pilot study. This is in line with the proposition of Fulekar, (2009) that an instrument is said to be reliable when the reliability co-efficient can be approximated to one (1).Thus, this instrument is said to be satisfactory for use in the study.

3.6 Procedure for Data Collection

A total number of six hundred and six (606) questionnaires were distributed to the respondents in the two universities under study. The researcher will distribute the questionnaire to students, lecturers and technical staff from educational technology departments, systematically selected taking in to cognizance their designation and sex. The researcher was assisted by the service of research assistant in the respective departments of the two universities.

3.7 Procedure for Data Analysis

Data collected on the basis of the research questions set in chapter one were analyzed using descriptive statistics (i.e frequency, percentage, mean and standard deviation). The limit for decision rule: An average mean of 2.50 and above was considered as agreed, while an average mean of 2.49 and below was considered disagreed with respect to research questions. A theoretical mean of 2.5 according to David (2005) should be used as a criterion to judge mean scores for four items likert questions format. Therefore, the mean criterion of 2.5 was calculated from the sum of 4+3+2+1 divided by 4.

Null hypotheses one, three and five were tested using Kruskal-Wallis Non parametric test and null hypotheses two, four and six were tested using Mann Whitney Non parametric test at 0.05 (95%) level of significant. The reasons for choosing this statistical technique was based on the nature of the data that was collected which is purely respondents' opinion. The limit for decision on hypotheses: If p-value is greater than alpha value the null hypothesis will be rejected. If p-value is lesser than alpha value the null hypothesis will be retained.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents the results of the data obtained from the study. A total of 606 respondents were the samples size for the study while 595 respondents were however used for the analysis. This implying a 98.4% returned rate. The analyses of the data were based on the research questions and the null hypotheses. The results obtained from the data collected for this study are presented in the following tables:

4.2 Demographic Data of the Respondents

Table 4.1 Frequency and Percentage Distribution of the Respondents by Gender

Respondents	Frequency	percentage
Male	386	64.87
Female	209	35.12
Total	595	100%

The data in table 4.1 revealed that out of 595 respondents, Three Hundred and Eighty Six 386 (64.87%) are male while Two Hundred and Nine 209 (35.12%) was female. This means that male educational technology stakeholders form the majority of the respondents that took part in the study.

Table 4.2 Frequency and Percentage Distribution of the Respondents by Designation

Designation	Frequency	Percentage
Students	538	90.42
Lecturers	37	6.21
Technical staff	20	3.36
Total	595	100%

The data in table 4.2 shows that 538 (90.42%) of the respondents took part in the study are students, followed by37 (6.21%) lecturers and20 (3.36%), technical staff from Educational Technology Departments.

4.3 Research Questions

Research Question One: What is the level of Educational Technology Stakeholders' Awareness on Green Computing practices in north central Nigeria?

To answer this question, respondents were asked to rate their awareness level on green computing practices. This was to identify the awareness on common green computing practices on four point modified likert scales. Item 1 – 10 of the research instrument was used to answer this question. The result is presented in Table 4.3 as follows:

Table 4.3.2: Educational Stakeholders to Green Computing Adoption Awareness

S/N	Item	N	Mean	SD	Decision
	I am aware that:				
1	Practicing green computing reduces energy Consumption	595	2.86	0.84	Agree
2	Green computing practices is fundamental and a major concern of the modern world	595	2.63	0.80	Agree
3	Green computing is an eco-friendly computing practice aimed at reducing carbon emission	595	2.55	0.87	Agree
4	Recycling computer hardware help to protect the environment	595	2.47	1.00	Disagree
5	Discarded computer leaks lead and mercury into the environment	595	2.42	0.97	Disagree
6	ENERGY STAR is an energy-efficient product labeling system	595	2.51	0.93	Agree
7	Using Google's Blackle search engine is faster and saves energy	595	2.54	0.94	Agree
8	Green manufacturing helps in reducing wastage	595	2.47	0.98	Disagree
9	17- inch monitor uses more energy than 14-inch Monitor	595	2.49	0.96	Disagree
10	Turning off the PC saves more energy than putting it on sleep mode	595	2.56	1.02	Agree
	CommutativeMean		**2.55**		

Decision mean=2.5

Table 4.3 shows the responses of Educational Technology Stakeholders level of awareness on Green Computing practices in North-Central Nigeria. Their response shows that educational Technology Stakeholders in north central Nigeria are aware of green computing practices because the cumulative mean value of 2.55 is higher than the decision mean value of 2.50. It was observed that stakeholders awareness on Practicing green computing reduces energy consumption had the highest cumulative mean of 2.86, followed by 2.63 cumulative mean that Green computing practices is fundamental and a major concern of the modern world. Stakeholders are also aware that Green computing is an ecofriendly computing practice aimed at reducing carbon emission with cumulative mean 2.55 and that ENERGY STAR is an energy-efficient product labeling system with 2.51cummulative mean. Awareness on using Google's

Blackle search engine is faster and saves energy has 2.54 cumulative mean, and 2.56 cumulative mean in agreement that Turning off the PC saves more energy than putting it on sleep mode.

Research Question Two: what is the level of Educational Technology Stakeholders' Readiness to Green Computing Adoption in North-central Nigeria?

To answer this question, respondents were asked to rate their readiness level on green computing adoption. This was to identify stakeholders' readiness towards green computing adoption on four point scale. Item 11– 25 of the research instrument was used to answer this question. The result is presented in the table 4.3.2 as follows:

Table 4.4: Readiness of Educational Stakeholders to Green Computing Adoption

S/N	Item	N	Men	SD	Decision
I am ready to:					
11	adopt green computing practices	595	3.19	0.17	Agree
12	Turn off my computer when not in use to save energy	595	2.91	0.86	Agree
13	Use screen saver function	595	2.66	0.89	Agree
14	Use the system sleep function	595	2.53	1.08	Agree
15	Reduce the time spent using computers	595	2.61	0.98	Agree
16	Print on both sides of the paper	595	2.52	0.94	Agree
17	Save documents on disk rather than print them on paper	595	2.55	0.97	Agree
18	Print only when necessary	595	2.80	0.96	Agree
19	Adopt multi-page printing	595	2.22	0.97	Disagree
20	Reuse printed papers for testing printers	595	2.56	1.05	Agree
21	Use re-writeable storage media	595	2.54	1.03	Agree
22	Recycle unwanted lithium (laptop) batteries	595	2.32	1.06	Disagree
23	Recycle unwanted computer equipment	595	2.56	1.06	Agree
24	Buy new computer device only when necessary	595	2.69	1.09	Agree
25	Use environmentally friendly alternatives	595	2.84	1.09	Agree
Commutative Mean			**2.60**		

Decision mean=2.5

Table 4.4 showed the: the responses of Educational Technology Stakeholders` readiness towards Green computing adoption in North-Central Nigeria. It was discovered that, in summary they are in agreement with 1items on readiness to Green computing practices and the cumulative mean 2.60 is greater than the decision mean of 2.50. It was also noticed that item 11 on stakeholders readiness to adopt green computing practices attracted the highest mean score of 3.19 followed by item 12 with 2.91 had the second highest mean score. Stakeholders were not in agreement with item 19 and 22 on their readiness to adopt multi page printing as well as recycle unwanted lithium (laptop) batteries. This indicates that educational Technology Stakeholders in north central Nigeria are indeed ready to adopt Green computing practices.

Research Question Three: what is the level of Educational Technology Stakeholders' Green Computing adoption in North-Central Nigeria?

To answer this question respondents were required to rate their green computing adoption level using modified four point likert scale. Item 26-40 of the research instrument was used to answer this question.

Table 4.5:Educational Technology Stakeholders' Green Computing Adoption

S/N	Item	N	Mean	SD	Decision
	I				
26	Adopt green computing practices	595	3.17	0.79	Agree
27	Turn off my computer when not in use to save energy	595	2.89	0.87	Agree
28	Use screen saver function	595	2.68	0.88	Agree
29	Use the system sleep function	595	2.54	1.08	Agree
30	Reduce the time spent using computers	595	2.63	0.98	Agree
31	Print on both sides of the paper	595	2.51	0.94	Agree
32	Save documents on disk rather than print them on paper	595	2.54	0.98	Agree
33	Print only when necessary	595	2.80	0.96	Agree
34	Adopt multi-page printing	595	2.67	0.97	Agree
35	Reuse printed papers for testing printers	595	2.55	1.05	Agree
36	Use re-writeable storage media	595	2.52	1.03	Agree
37	Recycle unwanted lithium (laptop) batteries	595	2.25	1.06	Disagree
38	Recycle unwanted computer equipment	595	2.34	1.06	Disagree
39	Buy new computer device only when necessary	595	2.68	1.08	Agree
40	Use environmentally friendly alternatives	595	2.81	1.09	Agree
Commutative Mean			**2.64**		

Decision mean=2.5

Table 4.5 shows the level of green computing adoption of Educational Technology Stakeholders in North Central Nigeria. It was discovered that, 13 items are in agreement while 2 items were not in with the statement on green computing adoption. Reason being that the cumulative mean of 2.64 on all the 15 items is higher than the decision mean of 2.50. Specifically, item 26 which state that 'I adopt green computing practices' attracted the highest mean value of 3.17. Likewise item 27 have the second highest mean of 2.89 in agreement that Educational Technology Stakeholders in north central Nigeria turn off their computer when not in use to save energy. Stakeholders were not in agreement with item 37 on their readiness to recycle unwanted lithium (laptop) batteries and item 38 on stakeholders` readiness to recycle unwanted computer equipment.

Research Question Four: what is the difference in the level of green computing awareness of students, lecturers and educational technologist in North Central Nigeria?

Table 4.6: Green Computing Awareness of Students, Lecturers and Educational Technologist in North Central Nigeria.

Respondents	N	Mean	SD
Students	538	2.52	0.49
Lecturers	37	2.54	0.46
Technologist	20	2.32	0.28

Table 4.6 shows the level of green computing awareness of students, lecturers and educational technologist in North-Central Nigeria. The result shows that technologists have the highest level of green computing awareness with mean score of 3.32 followed by lecturers with 2.54 and then students with the mean value of 2.52. Thus technologists are considered to have high level of green computing awareness over lecturers and students. However, there exist a slight difference between lecturers and students.

Research Question Five: what is the difference between male and female educational technology stakeholders' green computing awareness in North Central Nigeria?

Table 4.7:Response of Educational Technology stakeholders' Green Computing Awareness Based on Gender

Respondents	N	Mean	SD
Male	386	2.61	0.53
Female	209	2.43	0.41

Table 4.7 revealed that male Educational Technology stakeholders have higher Green Computing awareness than their female counterpart. Male educational technology stakeholders' awareness recorded a mean value of 2.61and 0.53 standard deviation whereas female educational technology stakeholders are slightly down with a mean value of 2.43 and 0.41 standard deviation.

Research Question Six: What is the difference in the level of Green Computing Readiness of students, lecturers and educational technologist towards Green Computing Adoption in North Central Nigeria?

Table 4.8: Green Computing Readiness of Students, lecturers and Educational Technologist in North-Central Nigeria

Respondents	N	Mean	SD
Students	538	2.67	0.49
Lecturers	37	2.71	0.51
Technologist	20	2.76	0.60

Table 4.8 indicated that technologist have higher level of intent towards adopting green computing practices than the lecturers and students. This is evident from the stakeholders' cumulative mean of 2.76 and a standard deviation of 0.60 for technologists as well as 2.71 cumulative mean values and a standard deviation of 0.51 for lecturers, with students having 2.67 cumulative mean values and a standard deviation of 0.49.

Research Question Seven: What is the difference between male and female Educational Technology stakeholders' readiness to Green Computing adoption in North Central Nigeria?

Table 4.9: Response of Educational Technology stakeholders' Green Computing Readiness Based on Gender

Test Variables	N	Mean	SD
Male	386	2.70	0.50
Female	209	2.63	0.48

Table 4.9 revealed that male educational technology stakeholders are more ready to adopt green computing practices than their female counterpart. Male educational technology stakeholders recorded a mean of 2.70 and a standard deviation of 0.50, slightly ahead of female Educational Technology stakeholders with the mean value of 2.63 and a standard deviation of 0.48.

Research Question Eight: what is the level of Green Computing adoption of students, lecturers and educational technologist in north central Nigeria?

Table 4.10: Green Computing Adoption of Students, Lecturers and Educational Technologists in North central Nigeria

Test Variables	N	Mean	SD
Students	538	2.65	0.47
Lecturers	37	2.88	0.62
Technologist	20	2.76	0.60

Tables 4.10 indicate that lecturers in north central Nigeria adopt green computing practices very often than the technologists and students. Lecturers recorded a cumulative mean of 2.88 and a standard deviation of 0.62 slightly ahead of the technologists with a cumulative mean of 2.76 and a standard deviation of 0.60, and well ahead of the students with a cumulative mean of 2.65 and a standard deviation of 0.47.

Research Question Nine: what is the difference between male and female Educational Technology stakeholders Green Computing adoption in North Central Nigeria?

Table 4.11: Response of Educational Technology stakeholders' Green Computing Adoption Based on Gender

Test Variables	N	Mean	SD
Male	386	2.69	0.50
Female	209	2.63	0.48

Table 4.11 shows that male Educational Technology stakeholders adopt green computing practices more than their female counterparts. This is because male Educational Technology stakeholders have a greater mean value of 2.69 and a standard deviation of 0.50 slightly ahead of female Educational Technology stakeholders with a cumulative mean value of 2.63 and a standard deviation of 0.48.

4.4 Testing Null Hypotheses

Research Hypotheses One: There is no significant difference in awareness of Green Computing practices among students, lecturers and technologist in North-Central Nigeria.

Table 4.12: Kruskal-Wallis Results of Students, Lecturers and Technologists on Green Computing Awareness in North Central Nigeria.

Test variable	Designation	N	Mean Rank	df	$X^2(2)$	P-value
	Students	538	289.61	2	38.016	0.000
Green Computing	Lecturers	37	294.42			
Awareness	Technologist	20	530.45			
	Total	595				

Result of the Non parametric test of Kruskal-Wallis test in Table 4.12 showed the mean rankings of the three designations of respondents (students, lecturers, and technologist) in their awareness of green computing practices in north central Nigeria. The result showed that there is a significant difference in their mean rankings opinions on green computing awareness. This is because the calculated p-value of 0.000 is less than the 0.05 alpha value of significance. The mean ratings of green computing awareness were 289.61, 294.42, and 530.45 for students, lecturers and technologists respectively. This shows that there is a significant difference in green computing awareness among educational technology stakeholders in North-Central Nigeria. Therefore, the null hypothesis which states that "There is no significant difference in awareness of Green Computing practices among students, lecturers and technologist in North-Central Nigeria" is hereby rejected.

Research Hypotheses Two: There is no significant difference between male and female educational technology stakeholders' green computing awareness in North-Central Nigeria.

Table 4.13: Mann-Whitney Test between male and female educational technology Stakeholders' Green computing awareness.

Test Variable	Gender	N	Mean Rank	Sum of Ranks	U (1)	p-value
Green Computing Awareness	Male	386	318.74	123032.00	3.233	0.000
	Female	209	259.70	54278.00		
	Total	595				

A mann whitney u test indicate that there is significant difference U = 3.233, p= 0.000. The result of Mann-Whitney test in the table 4.13 showed the mean rankings of male and female educational technology stakeholders' green computing awareness in north central Nigeria. The result showed that significant differences exist between male and female educational technology stakeholders in North-Central Nigeria. This is because the P-value of 0.000 is lesser than the 0.05 alpha value of significance. Their mean rankings on green computing awareness were 318.74 and 259.70 by male and female students respectively. This shows that male educational technology stakeholders had higher mean ranking on green computing awareness than the female educational technology stakeholders. Consequently, the null hypothesis which states that there is no significant difference between mean rating of male educational technology stakeholders and female educational technology stakeholders on green computing awareness" is hereby rejected.

Research Hypotheses Three: There is no significant difference in the extent of readiness of Green Computing adoption among Students, lecturers and technologist in North Central Nigeria.

Table 4.14: Kruskal-Wallis results of rating of students, Lecturers and Technologists' Readiness to Green Computing Adoption in North Central Nigeria.

Test variable	Designation	N	Mean Rank	df	X^2 (2)	p-value
	Students	538	296.22	2	0.620	0.733
Readiness to green Computing Adoption	Lecturers	37	316.99			
	Technologist	20	310.68			
	Total	595				

This study did not indicate any significant difference in the stakeholders readiness to adopt green computing X^2 (2)= 0.620, P=0.733. Result of Kruskal-Wallis test in Table 4.14 showed the mean rankings of the three sets of respondents (students, lecturers and technologists) in their readiness to adopt green computing practices. The result showed that there is no significant difference in their mean rankings on their readiness to adopt green computing practices. This is because the p-value of 0.733 is greater than the 0.05 alpha value of significance. Their mean ratings on readiness to green computing adoption were 296.22, 316.99 and 310.68 for students, lecturers and technologist respectively. This shows that irrespective of respondent's designation their mean rating on readiness to green computing adoption is not significantly different. Therefore the null hypothesis which states that "there is no significant difference in the mean rating of students, lecturers and technologists on readiness to green computing adoption" is hereby not rejected.

Research Hypotheses Four: There is no significant difference between male and female educational technology stakeholders' readiness to Green Computing adoptions in North Central Nigeria.

Table 4.15: Mann-Whitney Test Between Male and Female Educational Technology Stakeholders' Readiness to Green Computing.

Test Variable	Gender	N	Mean Rank	Sum of Ranks	U (1)	p-value
Readiness to Green Computing Adoption	Male	386	308.13	118939.00	3.643	0.050
	Female	209	279.29	58371.00		
	Total	595				

Result of the Mann-Whitney U test in Table 4.15 showed the mean rankings of male and female educational technology stakeholders' readiness to green computing adoption in north central Nigeria. The result showed that significant differences exist between male and female educational technology stakeholders in North-Central Nigeria. This is because the p-value of 0.05 is equal to the 0.05 alpha value of significance. Their mean rankings on green computing awareness were 308.13 and 279.29 by male and female students respectively. This shows that male educational technology stakeholders had higher mean ranking on green computing awareness than the female educational technology stakeholders. Consequently, the null hypothesis which states that there is no significant difference between mean rating of male and female educational technology stakeholders on readiness to green computing adoption is hereby not rejected.

Research Hypotheses Five: There is no significant difference in the level of Green Computing adoption among educational students, lecturers and technologist in north central Nigeria.

Table 4.16: Non Parametric test of Kruskal-Wallis in the Mean Rating of Students, Lecturers and Technologists' Green Computing Adoption in North Central Nigeria

Test variable	Designation	N	Mean Rank	df	X^2 (2)	P-value
	Students	538	293.50	2	4.654	0.098
Green Computing Adoption	Lecturers	37	355.27			
	Technologist	20	313.20			
	Total	595				

Result of Kruskai-Wallis H test in Table 4.16 showed the mean rankings of the three sets of respondents (students, lecturers and technologist) the adoption of green computing practices. The result showed that there is no significant difference in their mean rankings towards adopting green computing practices. This is because the calculated p-value of 0.098 is greater than the 0.05 alpha value of significance. The mean ratings on green computing adoption were 293.50, 355.27 and 313.20 by students, lecturers and technologist respectively. This shows that irrespective of respondent's designation their mean rating on green computing adoption is not significantly different. Therefore the null hypothesis which states that there is no significant difference in the mean rating of students, lecturers and technologists' green computing adoption, is hereby not rejected.

Research Hypotheses Six: There is no significant difference between male and female educational technology stakeholders' green computing adoption in North-Central Nigeria

Table 4.17: Mann-Whitney Test between Male and Female Educational Technology Stakeholders' Green computing Adoption.

Test Variable	Gender	N	Mean Rank	Sum of Ranks	U (1)	p-value
Green Computing Adoption	Male	386	305.34	117860.50	3.750	0.156
	Female	209	284.45	59449.50		
	Total	595				

Result of the Mann-Whitney test in Table 4.17 showed the mean rankings of male and female educational technology stakeholders' green computing awareness in north central Nigeria. The result showed there is no significant difference between male and female educational technology stakeholders in north central Nigeria. This is because the calculated p-value of 0.156 is greater than the 0.05 alpha value of significance. Their mean rankings on green computing adoption were 305.34 and 284.45 by male and female students respectively. This shows that male educational technology stakeholders had higher mean ranking on green computing adoption than the female educational technology stakeholders. Consequently, the null hypothesis which states that “there is no significant difference between mean rating of male educational technology stakeholders and female educational technology stakeholders on green computing adoption is hereby rejected.

4.5 Summary of Findings.

The following are the summary of the major findings of the study:

1. Educational technology stakeholders in North-Central Nigerian universities have high level of green computing awareness.
2. Educational technology stakeholders in North-Central Nigerian universities are ready to adopt green computing practices.
3. There is high level of green computing adoption among educational technology stakeholders in North-Central Nigeria universities.
4. There is a significant difference in green computing awareness of students, lecturers and technologists in North-Central Nigeria universities.
5. There exists a significant difference between male and female educational technology stakeholders in green computing awareness in North-Central Nigerian universities.
6. There is no significant difference among students, lecturers and technologists in their readiness to green computing adoption in North-Central Nigeria universities.
7. There is no significant difference between male and female educational technology stakeholders in their readiness to green computing adoption in North-Central Nigeria universities.
8. It was found that there is no significant difference among students, lecturers and technologists on green computing adoption in North-Central Nigerian universities.
9. There is no significant difference between male and female educational technology

stakeholders in green computing adoption in North-Central Nigerian universities.

4.6 Discussion of Findings

Responses of educational technology stakeholders on green computing awareness were found to be high. Stakeholders are aware that practicing green computing reduces energy consumption and carbon emission, using fast browsers as well as turning off their computer while not in use. This finding is in agreement with the findings of Dookhitram et al (2012) who found that there is a slightly higher level of green computing awareness among Mauritian students. This is not in agreement with the findings of Courtney (2008) who reported many information technology decision-makers in the UK did not even know what the requirements were for purchasing green systems for their companies and had completely no knowledge of green computing by which to judge the green products promoted in the market.

On the responses of educational technology stakeholders` readiness towards green computing adoption in North-Central Nigerian universities, it was discovered that, educational technology stakeholders are ready to adopt green computing practices. This is in agreement with the findings of Bello (2015) who found that, majority of students in public universities in Nigeria are ready to go green. The findings is also in agreement with the findings of Miswan and Abdurrahman (2013) in a survey investigating end users` green IT readiness in university technology Malaysia involving students, academic staff and admin staff using questionnaire as the instrument, found that users are ready for green IT implementation only that they have some slack in adopting the practices.

The study revealed that, educational technology stakeholders in North central Nigeria are adopting green computing practices. The findings is not in agreement with the findings of Lay et al (2006) who found that there is low level of green computing adoption among students in higher institution in Malaysian. They further identified the key barriers to green computing adoption among higher education institutions in Malaysia to include high adoption cost, lack of environment knowledge and green awareness, lack of trust, adoption skepticism, institution adoption rate and switching barrier issues.

Findings of the study revealed that there is no significant difference in awareness of Green Computing practices among students, lecturers and technologist in North Central Nigeria. The result showed that there is a significant difference in green computing awareness among educational technology stakeholders in North-Central Nigeria. The result further illustrate that students are having the lowest level of green computing awareness. This is in agreement with the findings of Batlenga (2012) who found that students in Botswana in spite the effort made by their university to create energy conservation awareness via posting of green ICT messages and power saving tips in all classes and computer labs, students' levels of green environmental awareness remained low and discouraging.

Moreover, the study revealed that significant differences exist between male and female educational technology stakeholders in their level of green computing awareness with male educational technology stakeholders having higher level of awareness than their female counterpart. This is not in agreement with the findings of Shittu, Gambari and Alabi (2016) who found that there is no significant difference between male and female students' green computing awareness. The further indicate that male educational technology stakeholders had higher mean ranking on green computing awareness than the female educational technology stakeholders.

The study also established that, there is no significant difference in the mean rankings of students, lecturers and technologists in their readiness to adopt green computing practices. This finding is not in agreement with the findings of Seitz et al. (2011) who discovered that students' readiness to green ICT and their intention to adopt it to be significantly influenced by their awareness. The respondents demonstrated positively compliant behaviors following initiatives that increased their awareness of green behavior. The study also revealed that there is a significant difference between male and female educational technology stakeholders' readiness to green computing adoption in North-Central Nigeria. This is in agreement with the findings of Bello (2015) who found that there is significant difference between male and female university students in public universities in Nigeria. The result further illustrate that female university students are more concerned and ready to adopt green computing practices than their male counterpart.

The result of the study showed that there is no significant difference among educational technology stakeholders` in adopting green computing practices. This shows that stakeholders' designation has no significant influence on their green computing adoption. The finding is not in agreement with the findings of Marshall (2002) who identified time and absence of ICT skills and knowledge as significant barriers to technology adoption. Moreover, the study found that there is no significant difference between male and female educational technology stakeholders' level of green computing adoption. This is not in line with the findings of Bello (2015) who reported that female university students were more concern and has a significant difference positive attitude toward green environment compared to their male counterpart.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, the major findings of the study, and implications of the findings to education, conclusion and useful recommendations. It also suggests areas for further studies, generalization and limitations of the study.

5.2 Summary

The main aim of this study was to assess the awareness and readiness of educational technology stakeholders in the adoption of green computing practices in North-Central Nigeria. The objectives of this study, research questions and research hypotheses were drawn based on the major variables as outlined in this study. The study covered two Educational Technology Departments in North-Central Nigeria. They are Educational Technology Department Federal University of Technology Minna and Educational Technology Department, University of Ilorin. Most of the reviewed literature and empirical studies shared the conviction that computer users do not possess adequate knowledge on the use of green computing and that no innovation can be adopted without its awareness.

The study adopted a cross sectional survey research design. The population of the study comprises of all the educational technology stakeholders in North-Central Nigeria. They are 1172. A sample size of 606 educational technology stakeholders were drawn from the population and 595 was used for the study. The instrument used for data collection was a researcher-made questionnaire. A modified four point likert scale format were used.

Frequency counts and percentage was used in explaining the demographic data of the study.

Nine research questions were answered using mean and standard deviation. The major findings were highlighted. The research hypotheses were tested at 0.05 alpha level of significance using the Non parametric statistics. Hypotheses 1, 3, and 5 were tested using Man Whitney while hypotheses 2, 4 and 6 were tested using Kruskal Wallis statistical test. The results of Null hypotheses 1, 2 and 4 were rejected while Null Hypotheses 3, 5 and 6 were not retained.

5.3 Conclusion

In view of the findings of this study, it is concluded that educational technology stakeholders in north central Nigeria are aware of some green computing practices. Stakeholders are conscious of the fact that, common green computing practices like switching off their computers while not in use as well as using fast browsers reduces energy consumption. It was also found that stakeholders are aware that green computing is fundamental and a major concern of the modern world. However, there is relatively low awareness among students, lecturers and technologist on the environmental effects of discarding computer hardwires instead of recycling them.

Educational technology stakeholders' readiness to green computing adoption was found to be high as many educational technology students, lecturers and technical staff were found fully ready to turn off their computers when not in use or use screen savers and sleep function mode and reduces the time they spent using computers. Students, lecturers and technical staff from educational technology departments in North-Central Nigeria, were not ready to recycle obsolete computer equipment. This may be due to lack of accessibility to companies and agencies that recycle computer components. It was also found that majority of educational technology stakeholders do not recycle unwanted lithium batteries and other computer equipment.

Significant difference exists among students, lecturers and technologists' opinion on green computing awareness. Male and female educational technology stakeholders are aware of green computing. Male and female educational technology stakeholders' have different opinion on the level of readiness to green computing adoption.

5.4 Recommendations

i) Workshop and seminars should be organized by the university management on proper disposal and recycling of computer hardwires among students, lecturers and technologists.

ii) Students should be encouraged on behavior change in the usage pattern of computer and its subsystem to reduce their carbon foot-print in Universities.

iii) Heads of Departments and technologists in the universities should recommend the procurement of computers with energy efficient product labeling system.

iv) Educational technology departments should put in place a sustainability website to accessible to both lecturers and students.

v) The national university commission should put in place a green technology policy across universities and ensure its implementation.

vii) Universities authorities in Nigeria should include pro-environmental behavior courses and make it compulsory in their curriculum.

5.5 Suggestions for Further Study

This study considers the following research areas for further studies:

i) Factors influencing Green Computing Adoption among undergraduates in public Universities in North western Nigeria should be investigated

ii) Assessment of final year computer science undergraduates' Green Computing knowledge in Northern Nigeria Universities should be investigated.

iii) Green computing Adoption: A solution to electricity power crisis in Nigeria.

iv) Comparative study of computer science and educational technology students' Green computing Awareness in federal universities in Nigeria.

vi) Additional variables other than the ones used in this study should be explored.

vi) In order to improve the generalization of this study's findings, future studies should increase the population of the study as well as the sample size.

5.6 Limitations of the Study

This study, like human endeavors, had its limitations. First, it is limited to universities in north central Nigeria with Educational Technology Departments of Education and covered only two universities out of 20, with a total number of 595 educational technology stakeholders as participants. But this limitation is addressed considering the fact that the two universities under study are the only universities with educational technology department. This means that the findings of this study are supposed to be generalized. Secondly, the sample size used in this study was drawn from Universities only. In order to increase the sample size as well as take into accounts the composition of the research subject, colleges of education and poly techniques in north central Nigeria need to be incorporated to further validate this study's findings. However, these limitations have no any adverse effect on the findings of this study.

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APPENDIX 1

QUESTIONNAIRE FOR EDUCATIONAL TECHNOLOGY STAKEHOLDERS AWARENESS AND READINESS OF ADOPTING GREEN COMPUTING PRACTICES IN

NORTH CENTRAL NIGERIA

I, YeroShehu(P13EDFC8013) of educational foundation and curriculum, Faculty of Education,Ahmadu Bello University Zaria, am carrying out a research on "Awareness and Readiness of educational Technology stakeholders in adopting green computing practices in North central Nigeria".Please, read carefully and provide information on your opinion on each item stated below. The information you provide shall be treated with utmost confidentiality. Thanks for your anticipated cooperation.

SECTION A: BIO-DATA

Demographic Data: Sex: Male [ ] Female [ ]

Designation: Student [ ] Lecturer [ ] Technical staff [ ]

Definition of Green Computing: it refers to energy efficient computing practices and environmentally responsible use of computer and its subsystems.

SECTION B: items on educational technology stakeholders` awareness on green computing

Note: FA (fully aware) A (aware)NFA (not fully aware) NA (not aware)

S/N	**Rating Items**	**FA (4)**	**A (3)**	**NFA (2)**	**NA (1)**
	I am aware that:				
1	Practicing green computing reduces energy consumption				
2	Green computing practices is fundamental and a major concern of the modern world				
3	Green computing is an ecofriendly computing practice aimed at reducing carbon emission				
4	Recycling computer hardware help to protect the environment				
5	Discarded computer leaks lead and mercury into the environment				
6	ENERGY STAR is an energy-efficient product labeling system				
7	Using Google's Blackle search engine is faster and saves energy				
8	Green manufacturing helps in reducing wastage				
9	17- inch monitor uses more energy than 14-inch monitor				
10	Turning off the PC saves more energy than putting it on sleep mode				

SECTION C: Items on educational technology Stakeholders' Readiness to green computing adoption

Note: FR (fully ready)R(ready) PR(partially ready) NR(not ready)

S/N	Rating Items	FR (4)	R (3)	PR (2)	NR (1)
	I am ready to:				
11	Adopt green computing practices				
12	Turn off my computer when not in use to save energy				
13	Use screen saver function				
14	Use the system sleep function				
15	Reduce the time spent using computers				
16	Print on both sides of the paper				
17	Save documents on disk rather than print them on paper				
18	Print only when necessary				
19	Adopt multi-page printing				
20	Reuse printed papers for testing printers				
21	Use re-writeable storage media				
22	Recycle unwanted lithium (laptop) batteries				
23	Recycle unwanted computer equipment				
24	Buy new computer device only when necessary				
25	Use environmentally friendly alternatives				

SECTION D: Items on educational technology Stakeholder s level of Green Computing Adoption

Note: A (always) S (sometimes) R (rarely) N (never)

S/N	Rating Items	A (4)	S (3)	R (2)	N (1)
	I:				
26	Practice green computing				
27	Turn off my computer when not in use for a long break				
28	Use screen saver function on my computer				
29	Use sleep mode function on my computer				
30	Reduce the time spent unnecessarily using my computer				
31	Print on both sides of the paper				
32	Print on paper only when necessary				
33	Save document on disk rather than print them on paper				
34	Use of multi-page printing				
35	Re-use printed papers for testing printers				
36	Use rewritable storage media				
37	Recycle unwanted lithium (laptop) batteries				
38	Recycle unwanted computer equipment				
39	Buy new computer peripheral only when necessary				
40	Use more environmentally friendly alternatives				

Thank you