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An Assessment Of Nigerian Polytechnic Students' Behavioural Intention To Adopt Green Computing Practices

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ABSTRACT
Organizations, including institutions such as polytechnics and universities' campuses world over have come to realize the necessity for going green not only for the protection of the environment but for cutting cost of the computing operational expenses. This study is an extension of an empirical study that examined the dimensions that influence Nigerian polytechnic students' intention to adopt green computing practices by using an extended theory of planned behaviour (TPB) of Ajzen's (1992). The data used for this study was drawn from a Nigerian public polytechnic. Principal component analysis (PCA) using SPSS version 16 and Confirmatory factor analysis (CFA) were used to assess the dimensionality of the constructs' (*attitude, subjective norm, perceived behavioural control and knowledge*) validity. Standard regression was later used to address the research questions of the study and see if we can establish evidence that *attitude, subjective norm, perceived behavioural control and knowledge* can play a vital role in influencing students' behavioural intention to green computing practices. Overall, a significant model emerged that produced a result in which all the four predictors (attitude, subjective norm, perceived behavioural control and knowledge) were found to be practically significant in predicting polytechnic students' behavioural intention to green computing practices.
Keywords: Green computing, influence, intention, predicting

INTRODUCTION

The use of electrical and electronic appliances require electricity to power them in order to function, and these electrical and electronic products are chemically manufactured; they are usually disposed of after use or when they get older. This disposal generates environmental waste which in turn produces toxic chemicals that result in the pollution of the air, soil and water, which are natural resources that human beings need to survive. Desktop computers, laptops and mobile devices are digital equipment most widely used today, not just by students and faculty members, but also by people from all world of life. These equipment require a massive amount of electricity whether to power the system unit and monitor, recharge batteries, or print. The manufacturing process of these computing equipment uses toxic chemicals, such as lead, mercury and cadmium that that are dangerous to the environment when discarded into water, soil or air (Stefanski, 2008; Stonecypher, 2010; Bell & Gonzalez, 2011). This chemical hazard of these computing equipment and its consequences need to be checked along with the financial effect of its electrical consumption on the organizations.

This process of checking the environmental effects and the electrical consumption resulting from computing processes is part of a great movement called green computing (Shelly, Vermaat, Quasney, Sebok & Freud, 2010). The environmentally responsible and eco-friendly use of computers and its resources is called green computing (Schneider, 2008). The objective of green computing is all about promoting efficient waste-free energy usage, and efficient systems with less or no hazardous materials, and the recycling of used computer products and other electronic waste (Shelly, et al., 2010). The society must therefore, be environmentally conscious and desirable in reducing electricity consumption while using computer and its resources. This environmental consciousness may be achieved by alerting the society to recognize computer and electrical hazards, as well as the importance of consuming energy responsibly. The need to take a giant stride to adopt environmentally safe computing practices that will address the issue of degrading environmental problems and global warming cannot be overemphasized. In light of this green computing consciousness, computer products, IT vendors and technology users must go green in order to assist in building a free, egalitarian and sustainable society that is environmentally safe, healthy and economically viable. Green computing has different dimensions which include green PC, carbon free computing, Energy Star program, e-waste, E-PEAT and carbon footprint, all of which refer to environmentally sustainable computing measures (Long & Long, 2004; Taruna, 2014; and Michigan, 2017)..

LITERATURE REVIEW

The term "green computing" started around 1992 following the U.S. Environmental Protection Agency (EPA) launching of the Energy Star program, and since then it became a global issue and a goal that most companies strive to meet. The "Energy Star" is a voluntary labeling program that promotes the recognition of energy efficient computing equipment and technologies, (Jean, 2010; Scudder, & Weems, 2010). This program, according to Carson and Patsalides (2010) makes many computer and electronics equipment manufacturers include the program's compliance by launching sleep mode and hibernates in computer shut down option, and this in turns make millions of computer users around the world began to adopt this policy to help save energy and sustainability when they were not using their computers.

In October 2006, major expansion of the Energy Star program took place when the United States Department of Energy (DOE) joined as partner which helped in standardizing the policy requirements and the implementation of labelling and ranking system for all electrical and electronic products (Hargaman, 2010; & Weems, 2010). Since then, several government agencies and companies worldwide continued to comply with the requirement of this Energy Star program guide line so as to promote green computing practice.

The emergence of green computing as an important issue was triggered by the recognition of the fact that environmental sustainability and the cost of maintaining computing activities around the world is becoming inevitable, and hence an imperative for information technology (Murugeson, 2008; Watson, Boudreau, and Chen, 2010). Organizations both public and private are now becoming more conscious about going green, even though most of them are not sure on how to go about it (Luo and Bose, 2011). The quests for greening and environmental sustainability coupled with increasing energy cost necessitate various organizations to now venture in the greening process and how to develop their green technology strategy and initiatives that will assist in regulating inefficient energy use (Luo and Bose, 2011). There is no doubt about the fact that information technology enhances the organizational efficiency, through substitution of costly human labour with improved new process and services. In addition to enhancing organizational efficiency, the green computing or green IT initiatives is also a stride that focus on how to reduce the effect of this information technology on the environment while cutting the running cost of these computing activities through designing, manufacturing, using and disposing of computers, servers, and associated subsystems efficiently and effectively with minimum or no impact to the environment (Murugesan, 2008; Dedrick, 2010).

It is also true that due to lack of a universal understanding of the actual concept in going *"green"* and what green computing means. This misconception of *"green"* by individuals and organizations is credited

to their own understanding or perception and the value they attached to green computing practices. It is based on the individual's orientation that suggests its perception in regard to *greenness* (Balassubramanian and Lieberman, 2010). The meaning of being "green" also as according to Luo and Bose, (2011) include e-waste management, electrical power control or buying electrical/electronic hardware that is energy efficient and environmentally friendly. Other aspect of green computing however are concerned with the life cycle of the electrical/electronic hardware and how to properly dispose them without affecting the environment (Isa and Suhaila, 2016).

Luo and Bose, (2011) were of the opinion that green computing or IT is a combination of whatever an individual/organization's conceived of being *"green"* in as much as that organization practice any or all of the mentioned concepts, means such organization is making contribution to themselves and the environment in which they live. So, green computing encompasses a wide range of subject ranging from manufacturing, energy consumption, and environmental side effect of the equipment to recycling and proper disposal of the hardware. Furthermore, the green computing practices also focuses on the industries that manufacture computing equipment down to the end users in a way that it does not damage the natural resources (Scudder, 2010). This means that green computing is making sure that, the industries are compelled to produce products that are fully recyclable and provides alternative on how to discard such product at the end of their life circle without damaging the environment. Therefore, green computing is proposing for alternative technologies in various fields and how to create a center of economic activity around those technologies by providing alternative non-hazardous materials in the manufacturing process. Thus reducing energy consumption and environmental protection are the central issues in green computing which is economic and environmental issue (Harris, Lay, Yates, and Kruck, 2011).

Statement of the Problem

The government and polytechnic managements have made huge investment in providing IT infrastructures and other electronic devices to make learning and campus life easy for students, as well as to promote efficient administrative transactions in the institution. Despite these efforts, students are fundamentally unaware of the toxic carbon emission and environmental side effects of these computer and its subsystems such as printers, toners and other computing resources (Shitu, Gambari & Alabi, 2016; Emanuel,et al., 2017; Gerrit, 2019). Additionally, they do not know the amount of electricity consumed by this widely used equipment, and as such do not know how to manage their power consumption effectively and efficiently without affecting the budgetary provision made for it by the polytechnic management. Thus, students being the largest group of computer users must be well-educated in this aspect. Their knowledge in green computing will assist polytechnic in their green initiatives. In addition, managing power consumption and improving efficiency by the institution will greatly contribute to green computing and serve as the key driver in the use of computing devices (Yuvraj, 2012).

Students form a large segment of the ICT users. They are very important unit of the organization affecting the institution's green efforts and initiatives as their computing habits have a direct impact on the environmental health and sustainability. These students do not care to log off their computer after use because they are ignorant of the amount of electricity they consume when the computers are idle (Michigan, 2017). They are also ignorant of the amount of carbon emission that computer emits into the atmosphere that affects the environmental sustainability and the learning institutions. As such, there is a need to identify and assess polytechnic students' current knowledge and understanding about green computing as well as their green computing practices in order to establish whether we can predict their intention to adopt green computing.

This study intended to address a better understanding of polytechnic students' behaviour toward green computing in term of their *Attitude, knowledge, perceived behavioural control, and subjective norm* which are important factors in determining students' behavioural intention to adopt other phenomena (Abdullahi, 2017).

Objectives of the Study

The purpose of this study is to establish the true nature of Nigerian polytechnic students' intention to adopt green computing practices and further to verify using extended Ajzen's theory of Planned behavior (TPB) the influence of knowledge, attitude, subjective norm and perceived behavioural control on students' intention to adopt green computing practices (Francis, et al.,2014; Ahmad, Bello & Nordin, 2019; and Abdullahi, 2017). In pursuance to the objectives of the study, the following research questions were formulated thus:

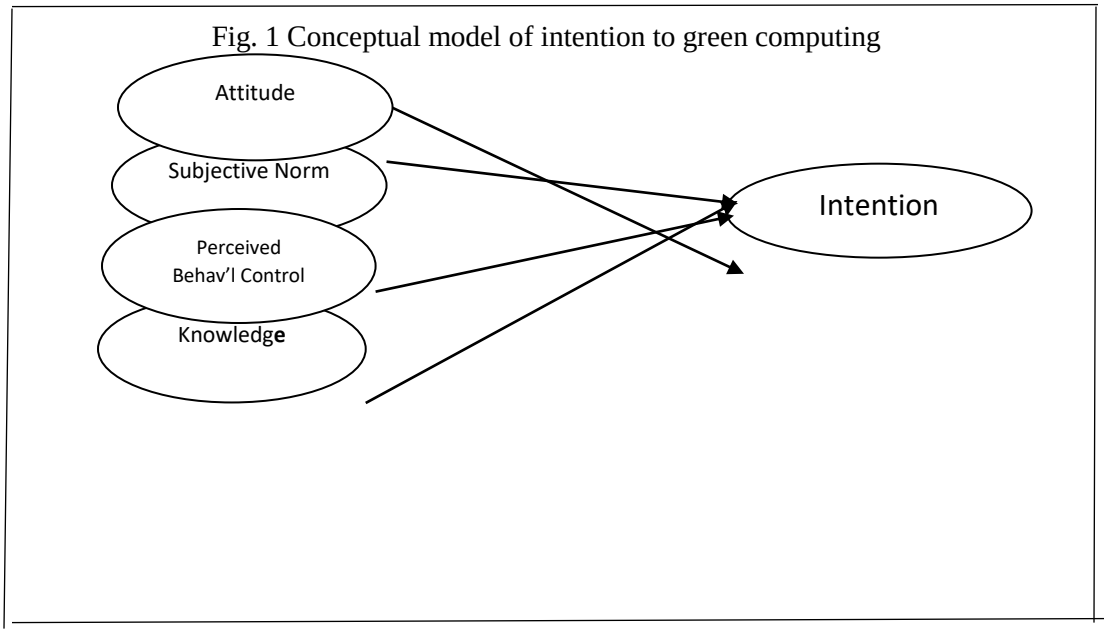
R1, Does students' attitude toward green computing influence their intention to adopt green computing practices?

R2, Does students' subjective norm towards green computing influence their intention to adopt green computing practices?

R3, Does students' perceived behavioral control towards green computing influence their intention to adopt green computing practices?

R4, Does students' knowledge towards green computing influence their intention to adopt green computing practices?

Fig. 1 Conceptual model of intention to green computing



RESEARCH METHODOLOGY

Measurement of Attitude

According to Ajzen's (1992), theory of planned behavior, an individual behavior in adoption or rejection of a phenomenon is determined by one's intention to perform the behavior, and this intention is influence by the individual's attitude. In this study, attitude refers to students' overall stance towards his/her intention to adopt green computing practices, which includes personal feeling of whether or not to go green and their evaluative judgement about green computing benefits and disadvantages. In other words, intention to perform a behavior is a functions of two basic determinants, one personal in nature and the other is familiarity and informational, that is attitude towards the behavior and knowledge of the consequences of environmental effect resulting from using computer and its sub-systems. Students' attitude in this study was assessed through 5-points Likert scale items that required students to agree or disagree with green computing practice behavior.

Measurement of Knowledge

Knowledge is defined as the amount of information held in the memory that affect the way individual assess, interpret and react to the stimuli around them Blackwell et.al, (2011); Brucks, (1985); provided a

categorization of knowledge by breaking it into subjective and objective types. Subjective knowledge is an individual's perception of what and how much he/she knows about a subject matter. Objective knowledge refers to accurate factual information stored in the memory. In this study, the researchers intend to assess whether students' knowledge of green computing influence their intention to adopt green computing practices, which was assessed through 5-points Likert scale items that required students to agree or disagree with the green computing practice behavior.

Perceived Behavioural Control

Perceived behavioral control (PBC) is defined as an individual's belief in the ability to execute certain behavior. The stronger the individual feels his ability to execute the behavior, the more the resources and opportunities he/she possess to execute the behavior, the higher the perceived behavioral control (Ajzen, 1991). Perceived behavioral control is very powerful in predicting individual intention to perform a behavior, as according to the Theory of Planned Behavior (TPB), perceived behavioral control together with behavioral intention can be use directly to predict behavioral accomplishment of certain task or event (Ajzen, 1989). Students' perceived behavioral control in this study was assessed through 5-points Likert scale items that required students to agree or disagree with green computing practice behavior.

Subjective Norm

Subjective norm refers to person's perception of general social pressure to perform or not perform the targeted behavior (Ajzen, 1991). It is a composition that includes social, organizational, departmental, parental and peer group (Mathieson, 1991). Subjective norm is made up of two components: beliefs about how other people wish someone to behave, and the outcome evaluation of each belief (Ajzen, 1991). The closer the affinity of the individuals' goals with their reference group at any level, the more likely the individuals is to perform the behavior according to reference group expectation. Students' subjective norm in this study was assessed through 5-points Likert scale items that required students to agree or disagree with green computing practice behavior.

Population of the study

A total of five hundred (N=500) students from a Nigerian public polytechnic participated in the survey out of which 485 (97%) questionnaires were returned. After sorting out and screening the responses to the questions, ten questionnaires were discarded due to poor responses of either omission or multiple choices living 475 (95%) of the original number of questionnaire distributed. The respondents of the study were randomly sampled from seven colleges of the polytechnic, and comprised of males (n= 332) and females (n= 168). All the polytechnic students were targeted to participate in the survey, and therefore every students had equal and likely chance to participate in the survey.

Instrument for Data Collection

A modified questionnaire that consist of the green computing performance indices as used by Ahmad, Tunku and Nordin, (2013) on green computing on other settings was used as the research instruments in this study. Each of the performance indices in the questionnaire was formulated to offer a representation and range of values between 1 to 5. The instrument are of two parts, the first part provide information about characteristics of each respondent, while the second part provide columns where a respondent can rank each of the indices as *'strongly disagree', 'disagree, 'neutral', 'agree' and 'strongly agree'.* The internal consistency of the items was assessed using a reliability test (i.e. Cronbach's) and found fit with = 0.88 which is good for explanatory study (Straub, Boudreau, and Gefen, 2004). The questionnaire was administered to students, of the Hassan Usman Katsina Polytechnic, Katsina, Nigeria.

Data Collection and Analysis

Copies of the questionnaires were administered through direct contacts and with the help of third parties. In the direct contact, the researchers was physically present in the classrooms and lecture theatre and the third parties were colleague lecturers and research assistants who assisted in distributing the questionnaires at the beginning and collect them at the end of the classroom instructions. This enables possible return of a good percentage of the questionnaire item. Analysis of the data consist of descriptive statistics (i.e. percentages and frequency counts) for the demographic data of the respondents and standard regression analysis was used to assess the students' intention to green computing practices.

PRESENTATION OF RESULTS

A total of 475 cases were analyzed and a summary (Table 1) was drawn from various displaced tables of the standard regression which indicates that all the four variables were found to have significant influence in predicting Nigerian polytechnic students' intention to adopt green computing practices. All the four coefficients paths in Table 1 were in the hypothesized direction, and therefore were statistically significant at ($p < 0.05$). The structural path between attitude and intention to adopt green computing showed a significant result. These results revealed that; standardized regression weight = 0.296, standard error = 0.071, critical ratio = 4.267, and level of significance = 0.000. This shows that attitude has a positive direct influence on polytechnic students' intention to adopt green computing,

The structural path between subjective norm and intention to adopt green computing showed a significant result. These results revealed that; standardized regression weight = 0.251, standard error = 0.078, critical ratio = 3.534, and level of significance = 0.012. This shows that subjective norm has a positive direct influence on polytechnic students' intention to adopt green computing. Also the structural path between perceived behavioural control and intention to adopt green computing showed a significant result. These results revealed that; standardized regression weight = 0.262, standard error = 0.088, critical ratio = 3.641, and level of significance = 0.011. This shows that perceived behavioural control has a positive direct influence on polytechnic students' intention to adopt green computing.

Lastly, the structural path between perceived behavioural control and intention to adopt green computing showed a significant result. These results revealed that; standardized regression weight = 0.286, standard error = 0.055, critical ratio = 4.272, and level of significance = 0.000. This shows that perceived behavioural control has a positive direct influence on polytechnic students' intention to adopt green computing,

Table 1 Standardized Regression weights of the variables

RQ	**Relationships between Exogenous and Endogenous**			**Std. Estimate**	**S.E.**	**C.R.**	**P-value**
R1	Intention to adopt green computing	<---	Attitude	0.296	0.071	4.267	***
R2	Intention to adopt green computing	<---	Subjected Norms	0.251	0.078	3.534	0.012
R3	Intention to adopt green computing	<---	Perceived Behavioural Control	0.262	0.088	3.641	0.011
R4	Intention to adopt green computing	<---	Knowledge	0.286	0.055	4.272	***

DISCUSSION AND CONCLUSION

In general, while perceived behavioral control and subjective norm remain significantly important predictors of behavior, it can be observed that attitude and knowledge proof to be the most consistent significant predictors of variance in the intention to adopt green computing practices. This result further buttressed other studies on the outstanding predictive power of knowledge and attitude on the intention to perform a behavior, some of these studies include that Abdullahi and Ahmad et. al; (2013) and Abdullahi, (2017) on the predicting power of knowledge and attitude on the intention to environmental sustainability. Therefore, based on this and previous studies on the predicting power of knowledge as included in the Azjen's Theory of planned behavior (TPB), one can safely conclude that knowledge is a good predictor of intention perform a behavior.

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