



INVESTIGATION ON LEVEL OF AWARENESS, ACCEPTANCE AND PRACTICES OF GREEN COMPUTING IN UNIVERSITIES IN NORTH WESTERN REGION OF NIGERIA

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Abstract: Green computing is a new phenomenon and an important strategic technology with various benefits such as reducing green house gas emissions and lowering electricity costs; thereby creating better environmental image. This study investigates on level of awareness, acceptance and practices of green computing among the staff and students of Federal Universities in the North Western region of Nigeria. It uses quantitative approach by means of hardcopy and online questionnaires in data collection. It employs a self designed five (5) Likert scale questionnaire administered physically and via online tool SurveyMonkey. The participants responded anonymously and voluntarily. The data was collected from a total number of 150 students, 100 teaching staff and 50 non-teaching staff. They were purposively and randomly drawn across the population of all students and staff in the seven (7) Federal Universities in North Western region in Nigeria. The study used descriptive analysis to identify the level of awareness, acceptance and practices on green computing as well as variance in terms of gender and disposition. A cronbach alpha of .95 was obtained whilst the analysis was on SPSS version 23. Result obtained was presented in form of tables and graphs based on the research questions. It concluded that level of awareness, acceptance and practices of green computing is significantly low; with no differences in terms of gender, disposition and institution among staff and students of Federal Universities in North Western Nigeria.

Keyword: Awareness, Acceptance, Green Computing, Universities, Nigeria

Introduction

Given the emphasis of saving the Earth against the effect of global warming, green technology has become mandatory in every aspect of life today. Green computing, sometimes referred to as green IT or green ICT can be seen as the 'practice of eco-friendly' and 'sustainable IT processes and its appliances'. Green computing involves 'study and practice' of using computing resources efficiently to reduce Carbon dioxide (CO₂) emission for eco-friendly environment. This can mean to reduce the energy demand, to avoid or at least to reduce the use of hazardous materials, or else to recycle as good as possible the materials in order to minimize

waste production (Zappa, 2019). Green computing is still a niche area; new technologies, computers and the Internet are supplementing its explosion. However, as good as the technologies appear to be, their negative impact is becoming so much serious threat to human existence. People mainly make use of such modern technologies without making recourse to that negative impact.

Okewu, (2017) viewed that "green computing embraces green infrastructure" and refers to the "efficient and effective handling of computers, servers and accessories such as printers, monitors, networking/communication gadgets, and storage devices with minimal or zero

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environmental impact. This is by studying and adopting global best practice right from their design, manufacture, usage, up to disposal".

Chaudhari (2011) opined that "green computing can reduce the environmental impact in two ways: 'direct and indirect.'" One can use improved materials and technologies in the manufacturing of IT components, making IT equipment and infrastructure more energy-efficient in order to reduce direct impact on the environment; and on the other hand one can develop more efficient information systems and technology solutions to support some initiatives to reduce indirect and negative impacts on the environment.

Pandikummar, Kabila and Amalry (2012), claimed that utilization of computer and the Internet is aggravating the emission of carbon monoxide (CO₂) into our environment. So this technology is consuming more energy than what we are aware of as users. Pandikummar, et al (2012) further asserted that impact of emission of computer and Internet is causing the accumulation of greenhouse gases that is affecting the climate and the weather condition of the world especially if not used and disposed properly. They further stated that the consequence of this "is the drought, flood, and general global warming and other hazard associated with disposal of computer and its accessories."

Purpose for the study

Due to the global common problem of negative impact of information technology (IT) tools on environment; green computing has gained much importance and attention among researchers, commercials, universities, governments etc. (Servaes, 2012). Servaes (2012) further asserted that production and use of IT-equipment are energy consumptive and it accounts for 2% of total carbon emissions. Patel, (2017) also reported that in India alone 4% of the Green House Gas (GHG) emissions are from the IT sector. So, there is increasing need for every organization and individual (male / female) to be aware and thereby, consider the practice reducing their carbon

footprint. Hence the need to have a safe environment and efficient energy utilization has created the utmost need for the study like this. Such study become necessary because green computing has become a global phenomenon because every nation have resolve to engage in reducing their carbon footprint so as to save their environment immediate and wider environment making it free from all sort and associated vulnerable computing system and other consumables. Mubarak and Augie (2020) asserted that in Nigeria, there is paucity of empirical study on green computing; perhaps no concrete evidence to show that faculty members in Nigerian Universities are aware of the threat the use of computing system poses on our environment. The acceptance also is still shrouded with few empirical evidences. Since awareness precede acceptance, this study therefore become imperative so as to further investigate and know whether or not this class of IT users are aware and ready to accept green computing. The realization of this has created the imperative for this study. Therefore, the study aimed to investigate the state of awareness acceptance and practice of green computing among staff and students in Nigerian Universities.

Objectives of the study

- Understand the extent of awareness of green computing in Federal Universities in North Western Nigeria.
- Understand the extent of acceptance of green computing Federal Universities in North Western Nigeria.
- Understand the extent of practices of green computing Federal Universities in North Western Nigeria.
- Understand whether there is difference in the level of awareness and acceptance of green computing base on Gender and disposition in



Federal Universities in North Western Nigeria.

Research questions

- To what extent is the awareness of green computing in Federal Universities in North Western Nigeria?
- To what extent is the acceptance of green computing Federal Universities in North Western Nigeria?
- To what extent are the practices of green computing Federal Universities in North Western Nigeria.
- What is the difference in the level of awareness, acceptance and practices of green computing base on gender, institution and disposition in Federal Universities in North Western Nigeria?

Green computing

Green computing is generally a sort of information technology which relates to system initiatives and programs that could address environmental eco-sustainability perspectives (Siegler & Gaughan, 2008; Chaudhari, 2011). Thereby green computing is defined by Molla, (2009) as the “systematic application of environmental considerations such as pollution prevention, product stewardship and use of clean technology”. Suryawanshi & Narkhede, (2015) saw it as Green ICT with an aspect of innovation in managing IT which only relates to the environmental issues and affairs. In another dimension Council of European Professional Informatics Societies, (2015) in Thongmak, (2016) saw it as “practice of designing, manufacturing, using and disposing of computers, servers, and associated subsystems-such as monitors, printers, storage devices, networking and communication systems efficiently and effectively to sustain environment.”

Gupta (2010) saw it as “the study and practice of designing, manufacturing, using, disposing of IT equipment efficiently and effectively with no impact on environment”. It a nut shell Gupta (2010) called it “environmentally sound ICT.”

Talebi & Way (2009) in their words also defined it from academic point of view. They stated that green computing is “a discipline that studies, develops and promotes techniques for improving energy efficiency and reducing waste in the full life cycle of computing equipment from initial manufacture, through delivery, use, maintenance, recycling and disposal in an economically realistic way”.

According to Gupta (2010), “the term ‘green computing’ gained popularity shortly after the establishment of Energy Star program in 1992 - a voluntary program that recognises products that conform to its high energy efficiency standards.”

Green computing in Nigeria

Green computing gained popularity in the global perspective by 90s. Many countries were trying to conform to global policies about the green computing by identifying the status and level of waste products in their regions. On this note Perkins, Brune-Drisse, Nxele and Sly (2014) claimed that the biggest producers of e-waste in 2012 were China (11.1 million tons) and U.S.A. (10 million tons). They further assert that most of those e-wastes ended up in Asian countries i.e. (China, India, Vietnam, Pakistan, Malaysia, Philippines, Singapore, Sri Lanka Thailand) and African countries i.e. (Kenya, Nigeria and Ghana). Perkins et al also reported that some e-waste get recycled informally, mainly with no care of adhering to any health and safety measures. It is reported by Greenpeace.org (2006) that the fumes emitted during the extraction of reusable metals can be lethal and can have adverse effect to the environment.

It is observed by Omobowale (2013) that in some countries e-waste is being ‘revived’ sold and recycles by the local residences. He further described an example of



such practice in various cities and villages in Nigeria. He also claimed that a huge number of imported e-waste finds its way to a Nigerian second hand market. Omobowale (2013) in his report wrote “the socially constructed symbolic value attached to those imported second-hand rationally presents it as a valuable alternative to expensive new ICT from the developed countries”. However, Nigeria is probably not the only country where sort such of such things occur.

In Nigeria, the National Information Technology Development Agency (NITDA) has started addressing the issue on the importation of climate friendly computer system into the country. Other agencies like Computer Registration Council of Nigeria (CPN), Nigeria Computer Society are ensuring that computer and other peripherals imported into the country are the approved types and environmental friendly (Nwankwo, 2007).

Taruna, S., Singh, P., & Joshi, S. (2014) hold that despite promotion of e-waste, green computing, disposal and recycling as well as eco-friendly computing through awareness among IT agencies and organization all over the world; some of these studies focused mainly on hardware manufacturers and software developers, while ignoring users. Mubarak and Augie (2020) reported that in Nigeria, there are less empirical evidences on green computing and perhaps no concrete justification that faculty members in Nigerian Universities are well aware of the threat on the use of computing system poses on our environment. Similarly the level of acceptance is still shrouded with very little empirical evidence.

Obviously there have been works on green computing in Nigeria, yet its take-up has not been noticed. Mubarak and Augie (2020) also opined that perhaps, majority of computer users are not either aware of the consequences or fail to key in to the use of energy star computing system. They further stated that Educators are best positioned to promote awareness of green computing, especially using the academic settings to encourage environmentally-conscious use of technology. These has

to do with movement towards a paperless and or less paper academic environment such as smart classroom, zero paper library, digital campus by use of online forms, tests, quizzes, electronic handouts, remote lectures, and conferencing, holographic presentations etc

Crook, Harvey, Lumbuwa, Newcombe, Rosa, Staple & Bayley, (2012), reported that in order to reduce the tide of carbon emission into the environment, every country of the world is creating awareness on how to reduce the carbon footprint of users of computer and internet. In view of that British Computer Society (BCS) initiated green computing awareness among end users of computer and internet in Britain. The campaign focuses on the reducing energy consumption vis-à-vis carbon emitted from computer.

Green computing in tertiary institutions

These days a lot of discussions centering upon how to control in order 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 (Dookhitram, Narsoo, Sunhaloo, & Sukhoo, 2012). 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 (Dookhitram, et al. 2012).

Mubarak & Augie, (2020) hold that the “use of ICT in educational institutions is very high these days. There is evidences that such usage increases emission of carbon dioxide (CO₂). These ICT usages indicate high consumption of high energy and probably produce harmful waste.” They further state that “in consideration of dense negative impact of ICT, the education institutions sought to be adopting green computing program and practice in order to minimize energy consumption, emission of carbon, ICT waste. This is by



maximizing the method of recycling & reuse so as to reduce the cost of energy.”

Some of the activities to reduce effect of green computing ranges from organizing seminars and symposium so as to sensitize the general public from academia to IT organization, local and national government agencies on the need for safe use and safe disposal of computer equipment. Similarly, in most countries it requires to be giving and gaining considerable attention through general campaign and advocacy on green computing and eco-friendly environment.

In line with responsibility of Universities as a solution provider to societal problems, by way of extension of knowledge and best practices, the present drive for green computing practice as a panacea to reduction in carbon emission, reduction in the cost of energy consumption and other computing related hazard need to be champion and promote by academia. In view of that IT users are taking more environmental conscious actions, such as printing only when necessary, duplex printing, switching off IT machines when not in use, shifting from desktop to laptop, using virtualization software, cloud computing etc. (Savvas, 2012)

Awareness on green computing

Schauer (2008) proposed that in order to achieve the behavioural change among people there is the need to be educated first and be oriented. Ahmad & Nordin (2014) also pointed out that individual need to adopt an idea; system or device, that individual needs to know something about it first.

Sendall, Shannon, Peslak & Saulnier (2011) stated that it is not surprising that many educated people even in the field of ICT lack the knowledge of the importance of sustainability issues. Issue regarding Green computing and its effect or impact on the environment is not given much concern even among the lecturers and their students.

Talebi & Way (2009) in their study suggested that the computer science educators in particular should be tasked

with teaching the Green Computing. At undergraduate level it can be made into modules such as ‘Introduction to GC’ and ‘Server Virtualisation’ can be introduced as argued by Dookhitram, et al, (2012). Another optional module could be in form of server virtualization which will allow for more efficient use of servers and thereby reduces energy consumption on the servers. The server virtualization module the Introduction to green computing could be mandatory to all the computing undergraduate students and optional to all other students. Penzenstadler & Bauer (2012) suggested that green computing could be promoted to the course of study at master’s level amongst software engineering students.

Methodology

This is a quantitative study that employed quantitative approach for data collection using hardcopy and online format. The designed questionnaire named green computing awareness, acceptance and practice (GCAAP) was on five (5) point Likert scale. It contained same format of thirty three (33) set of statement questions i.e. thirteen (13) questions on awareness, other thirteen (13) on acceptance and the remaining thirteen (13) on practices. In addition, there were other three (3) basic demographic questions of gender, institution and disposition to indicate either it’s a student, teaching or non-teaching staff. The questionnaires were administered physically and through an online survey tool called SurveyMonkey. The participating respondents were required to respond anonymously and voluntarily.

The study population covers all categories of students and all categories of staff in the seven (7) Federal Universities in North Western region in Nigeria. The targeted institutions and sampled were Ahmadu Bello University Zaria (ABU), Bayero University Kano (BUK), Federal University Dutse (FUD), Federal University Dutsin-Ma (FUDMA), Usmanu Danfodio University Sokoto (UDUS), Federal University Birnin Kebbi (FUBK) and Federal University Gusau (FUGUS). The sampling



modality for the selection of the participants was made purposively and on willingness.

A total number of 500 questionnaires were randomly administered. i.e. 350 were for students and 150 for staff across the seven (7) institutions. From the overall numbers of responses collected, only 300 were selected free of error after screening. That is total number drawn were 150 from students, 100 from teaching staff and 50 from non-teaching staff.

After responses were collected and screened, descriptive analysis using mean and standard deviation was made to identify the extent of awareness, acceptance and practices on green computing. The data was initially subjected to statistical analysis of principal component analysis for ascertaining validity. The main data was also run on analysis of variance i.e. t-test and ANOVA. That was to establish the differences in terms of awareness, acceptance and practices between gender, disposition and institution. The analysis used SPSS version 23. The results were presented in form of tables and graphs based on research questions.

Result Presentation

Table 1: Frequencies distribution on gender

Gender		Frequency	Mean	Std. Deviation	Percent
Valid	Male	175	1.4167	.49383	58.3
	Female	125			41.7
	Total	300			100.0

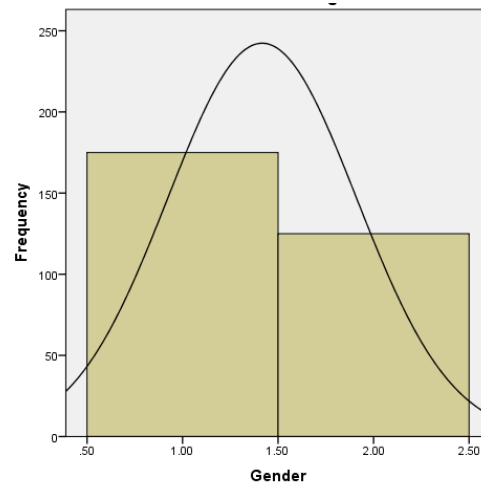


Figure 1: Frequencies distribution on gender

On table 1 results descriptive distribution in terms of gender. It indicates Frequency of total number N=300 where **Male=175** representing **58.3** percent and **Female=125** representing **41.7** percent. The result also shows mean and standard deviation as follows (M=**1.41**, SD=**.493**). Figure 1 further shows the graphic frequency representation in histogram with significantly normal curve.

Table 2: Frequencies distribution on disposition

Disposition		Frequency	Percent	Mean	Std. Deviation
Valid	Student	150	50.0	1.6667	.74660
	Teaching Staff	100	33.3		
	Non-Teaching Staff	50	16.7		
	Total	300	100.0		

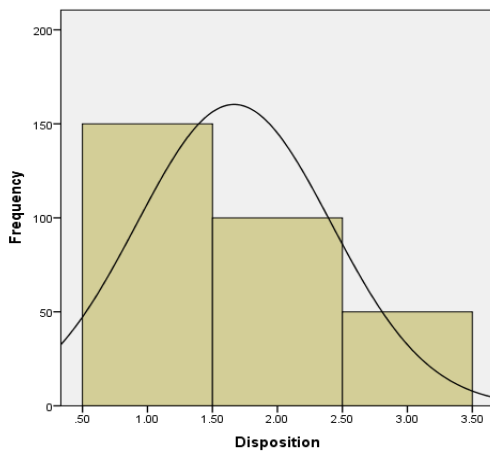


Figure 2: Frequencies distribution on disposition

On table 2 results descriptive distribution in terms of gender. It indicates frequency of the total number as (N=300) where students scored (N=150) representing (50 percent). Teaching staff stood at (N=100) representing (33 percent); while non- teaching staff scored (N=50) which represented (16.7 percent). The result also showed mean score and standard deviation as follows (M=1.66, SD=.746). Figure 2 further showed the graphic frequency representation in histogram with in significant normal curve.

Table 3: Frequencies distribution on Institution

Institutions		Frequency	Percent	Mean	Std. Deviation
Valid	ABU	60	20.0	3.5667	2.04765
	BUK	60	20.0		
	UDUS	40	13.3		
	FUD	35	11.7		
	FUDMA	35	11.7		
	FUBK	35	11.7		
	FUGUS	35	11.7		
	Total	300	100.0		

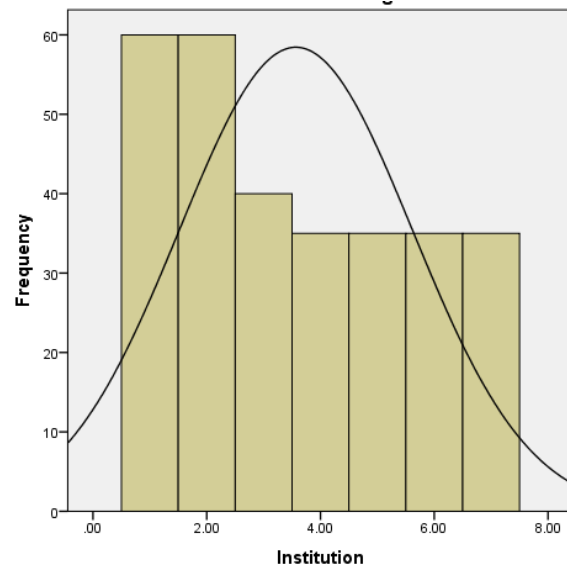


Figure 3: Frequencies distribution on institution

On table 3 results shows descriptive distribution in terms of institution. It indicated total frequency number of (N=300); where ABU and BUK had (N=60) each representing (40 percent). While UDUS is having (N=40) representing (13.3 percent). The remaining four institutions FUD, FUDMA, FUBK and FUGUS were having (N=35) each which stood for (11.7 percent) for each of them thus, totaled to (47.7 percent). The result also showed mean and standard deviation as follows (M=3.56, SD=2.04). Figure 3 further showed the graphic frequency representation in histogram with less significant normal curve of distribution.

Question 1: To what extent is the awareness of green computing in Federal Universities in North Western Nigeria?

Table 4: Descriptive result on Awareness of green computing in Federal Universities in North Western Nigeria



Descriptive Statistics on Green AWARENESS

	N	%	Mean	Std. D
Have an idea about green computing.	300		2.45	1.29
Have been reading about green computing.	300		1.76	1.15
Heard about green computing from media.	300		2.98	1.23
Taught about green computing in school.	300		1.76	1.11
Use to be discussing about green computing.	300		3.12	1.14
There are a lot of write-ups about green computing.	300		1.77	1.11
Understand some logos, symbols and signs of green computing inscribed/ indicated on computer systems: i.e. (epeat, energy star, TCO WEEE, CE).	300		1.64	1.07
Green computing is not a new thing.	300		3.14	1.15
Green computing is quite advantageous to academic institutions.	300		1.82	1.10
Green computing is necessary for environmental sustainability.	300		2.11	1.22
Screen savers; sleep mode and hibernation mode make computer system last longer.	300		2.84	1.55
The laptop uses LCD/LED monitor less as much energy as a desktop PC.	300		3.17	1.23
Increased computer use contributes to global warming.	300		2.07	1.35

The descriptive result on table 4 indicated that the extent of awareness of green computing in Federal Universities in North Western Nigeria is quite low with the mean distribution minimum range of (M=1.64; SD=1.07) to maximum of (M=3.17; SD=1.15). This suggests that there is a low level of Awareness of green computing among

the students, academic staff and non academic staff of the Federal Universities in North Western Nigeria.

Question 2: To what extent is the acceptance of green computing Federal Universities in North Western Nigeria?

Table 5: Descriptive result on acceptance of green computing in Federal Universities in North Western Nigeria

Descriptive Statistics on Green ACCEPTANCE

	N	%	Mean	Std. D
Using a screensaver conserves energy when computer is idle.	300		3.26	1.08
Recycling any computer storage devices is a bad idea, because the data on them can be used by other people.	300		2.06	1.28
Willing to be purchasing/upgrading computer and other tools annually.	300		1.99	1.28
Constant shutting down and restarting computer consumes more energy than just leaving it running.	300		1.74	.956
Use computing equipment as long as possible is better than to keep it from becoming disposed to e-waste.	300		2.36	1.17
Green computing activities are so expensive, so this institution cannot afford it.	300		2.15	1.12



Recycling printer cartridges is greener than refilling them.	300		2.51	1.22
Improperly discarded computer leaks chemicals i.e. lead and mercury into environment and pollute it.	300		2.33	1.23
This institution is willing in constant hardware upgrades of ICT tools	300		2.13	1.15
Use proper ways of disposing old computers and ICT tools.	300		1.98	1.12
Use of e-books, e-library and e-learning in this institutions because is better for our environment.	300		2.67	1.20
Cloud server hosting is greener than physical servers kept in server rooms.	300		2.37	1.26
Willing to accept green computing activities.	300		2.41	1.22

The descriptive result on table 5 indicated that the extent of acceptance of green computing in Federal Universities in North Western Nigeria is quite low with the mean distribution minimum range of (M=1.74; SD=.956) to maximum of (M=3.26; SD=1.08). This suggests that there is a low level of acceptance of green computing among

the students, academic staff and non academic staff of the Federal Universities in North Western Nigeria.

Question 3: To what extent are the practices of green computing Federal Universities in North Western Nigeria.

Table 6: Descriptive result on practices of green computing in Federal Universities in North Western Nigeria

Descriptive Statistics on Green PRACTICES				
	N	%	Mean	Std. D
Have been using a computer for many years.	300		2.28	1.18
Usually use the computer for hours per day.	300		2.67	1.43
Mainly connected to the internet for many hours per day.	300		2.42	1.37
Have been using personal computer for many years.	300		2.17	1.27
Have owned a computer and other ICT devices.	300		2.40	1.32
Print papers, memos, assignments, notes, etc. using laser printer.	300		2.46	1.26
Print average of more than one per day.	300		2.44	1.25
Switch computer to “low-power consumption” mode every time or always leave it to less power consumption.	300		2.40	1.35
Look for a recycling centre and dispose properly all damaged/old computing items with toxic components i.e. CD, Cartridge, Monitor, CPU, Printer.	300		2.31	1.37
Better been recycling ICT hardware tools to keep our environment clean.	300		2.40	1.27
Computers are thrown into garbage in this institution.	300		2.47	1.27
Used papers, empty cartons and cartridges are burn in this institution.	300		2.40	1.35
Use solar power in this institution to power some places	300		2.31	1.37

The descriptive result on table 6 indicates that the extent of practices of green computing in Federal Universities in North Western Nigeria is quite low with the mean distribution minimum range of (M=2.17; SD=1.27) to maximum of (M=2.67;



SD=1.43). This suggests that there is a moderate low level of practices of green computing among the students, academic staff and non academic staff of the Federal Universities in North Western Nigeria.

Question 4: What is the difference in the level of awareness, acceptance and practices of green computing base on gender, institution and disposition in Federal Universities in North Western Nigeria?

Table 7: t-test Result on green computing awareness in terms of gender

GreenComp Awareness		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
	Equal variances assumed	.555	.457	1.817	298	.070
	Equal variances not assumed			1.847	281.7	.066

On table 7 the result shows independent samples t-test on gender difference on extent of on green computing awareness. It indicates calculated t-value as (**t=1.817, p>0.05**) with **df= 298**. This shows no significant difference (**Sig=.070** at 2-tail) between the gender. On the Levene's test for Equality of Variances it further shows (**F=.55, Sig= .457**). It translates that there is no gender difference on the level of awareness on green computing in the Federal Universities in North Western Nigeria.

Table 8: t-test Result on green computing acceptance in terms of gender

GreenCompAcceptance		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
	Equal variances assumed	2.739	.099	.791	298	.430
	Equal variances not assumed			.808	285.3	.420

On table 8 results show independent samples t-test result on differences on extent of green computing acceptance in terms of Gender. It indicates calculated t-value as (**t=.791, p>0.05**) with **df =298**. This shows no significant difference (**Sig=.43** at 2-tail) between the gender based on the Levene's test for Equality of Variances which further shows (**F=2.7, Sig= .099**). It translates that there is no gender difference on the level of acceptance of green computing in the Federal Universities in North Western Nigeria.



Table 9: t-test Result on green computing practices in terms of gender

GreenCompAwareness		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
	Equal variances assumed	.007	.936	1.259	298	.209
	Equal variances not assumed			1.267	273.0	.206

On table 9 the result shows independent samples t-test result on extent of green computing practices in terms of gender. It indicates calculated t-value as ($t=1.259$, $p>0.05$) with $df= 298$. This shows no significant difference ($Sig=.209$ at 2-tail) between the gender based on the Levene's test for Equality of Variances which further shows ($F=.007$, $Sig= .936$). It translates that there is no gender difference on the level of practice of green computing activities in the Federal Universities in North Western Nigeria.

Table 10: Descriptive group statistics result of t-test on awareness, acceptance and practice of green computing in terms of gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
GreenCompAwareness	Male	175	29.326	5.36577	.40561
	Female	125	28.228	4.85913	.43461
GreenCompAcceptance	Male	175	28.150	4.79600	.36254
	Female	125	27.728	4.21930	.37739
GreenCompPractices	Male	175	29.428	5.45894	.41266
	Female	125	28.635	5.26019	.47049

On this table 10 it further shows descriptive result on the independent samples t-test on awareness, acceptance and practice of green computing in terms of gender. It indicates total number of sample ($M=175$, $F=125$). It shows the mean and standard deviation for each variable for both males and for females as follows: **Awareness:** ($M=29.32$, $SD=5.36$); ($F=28.22$, $SD=4.859$) **Acceptance:** ($M=28.15$, $SD=4.796$); ($F=27.72$, $SD=4.219$) **Practices:** ($M=29.42$, $SD=5.458$); ($F=28.63$, $SD=5.260$). It indicates that there is low level of awareness, acceptance and practices on green computing in the Federal Universities in North Western Nigeria.

Table 11: One Way ANOVA result on green computing awareness, acceptance and practices in terms of Institution

		Sum of Squares	Mean Square	df	F	Sig.	
GreenComp Awareness	Between Groups	135.472	22.579	6	.838	.541	$p>0.05$
	Within Groups	7889.987	26.928	293			



	Total	8025.459		299			
GreenComp Acceptance	Between Groups	61.140	10.190	6	.485	.820	p>0.05
	Within Groups	6161.691	21.030	293			
	Total	6222.830		299			
GreenComp Practices	Between Groups	94.953	15.826	6	.541	.777	p>0.05
	Within Groups	8567.148	29.239	293			
	Total	8662.101		299			

On table 11 it shows a one way ANOVA result on Green Computing Awareness in terms of institution. The result on 'awareness' indicates F-value ($F_{6,293}=.83$) with Sig. of (.541) thus ($p>0.05$). That shows there is no significant difference in terms of institution among the seven (7) universities. This signifies non difference on the level of awareness of green computing among ABU, BUK, UDUS, FUD, FUDMA, FUBK and FUGUS

It also indicates on 'acceptance' the F-value with degree of freedom ($F_{6,293}=.48$) at Sig. of (.820) thus ($p>0.05$). This shows there is no significant difference among the different institution of the three groups of teaching staff, non-teaching staff and students. This translates that there

is no differences on the level of acceptance of green computing among ABU, BUK, UDUS, FUD, FUDMA, FUBK and FUGUS

The result further indicates on 'practices' F-value ($F_{6,293}=.54$) with Sig. of (.777) thus ($p>0.05$). That shows there is no significant difference among the different institution among the seven universities. This assumes no difference on the level of practices of green computing among ABU, BUK, UDUS, FUD, FUDMA, FUBK and FUGUS.

Table 12: One Way ANOVA result on green computing awareness, acceptance and practices in terms of Disposition

				Mean Square	Sum of Squares	df	F	Sig.
GreenComp Awareness	Between Groups	(Combined)		42.569	85.138	2	1.592	.205
		Linear Term	Unweighted	9.414	9.414	1	.352	.553
			Weighted	.025	.025	1	.001	.976
			Deviation	85.113	85.113	1	3.184	.075
	Within Groups			26.735	7940.32	297		
	Total				8025.45	299		
GreenComp Acceptance	Between Groups	(Combined)		8.473	2		16.94	.667
		Linear Term	Unweighted	1.140	1.140	1	.055	.815
			Weighted	5.154	5.154	1	.247	.620
			Deviation	11.793	11.793	1	.564	.453
	Within Groups			20.895	6205.88	297		
	Total				6222.83	299		



GreenComp Practices	Between Groups	(Combined)		.852	2		1.703	.971
		Linear Term	Unweighted	.157	.157	1	.005	.942
			Weighted	.591	.591	1	.020	.887
			Deviation	1.112	1.112	1	.038	.845
	Within Groups			29.160	8660.39	297		
	Total				8662.10	299		

On table 12 it shows a one way ANOVA result on Green Computing Awareness, Acceptance and Practices in terms of Disposition. The result on 'Awareness' indicates F-value ($F_{2,297}=1.59$) with Sig. of (.205) thus ($p>0.05$). That shows there is no significant difference in terms of disposition among the three groups of teaching staff, non-teaching staff and students. This signifies non difference on the level of awareness of green computing among the teaching staff, non-teaching staff and students in Federal Universities of North Western Nigeria.

It also indicates on 'Acceptance' the F-value with degree of freedom ($F_{2,297}=16.9$) at Sig. of (.667) thus ($p>0.05$). This shows there is no significant difference among the different disposition of the three groups of teaching staff,

non-teaching staff and students. This translates that there is no differences on the level of acceptance of green computing among teaching staff, non-teaching staff and students in Federal Universities of North Western Nigeria.

The result further indicates on 'Practices' F-value ($F_{2,297}=1.70$) with Sig. of (.901) thus ($p>0.05$). That shows there is no significant difference among the different disposition among the three groups of teaching staff, non-teaching staff and students. This assumes no differences on level of practices of green computing among teaching staff, non-teaching staff and students in Federal Universities of North Western Nigeria.



Table 13: Scheffe Post Hoc Tests of Multiple Comparisons on One Way ANOVA result on green computing awareness, acceptance and practices in terms of Disposition

Dependent Variable	(I) Disposition	(J) Disposition	Mean Difference (I-J)	95% Confidence Interval		
				Lower Bound	Upper Bound	Sig.
GreenComp Awareness	Student	Teaching Staff	.94051			.372
		Non-Teaching Staff	-.50103	-.7017	2.582	.839
	Teaching Staff	Student	-.94051	-2.578	1.576	.372
		Non-Teaching Staff	-1.44154	-2.582	.7017	.275
	Non-Teaching Staff	Student	.50103	-3.644	.7617	.839
		Teaching Staff	1.44154	-1.576	2.578	.275
GreenComp Acceptance	Student	Teaching Staff	-.53051	-.7617	3.644	.668
		Non-Teaching Staff	-.17436	-1.982	.9213	.973
	Teaching Staff	Student	.53051	-2.010	1.662	.668
		Non-Teaching Staff	.35615	-.9213	1.982	.904
	Non-Teaching Staff	Student	.17436	-1.591	2.304	.973
		Teaching Staff	-.35615	-1.662	2.010	.904
GreenComp Practices	Student	Teaching Staff	-.16846	-2.304	1.591	.971
		Non-Teaching Staff	-.06462	-1.883	1.546	.997
	Teaching Staff	Student	.16846	-2.234	2.104	.971
		Non-Teaching Staff	.10385	-1.546	1.883	.994
	Non-Teaching Staff	Student	.06462	-2.197		.997
		Teaching Staff	-.10385	-2.104		.994

The mean difference can be observe on table 13 where Scheffe Post Hoc tests of Multiple Comparisons further shows were the difference exactly exists among the groups. It shows highest insignificance of (.275) especially between teaching staff and Non-teaching (1.44154) and less insignificance score of (.997) between non-teaching and students (.06462).

Discussion

The results presented shows low ‘understanding of some logos, symbols and signs of green computing inscribed on

computer systems: i.e. (epeat, energy star, TCO WEEE, CE)’; it translated to less awareness on green computing. However, some agreed that ‘laptop computer uses less as much energy as a desktop computer’. All these implied to less significant extent of awareness, acceptance and practice of green computing in the federal universities of North Western Nigeria. The result tallies with Mubarak and Augie (2020) who asserted that in Nigeria, there is less awareness and acceptance on green computing. They also viewed that no concrete evidence to show that



faculty members in Nigerian Universities are aware of the threat the use of computing system poses on our environment. They further hold that level of acceptance is still shrouded with few empirical evidences.

Results also indicates that respondents disagreed that ‘constant shutting down and restarting computer consumes more energy than just leaving it running’; which translates that they have less acceptance of green computing. However, they agreed that ‘using a screensaver conserves energy when computer is idle’. So the result simulates with Mubarak and Augie (2020) who opined that majority of computer users are not either aware of the consequences thereby fail to key in to the use of energy star computing system.

The result shows lowest difference of mean on the item that stated if the respondents ‘have been using personal computer for many years’. Majority of them disagreed on that which translates that they have significantly less application on practice of green computing. However, they agreed that they usually use the computer for hours per day and that ‘computers are thrown into garbage in their institution’ for other scavengers to pick and reuse them or sell. This shows power practices of green computing in the institutions and improper dispose of the items. It therefore tallies with Perkins, et al (2014) who claimed that most e-waste ended up in African countries. Perkins et al also reported that some e-waste get recycled informally, mainly with no care of adhering to any health and safety measures. It also supports Omobowale (2013) who observed e-waste is being ‘revived’ sold and recycles by the local residences while citing such practice in Nigeria as examples. As he also claimed that huge number of imported e-waste finds its way to a Nigerian second hand market.

Result translates that there is no gender difference on the level of awareness, acceptance and practices of green computing in the Federal Universities in North Western Nigeria. This result relates to Patel (2017) who stated that

there is increasing need for every organization and individual with no gender difference between male or female to be aware and thereby, consider practice green computing by reducing their carbon footprint.

The result as well signifies non difference on the level of awareness, acceptance and practice of green computing among the teaching staff, non-teaching staff and students in Federal Universities of North Western Nigeria. Thus, it extends on Dookhitram, et al. (2012) who suggested that going green is fundamental and a major concern of the modern world today among all and sundry. The global society as a whole is going through and that most people are becoming more environmentally conscious with the support of universities and campuses. He further viewed that Educators are best positioned to promote awareness of green computing, especially using the academic settings to encourage environmentally-conscious use of technology.

The obtained result also indicates non difference on the level of awareness, acceptance and practice of green computing among ABU, BUK, UDUS, FUD, FUDMA, FUBK and FUGUS. This corroborates with Savvas, (2012) as he stated that it is a responsibility of universities become solution provider to societal problems by way of extension of knowledge and best practices of the present drive to green computing. In view of that IT users are taking more environmental conscious actions especially in higher institutions of learning; that is through printing only when necessary, duplex printing, switching off IT machines when not in use, shifting from desktop to laptop, using virtualization software, cloud computing. This as well supported Sendall, et al (2011) who stated it is not surprising that many educated people even in the field of ICT even among the lecturers and their students lack the knowledge of the importance of green computing and its effect or impact on the environment.

Recommendations



1. Appropriate tax/levy be enforce on global computing industries, companies, institutes and organisations that violate the Green ICT rules in producing Green ICT products or practices; in the case of Nigeria importing companies.
2. There is need for constant supervision and monitoring on Green ICT polices & strategies in institutions in the country and should be reviewed/ amended frequently or periodically.
3. There is need for deployment and use of renewable energy like solar, wind and gas/thermal turbine in tertiary institutions in the country.
4. There is need to discourage the mode of recycling and reusing of computing tools that may cause harm to the environment while providing places for appropriate disposing of dead computing equipment in the country.
5. There is the need for an environmental advisory standing committee to be created in tertiary institutions with laid down norms on green computing and empower rules that its only energy certified computing equipment's should be purchased / procured and use in tertiary institutions.
6. There is need for general advocacy programme frequently organize in tertiary institutions through lectures, symposium, conferences, webinar, video conferencing, videos podcast clips, posters for promotion and making awareness on green computing.
7. Green computing can be included in curriculum as a core/compulsory subject of study in tertiary institutions and refresher training as certificate courses for teachers, students and other employees.
8. It will be of significance having online collaboration and communication among tertiary institution stakeholders via websites, email and social media in order to extend knowledge and awareness on green computing.
9. Regulatory and supervisory bodies like National Universities Commission (NUC), Nigeria Communication Commission (NCC), National information Technology Development Agency (NITDA), Nigeria Atomic Energy Commission (NAEC) should encourage institutions as mandatory to adopt green computing and be awarding scholarships and conduct researches in the area while formulating strong policies, decisions and regulations on general adoption green computing.
10. A radical rethink, revise and redesign of the existing ICT polices and strategies be regularly considered.

Conclusion

In conclusion, green computing is quite an interesting approach to the setup of IT-systems. Although it is not quite popular yet, green computing plays a major role in mitigating our environmental problems. Green computing is a new phenomenon yet an important strategic technology with various benefits in reducing green house gas emissions and lowering electricity costs for better environment. Green computing gained popularity in the global perspective including African and Nigeria in particular. It is just unfortunately observed that, some e-waste get recycled informally, mainly with no care of adhering to any health & safety measures. On that note fumes emitted during the extraction of reusable metals can be lethal and have adverse effect to the environment. The use of ICT in educational institutions is very high these days. There is evidences that such usage increases emission of cabon dioxide (CO₂). In line to that, green computing and its effect or impact on the environment is not given much concern even among the lecturers and their students. It is similarly established that green computing implies and poses many advantages; such as saving energy, saving money and saving environment.



Result concluded that level of awareness, acceptance and practices of green computing is significantly low; with no differences in terms of gender, disposition or institution among staff and students of Federal Universities in North Western Nigeria.

Conclusively it is observed and suggested that appropriate tax on computing firms or organizations be enforce for violation of green practice. Also constant supervision, design and implementation of policies as well as strategies on provision of alternative renewable energy be in place. Other issues discussed are proper ways of disposing ICT equipment, creation of environmental committees to be engaged in advisory and advocacy programme. It is also suggested that green computing should be taught as core subject and that only energy certified equipment be procure for use in tertiary institutions. Other issues identified are knowledge sharing and collaboration as well as engaging regulatory agencies and supervisory bodies on the viable implementation of green computing as well as empowerment and giving support in researches, training and monitoring on general well being of the green computing adoption, adaption and practices in the country.

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