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Knowledge of Green Computing among University Students and Lecturers in Malaysia

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Abstract

In this study, an assessment of the level of green computing knowledge among students and lecturers was made, and a comparison was also made to examine whether difference exist in the level of knowledge of green computing among students and lecturers and ICT and non-ICT. A sample of 240 ICT and non-ICT based (180 students and 60 lecturers) were used in the study at a University in Malaysia. A 27 items/statements format questionnaire of two sections on knowledge of idea of green computing was used as an instrument for data collection. Section "A" consist of ten items of 5 points Likerts' scale, while section "B" consist of a 17 true or false and don't know items, on which respondents were asked to choose by ticking the appropriate option for each item. The items are self-developed and were subjected to expert validation. In addition, the reliability of the instrument was found fit at 0.940 using Cronbach's alpha coefficient after exposing them to pilot testing and the actual survey. Three research questions were formulated and tested at 0.05 significance level. The findings of the study revealed that majority of the respondents (64.1%) have either low or no knowledge of green computing, and there was also a significance difference between ICT and non-ICT-based respondents in the level of knowledge of green computing, but it further revealed that there is no significant difference in the level of knowledge reported between students and lecturers.

Key words: ***Green computing, energy saving, environment, energy-star, e-peat***

Introduction

Green computing is now gaining attention of not only environmental organizations, but all sectors of human activities. Business organizations, institutions and industries are beginning to realize the necessity for protecting the environment and energy saving along with computing operational expenses. Companies in the computing industry have come to realize that the urgency for going green is in their best interest both in terms of public relations and cost reduction.

One of the most widely used electrical and electronics products today is the computer, which requires electricity whether to power the system unit and monitor, recharge batteries, or print. The manufacturing process of this computer system often uses toxic chemicals that tend to become dangerous to the environment which need to be checked. Additionally, not only the chemical hazard and its consequences that need checking, but the electrical consumption of the computing equipments and its financial effect to the organizations also need to be checked. This process of checking the environmental effect and the electrical consumption resulting from computing process is referred to as green computing. (Shelly, Vermaat, Quasney, Sebok & Freud, 2010).

Green computing according to Long and Long (2004), refers to environmentally sustainable computing. It is the study and practice of efficient and effective way of designing, manufacturing, usage and disposing of computers, and its associated subsystems, such as monitors, printers, storage devices, and networking and communication system with minimal or no impact to the environment.

Scudder (2010) sees green computing as a way to achieve economic viability and improving system performance and usage, bearing in mind the societal norms and ethical responsibilities toward the environment. It include the study and practice of using computing resources efficiently, considering the environmental sustainability and the economy of energy efficiency, as well as the total cost of disposal and recycling of the old products.

Shelly et al. (2010) further defined green computing as the practices that involve reducing the electricity consumed and the environmental waste generated when using a computer and other electrical and electronic appliances. It includes regulating the computer manufacturing process and its life span, and recycling or immediately donating, or properly disposing of replaced systems.

The objective of green computing is to promote an environmentally friendly computer technologies and efficient system with less or no hazardous materials, and promoting recyclability of biodegradability of used products and factory waste. It is desirable that the society must be environmentally conscious in reducing electricity and environmental waste resulting from the increasing recognition and demand for computer and other electronic devices. The purpose of this study was to assess the level of knowledge of green computing among students and lecturers on the consequential effect of computers and other electronic devices we put in to our daily use, which

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have direct bearing on the environment and the cost of electricity incurred. Specifically, the study was intended to assess the levels of green computing knowledge among students and lecturers, and to examine if significant differences existed in the level of knowledge between ICT and non-ICT respondents, and between students and lecturers.

Literature review

Knowledge and awareness is the understanding of all facts that someone knows about a particular subject, issue, or ability to perceive or to be conscious of events, objects or situation (Tomonaga & Keneko, 2011). Therefore, in relation to green computing, knowledge is the understanding of all the facts that someone should know about efficient use of computer, so that the environment is not affected.

It is evidently true that, most computer users do not have knowledge of the amount of electricity the computers consume daily, and that is why users don't mind to switch off or log off their computers when not in use. It is a common practice to find Governments' libraries, laboratories and offices computers left permanently on, even after working hours which is a clear indication that users of such computers, and managements are not aware of the electricity they consume and the amount of Carbon dioxide they emit into the atmosphere. According to a research conducted by Schneider (2008), an average desktop computer requires 85 watts just to idle, even with its monitor off. If that computer was log off when not in use instead of idling for 40 hours a week instead of full 168 hours, and over $40 in energy costs would be saved annually.

This same study by Schneider (2008) also further reported that, one computer left for 24 hours a day consume between $115 to $160 electricity annually, and will dump 1,500 pounds of Carbon dioxide into the atmosphere. The study further reported that a tree absorbs between 3 to 5 pounds of Carbon dioxide each year. That is to say up to 500 trees are needed to offset the annual emission of one computer if left on all the time. That means for Carbon dioxide emitted by the computers in the IIUM library alone over one billion trees are required, even when such computers are left in a hibernate or sleep mode.

In a similar study by Chakraborty, Bhattacharyya, Nargiza and Bedajna (2009), it was reported that an estimated of $250 billion per year is spent on powering computers worldwide, and only about 15% of that power is spent on computing, the rest is wasted idling. That is either these computers are left unattended to during working hours, or throughout the day. Thus energy saved on computing and computer hardware will equate tonnes of carbon emissions saved per year. Mallard (2010) also reported that an average business consumption of a computer is 150 watts of electricity per day, and the average cost per kilowatt hours was 11 cents in April 2008, across the United States.

A kilowatt hour is if a kilowatt is being used continuously for an hour. This, it was estimated, if an organization is using 400 pieces of computers would cost about $4500 per month, which would be equalled to $54,000 per annum. Chakraborty et al. (2009) stated that if we think computer consume very little energy and is none polluting, then we need to think again, because it is not true, taking into consideration the popular use of information technology. There is urgent need to go green with everybody mobilized to contribute so that electric consumption and carbon emission resulting from using computers need to be checked if we must save our environment.

The practice of Green Computing as according to Mujitaba (2009) is an interesting aspect that contributes towards improving energy efficiency and reducing waste in the life cycle of computing equipments. The life cycle of computing equipment include the energy consumed to create computing equipment, get the computing equipment to a consumer, use and maintain the computing equipment and discarding or recycling of the equipment at the end of its life cycle (Mujitaba, 2009). Shelly et al. (2010) see the green computing as the practice that involves reducing the electricity consumption as well as being environmentally friendly in terms of waste generated when using computing. This includes recycling, regulating, and manufacturing process, extending life cycle of a computer and immediate denoting or properly disposing or replacement. In addition, to save electricity on your home computer, don't use a screen saver (Mallard, 2010). Allowing your computer to sleeve and or hibernate is the most energy efficient method for saving electricity consumption. Screen saver uses both the Graphical User Interface (GUI) and the Central Processing Unit (CPU) on computer and therefore uses the same electricity as when a computer is being used, and with the monitor on, there is no saving of electricity (Mallard, 2010).

It is also necessary to go green, looking at the rate of electricity consumption of our computers especially desktop using LCD or CRT monitor to power the computer. A typical computer uses 60- 500 watt average, and with LCD or CRT monitor, a computer will use an additional 35- 150 watt of electricity, thereby making a computer being used consume 95-650 watts of electricity (Mallard, 2010). Moreover, the question of what to do with old computer monitor is still an important consideration, as the leaded glass portion of the cathode ray tube (CRT) is toxic and may explored when deposited in to a landfill, and react with other elements. This can contaminate the air, as well as

the soil and ground water, and the resulting effect is very dangerous. All these problems can be avoided by simply going green.

Window users according to Graham (2010), have three choices any time they walk away from their computers; standby, hibernate or shutdown but, the simplest and best choice he said is to shutdown, as this saves power and is good for the computer. This is a good practice of green computing. Other alternatives like the Standby or sleep application, keep your computer running and documents open, and power is feeding to your computer memory, even though the peripherals has power off and the hard driver power is minimized, the computer wakes up quickly when you touch it just like it did when you left it, and this consume power. Hibernate on the other hand is like short sleep, it recalls all documents and applications, and shut down power to the computer just as it did in a standby application, it only takes longer time to wake up from hibernate.

A full shut down of a computer is just like a full sleep, it powers off your computer completely, and is always the best option when you are not using your computer. It is the best environmentally friend option because it draws no power, and power saving means financial savings. The statement was buttressed by an USA Today's survey as reported by Mujitaba (2009), where it was established that US organizations waste $2.8 billion and 20 tons of carbon dioxide each year powering idle computers, which can be saved if these computers were simply shut down.

Methods

This study was designed to identify the level of respondents' knowledge of green computing and to compare the knowledge among students and lecturers and between ICT and non-ITC based respondents in a university in Malaysia. The sample of the study consist of 180 students and 60 lecturers randomly and purposively drawn from six faculties of the university, with all the sampled students being postgraduate and undergraduate, ICT and non-ICT based, and male and female students.

Research Questions

The study was designed to answer the following questions in relation to students and lecturers knowledge of green computing.

1. What is the level of green computing knowledge reported by the university students and lecturers?
2. Is there a statistically significant difference in the level of green computing knowledge reported between university students and lecturers?
3. Is there a statistically significant difference in the level of green computing knowledge reported between ICT and non-ICT respondents?

Instrument for the Study

The instrument used for collecting data for the study is a self-developed questionnaire. The questionnaire consists of 27 items of two sections developed based on that aspect that has to do with knowledge of green computing. Section "A" consist of 10 items with 5 points Likert's scale (High, Quite high, Moderate, Low, and None), while section "B" consist of 17 true or false and "don't know" items. After generating the items, they were subjected to validation by experts before they were exposed to pilot testing. The reliability index of the instruments was found to be replicable (0.940) before and after the actual survey, which is a good fit of reliability for a study (Golafgshani, 2003; Kirk & Miller, 1986).

Method of data analysis

Descriptive statistical analysis was used to answer research question 1 on the 5 points Likerts scale items in section "A" and a t-test statistical analysis score of the different groups using SPSS were computed to answer research questions 1 and 2. The level of the significance adopted for the analysis was $P \leq 0.05$, which formed the basis of whether a significant difference exist between groups or not.

Results

Descriptive statistics analysis of the ten items with 5 points Likert's scale on the level of knowledge of green computing shows that majority (64.1%) of the respondents have either very low or no knowledge of green computing at all. And the remaining 35.9% of the respondents have between moderate to high level of knowledge about green computing.

While an independent sample t-tests were performed on the groups' scores to answer questions 1 and 2, and to see if statistically significant differences exist between the groups with respect to their objectives knowledge of green computing measured through the 17 items. The result indicated a significant difference between the ICT and non-ICT at 0.05 level of significance, with the ICT respondents showing a higher score in (mean=9.66, Std Dev=3.692) than the non-ICT respondents, (=6.444, df=234, p=0.000, $p \leq 0.05$), table 1. This shows that there is significant difference among ICT and non-ICT based respondents with respect to their objective knowledge of green computing.

Table 1: t-test of ICT versus non-ICT respondents on knowledge of Green computing

Respondents	n	df	mean	SD	t	P-value	Remarks
ICT	119	234	9.66	3.692	6.444	0.000	Significant
Non-ICT	117		6.53	3.759			

*Significant at 0.05

Table 2: t-test of Students versus Lecturers on Knowledge of Green Computing

Respondents	n	df	mean	SD	t	P-value	Remarks
Lecturers	58	234	8.50	4.301	.856	0.393	Not significant
Students	178		7.98	3.947			

*Not significant at 0.05

The result (of the t-test analysis) in table 2 shows that even though lecturers yielded higher mean score (mean=8.50, Std Deviation=4.301) than students, but no significant difference existed in the levels of green computing knowledge reported between them (t=0.856, df=234, p=0.393). This means that there was no significant difference at 0.05 level of significant between students and lecturers with respect to their objective knowledge of green computing.

Discussion

The finding of the study on the level of green computing knowledge reported by (students and lecturers) supports Raj (2008), that little consciousness exist on the need to go green in ASIA and they do not feel the pain of adding IT infrastructures, as they are still in the higher growing phase of IT investment, unlike such countries like America, Australia, and Japan where operational cost outweighs capital expenditure.

One of the surprising result of the study is the insignificant difference between the level of knowledge of green computing reported by students and lecturers, which shows contrary to assumption that lecturers being the custodian of knowledge in the university, were expected to have a significant higher level of knowledge of green computing than students who are the receivers of knowledge. This means that people may not be willing to go green by reducing power consumption based on purely green reasons no matter their status, but may be interested in learning how to save money.

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