Green ICT: A Study of Awareness, Attitude and Adoption among IT/Computer Engineering Students of LDRP-ITR, Gandhinagar

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Abstract

Green ICT is an important strategic technology which has various benefits such as reducing green house gas emissions, lowering electricity costs, creating good corporate image, etc. This study is an attempt to determine the awareness and attitude carried out by the IT/Computer engineering students towards the Green ICT. This study also examines the acceptance of younger people concerning Green ICT practices and to identify the reasons, barriers and their views regarding IT. The present study has been made by surveying the IT/Computer engineering users groups at LDRP-ITR, KSV University Campus, by using random sampling techniques and the questionnaire tools. After the analysis, few suggestions have been given, which could increase the use of Green ICT in younger people and minimize the harmful impact to the environment. Academic libraries are an integral part of academic institutes; play a vital role in teaching, learning, scholarships and research activities for academic communities. Librarians take initiatives to create awareness and adopt Green ICT efficiently and effectively among academic communities which provide good and healthy environment to community for their better life and thus, to conserve global environment.

Keywords: Green ICT, Green ICT Awareness, Academic Libraries

1. Introduction

ICT has reshaped every activity of today's environment and have brought about an enormous impact on the way we live, work, think and play. These changes are quite widespread in our everyday lives namely, use of computers, electronic devices and other ICT infrastructures at home and place of work. It creates cruel environmental issues from beginning to end its manufacture to disposal. ICT infrastructures absorb significant amount of electricity and contributing Green House Gas (GHG) emission. That is why global warming and climate change are the major issues to discuss at global forum. Educational institutes where IT/Computer courses are being taugh, uses huge numbers of ICT equipments to fulfil the requirement of its Statutory/ Regulatory body, and vast number of students using ICT in their educational activities. The use of ICT in educational institutes is because of CO2 emission, consumes high energy and produces harmful waste. Due to the negative impact of ICT, education institutions adopt Green ICT and minimize energy consumption, carbon footprint, ICT waste and maximize recycling & reuse so that it can reduce the cost of energy. The study aims at understanding the awareness and adoption of green ICT among the IT/Computer engineering students of LDRP-ITR, Gandhinagar.

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2. What is Green ICT?

Green IT refers to information technology and system initiatives and programs that address environmental sustainability (Siegler & Gaughan, 2008 and Chaudhari, 2011). Green ICT defined at varied point of views and perspectives. Green ICT as eco-sustainability perspectives, can be defined as the systematic application of environmental considerations such as pollution prevention, product stewardship and use of clean technology (Molla, 2009). The Green ICT has an aspect of innovation in managing ICT related to the environment (Suryawanshi & Narkhede, 2015). The concept of IT is very broad and needs to unbundle (Molla, 2009). Green ICT define as :

"....The study and practice of designing, manufacturing, using and disposing of computers, servers, and associated subsystems-such as monitors, printers, storage devices ,net working and communication systems efficiently and effectively, with minimum or no impact on the environment." (Council of European Professional Informatics Societies, 2015 in Thongmak, 2016 p.1)

According to Chaudhari (2011) Green IT 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 to reduce direct impact on the environment; and on the other hand one can develop more efficient information systems and technology solutions to support business initiatives to reduce indirect and negative impacts on environment.

Computers, Internet, www and e-mails are the main components of ICT. (Attama & Qwolabi, 2008 cited in Nwabuese & Ozlok, 2011) Following four major components of Green IT have been provided by (Sen ,2008 cited in Norazila Samuri, 2014, p.13).

Manufacturing & Production of Computer resource	Design of Computer System Resources
Usage of Computer Resource Management	Disposal of Computer Resource and e-waste

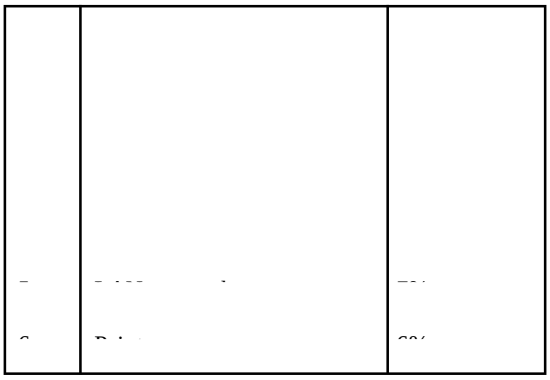
Source: Norazila Samuri, Making Green IT "Alive" at TVET Institution of Malaysia, 2014

The four main component of ICT are desktop usage & management, mobile device usage & management, printing & consumable, disposal & e-waste management. (Gartner, 2007 cited in Samuri,2014). Whereas Singh & Singh (2015) identified personal computers, servers, cooling equipment, fixed and mobile telephone instruments and networks, local area networks, office communication and printers as a key component of ICT. Eco hardware, automated power control programs, server virtualization, selection of PC, thin client solution, integrated telephony, efficient storage system, paperless office, fibre-based broadband infrastructure, proper recycling of IT equipments, etc. are the Green technologies, provided and applied in many institutions. Molla et.al (2009) proposed the Green IT readiness model to express an organization's capability for Green ICT in five dimensions: attitude, policy, practice, technology and governance. Green IT measures reduced energy consumption and waste of computing resources by making optimum use of hardware, software and networks by consolidation servers using virtualization software, and reducing waste associated with obsolete equipment,

etc.(Jenkin et al.,2010; Watson, Boudreau & Chen, 2008 cited in Chaudhari,2011). Extreme low energy servers and cloud computing, was ranked as one of the top ten strategic technologies for 2010 and 2012 (Gartner, 2009, 2011 cited in Thongmak, 2016)

3. ICT impact on environment

IT equipments and networks create cruel environmental issues from their manufacture to their disposal. Currently, as mentioned in the Gatrner report (2007), the ICT sector is responsible for around 2% of global CO_2 emissions worldwide. A single PC on an average generates 1.4 ton of CO_2 per annum (McBrayne & Lanyon-Hogg, 2007 cited



Source:: Allan Chen (2001) cited in Samuti (2014)

In India 4% of the GHG (Greenhouse Gas) emissions are from the IT sector. The smart 2020 report suggested that the appropriate use of IT can reduce global emissions by as much as 15% by 2020 - a volume of CO_2 five times its own footprint in 2020. It also suggested that replacing physical information products and services with their digital equivalents can help in the reduction of environmental impacts and this can be achieved by using appropriate IT and online information services models (The climate group, 2008 cited in Chaudhari, 2011). The government has a significant role to play in promoting Green ICT polices and initiatives against

reduction

4. ICT impact on Education

ICT is playing a vital role in education. "UNESCO aims to ensure that all countries, both developed and developing, have access to the best educational facilities necessary to prepare young people to play full roles in a modern society and to contribute to a knowledgeable nation" (Blurton cited in Suryawanshi & Narkhede, 2015, p.1).Today educational institutes use more and more ICT for their functions and services. All higher educational institutes need to be comply with the UGC and AICTE norms. Moreover, they need to apply for NAAC accreditation (National Accreditation Assessment Council) and NIRF ranking (National Institutional Ranking Framework) of NBA (National Board of Accreditation). As per norms they require well equipped and latest configuration of ICT tools with laboratories, office, library, teaching and learning aids, modern class rooms, etc., in institutions. One estimate indicates that in 2008-09 universities and colleges in the U.K. alone used nearly 1,470,000 computers, 2,50,000 printers and 2,40,000 servers; the IT related electricity bill to run this equipment was estimated to be around 500000 metric tons of CO2 emissions from this electricity use (James & Hopkinson, 2009 cited in Chaudhari, 2011). As a result IT equipment and Networks consume more electricity during the usage in institutions. That means ICT can significantly increase the environmental footprint of organization. This pressure led to adopt Green ICT, which minimizes

energy consumption, carbon footprint, ICT waste, to maximize recycling, reuse and to reduce energy cost. As such it has become mandatory for educational institutes to pay more attention towards Green ICT. Therefore, there is an urgent need to understand impact of ICT on environment, create awareness about Green ICT to protect our environment and health.

5. Objectives

The major objectives of the present study are as follows:

- ❖ To understand the present situation of knowledge regarding Green ICT among IT/ Computer engineering students in LDRP-ITR, Gandhinagar;
- ❖ To understand the attitude and awareness regarding Green ICT among IT/Computer engineering students in LDRP-ITR, Gandhinagar;
- ❖ To identify the reasons for adopting Green ICT among IT/Computer engineering students in LDRP-ITR, Gandhinagar;
- ❖ To identify the rejection for adopting of Green ICT among the IT/Computer engineering students in LDRP-ITR, Gandhinagar;and
- ❖ To facilitate the development of Green ICT polices in professional educational institution.

In other words, the principle aims of the present study are

- ❖ To be equipped with the knowledge regarding Green ICT efficiently and effectively and to use it in responsible and eco-friendly ways;
- ❖ To fill up the gap between the perceived knowledge and objective knowledge of green ICT; and
- ❖ To aware and motivate students regarding Green ICT, that minimize the energy, carbon footprint, hazardous ICT west and cost which provide healthy environment to the communities for their better life and conserve out global environment.

6. Methodology

An attempt has been made to survey semester IV and VI IT/Computer engineering students of LDRP-ITR, Gandhinagar.. A well-defined questionnaire was prepared and circulated to target users for getting the comprehensive and relevant data for Green ICT.. As a sample 80 questionnaires were distributed to semester IV and VI IT/Computer engineering students of LDRP-ITR, Gandhinagar. The duly filled-in questionnaires were received, showing an overall response rate of 75%**.**

7. Scope and Limitations of the Study:

The scope of presen study is confined only to semester IV and VI IT/Computer engineering students of LDRP-ITR managed by Kadi Serva Vishwa Vidhyalaya University, Gandhinagar. The study analyses the awareness, attitude and adoption of Green ICT among IT/Computer engineering students of LDRP-ITR. Conclusions from this study regarding Green ICT should be made only in the tentative view.

8. Analysis, Presentation, Interpretation& Findings of Collected Data:

After collecting the questionnaire, the data is analyzed and interpreted with the help of scientific and statistical techniques. The finding of the present

study is purely based on the responses received through the questionnaires filled-upby the users. The results of the study are as under:

8.1 Responses received from the Users:

Total 80 questionnaires were distributed among semester IV and VI IT/Computer engineering students of LDRP-ITR. Out of which 60 (75%) users have responded to the questionnaire.

Category of Respondents	Total no. of questionnaires Distributed	Total no. of questionnaires received
IV and VI IT/Computer engineering students	80 (100%)	60 (75%)

8.2 Take a care about environment:

A question about the environment was asked to respondents, the following data is collected. It is analyzed and represented in Graph.

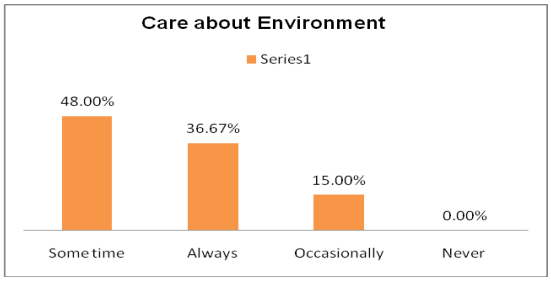


Figure 1: Care about Environment

It shows that 36.67% of despondences said that they are always taking care about environment; 48.00 % said that they are sometime take care about environment and rest 15.00 % said that they are occasionally take care about an environment.

8.3 Awareness about the Green ICT

The target users were asked a question regarding awareness about the green ICTs.

The result reveals that most of the respondents were aware about the green ICTs. 70.00% respondents were aware with green ICTs and the rest 30% were not aware with green ICTs.

The following data is collected, analyzed and represented in graph.

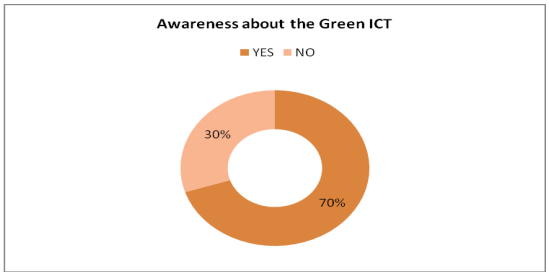


Figure 2: Awareness about the Green ICT

8.4 Motivation about Green ICT:

The target users were asked a question regarding motivation for Green ICT, the following data is collected, analyzed and represented in graph. The study revels that 40.00 % respondent indicated that they are motivated by friends, whereas 28.34% students are motivated by teaching faculties; 10.00% students are motivated by families; 8.33% students are motivated by literature review. Similarly 8.33% students are motivated by internet, 5% students are motivated by Google.

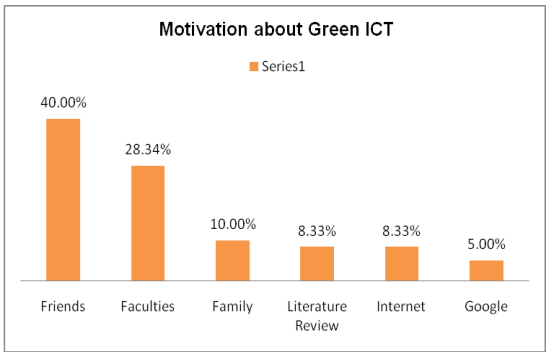


Figure 4: Movitation about Green ICT

8.5 Importance of Green ICT:

The importance of Green ICT among semester IV and VI IT/Computer engineering students is shown graph.

Table: 2 Importance of ICT

Respondents	Importance of Green ICT	
	YES	NO
IV and VI IT/Computer engineering students	41 (68.33%)	19 (31.66%)

It is observed from the table 1 above that the majority of students (68.33%) agree that Green ICT is important, whereas 31.66% disagree that Green ICT is important.

8.6 Adopting Green ICT:

The target users were asked a question regarding the level of adopting Green ICT, the figure 5 below data reveals that none of the students indicated that they are adopting Green ICT always, whereas 36.67% students are utilising it some time; 26.66% students are occasionally and 36.67 % are never adopting Green ICT.

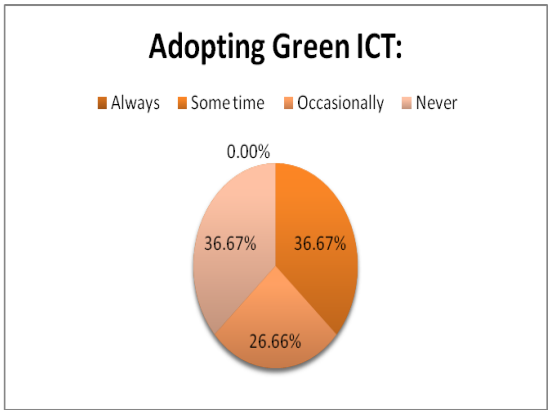


Figure 5: Adoption of Green ICT

8.7 Reasons for adopting Green ICT

As shown in the figure 6 below the reasons for adopting the Green ICT, the most students (70.00 %) mentioned the reason is to support the environment. The second reason mentioned by students (63.33 %) is to decrease energy consumption and to cut down total cost; 61.67% students agreed to solve global warming problems, 20.00% students mentioned the reason as to achieve social responsibility 6.67% students mentioned the reason is to minimize the carbon footprints and to minimize the hazardous ICT waste.

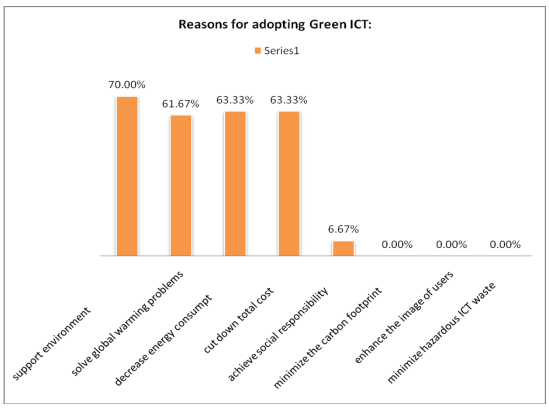


Figure 6: Reason for adopting Green ICT

8.8 Reasons for not adopting Green ICT

The respondents were asked a question to indicate reason for not adopting the Green ICT. As shown in the figure 7 below it is revealed that 66.66% students indicated that lack of knowledge is the reason for not adopting Green ICT. 26.66 % students indicated ignorance to use; 20.00 % students indicated that lack of motivation; 13.33% students indicated that lack of government strict policies; 6.66 % students indicated that old equipment is still functioning and Green ICT devices are costly and thats the reason for not adopting Green ICT.

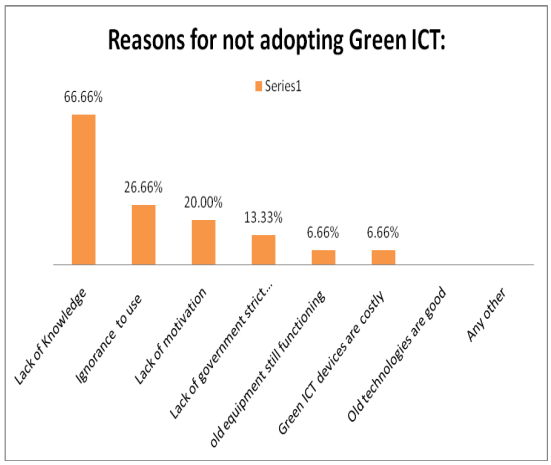


Figure 7: Reason for not adopting Green ICT

8.9 'Energy star' logo considered to purchase a new electronic device:

It was asked respondents about the energy star logo passed on electronic devises while purchasing. The result revels that only 36.67% students some time consider 'Energy star' logo when they are purchasing a new electronic device, whereas 15.00 % students always consider 'Energy star' logo.

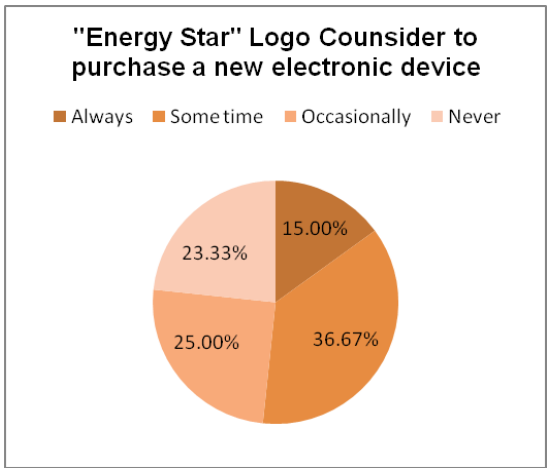


Figure 8: Energy Star Logo

8.10 Green ICT is important for educational institutes:

The respondents were asked a question regarding an importance of Green ICT in educational institutes and the following data is collected. Result shows that 33.33 % students strongly agreed that Green ICT is important in educational institutes. Whereas 53.33% students agreed; 10.00% students disagreed and rest 3.33% students strongly disagreed that there is no need for green ICT in educational institutes.

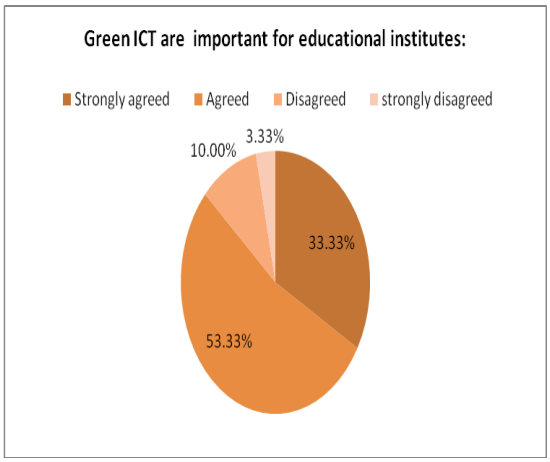


Figure 9: Importnace of Green ICT in Educational Institute

8.11 Attempt to search/read on Green ICT:

The respondents were asked a question about to search/read on Green ICT. The figure 10 shown below revels that 10.00% respondents always attempt to search/read on green ICT, while 50.00% respondents some time; 25.00 % occasionally and 15.00% never attempt to search/read on Green ICT.

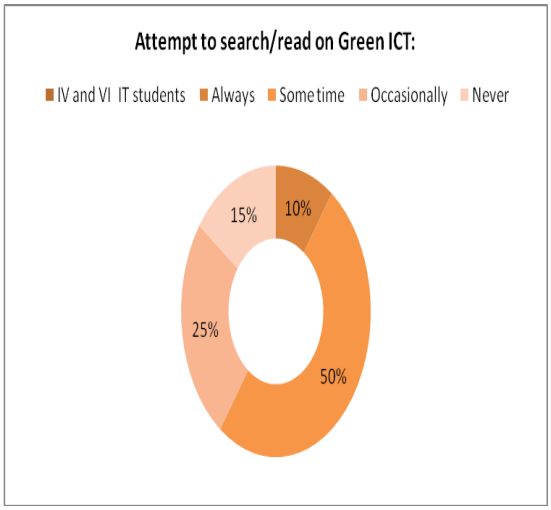


Figure 10: Attempt to Search on Green ICT

8.12 Green ICT practices followed by respondents:

To fulfil our objectives, an attempt was made to know which Green ICT practices are being followed by respondents. The table 2 below is the compiled from the responses received from the respondents.

8.13 Futuristic question about Green ICT:

In response of a futuristic question about "How important is the issue of Green ICT be over in the next two/three years. Majority of the respondents (90.00%) said that this question is very important 5.00% respondents said that it is quite important and remaining 5.00 % respondents said that they can't say.

Table 2: Green ICT Practices Followed by Respondents

No.	Green ICT practices	Always	Some time	Occasionally	Never
1	Switch off PC when not in use	20 (33.33%)	35 (58.33%)	5(8.34%)	-
2	Reducing energy consumption by powering down of ICT devices	17 (28.33%)	37 (61.67%)	3(5.00%)	3 (5.00%)
3	Use of e-books and e-learning tools	11 (18.33%)	27(45.00%)	13(21.67%)	9(15.00 %)
4	Improved telecommuting capabilities to reduce travelling/co_2 emissions	21(35.00%)	27(45.00%)	9(15.00%)	3(5.00%)
5	Use of recycled paper and reduce paper consumption	10 (16.67%)	30(50.00%)	15(25.00%)	5(8.33%)
6	If, Any other, please specify				

Table: 3: Futuristic Question about Green ICT

Respondents	Futuristic questions about Green ICT			
	Very Important	Quite Important	Not Important	Can't Say
IV and VI IT/Computer engineering students	90.00%	5.00%		5%

9. Findings

This study provides a survey of Green ICT awareness, attitude and adoption among IT/ Computer engineering students of LDRP-Institute of Technology and Research. On the basis of the information collected from IV and VI IT/Computer engineering students of LDRP-ITR, some of the important findings with regards of different aspects are as follows:

The study revealed that the Green ICT is not yet widespread among the IT/Computer engineering students. The IT/Computer engineering students of LDRP-ITR have a superficial knowledge of the Green ICT, but did not have a deep comprehensive knowledge on their application. They knew that Green ICT is important for their education and life. Some of the IT/Computer engineering students used green ICT practices in their day-to-day life and education but, fewer IT/Computer engineering students are do not use of Green ICT. The study indicated that the awareness among the IV and VI IT/Computer engineering students is not at satisfactory level. Most of the targeted students are motivated by friends and faculties and fewer are motivated by family, literature review, Google and internet. The study observed that to support the environment; to solve global worming problems; to decrease energy consumption; to cut down the total cost are the most popular reasons for adopting Green ICT. To minimize the carbon footprints and hazardous ICT waste, to achieve social responsibility and to enhance the image of users are still a little common reasons for adopting Green ICT. To minimize land and water pollution and to provide healthy environment are the untouched reasons for adopting Green ICT. The study revealed that lack of deeper knowledge, motivation, training programmes and government strict policies are the main barriers of adopting Green ICT practices. Most of the students know the presence of "Energy star" logo but unfortunately not all the students owned the product of "Energy star". Majority of the students agreed that Green ICT is important in educational institutes and the statement - there is an urgent need to cut down the carbon emissions, use energy efficient methods and manage the resources intelligently and effectively for future sustainability of ICT. Moreover the students tried to familiarize with Green ICT through search/read on Green ICT, but the progress is very slow. While reducing energy consumption by power down of ICT devices, improved telecommuting capabilities to reducing travelling/co_2 emissions, use of e-books and e-learning tools are also a common practices adopted by the students. Use of recycled paper and reduced paper consumption are the untouched practices adopted by the students. Majority of the IT/Computer engineering students believed that the issue of Green ICT is very important in upcoming

years and they must require guidance/ training programmes from their institute to improve the knowledge regarding Green ICT practices and benefits.

10. Suggestions

Based on the surveyedlLiterature and results of the study, some following are the suggestions to use Green ICT in educational institutes:

- ❖ The National and State Government should create strong Green ICT polices & strategies for IT companies, IT vendors, institutions, industries and people. The Government should radically rethink and redesign ICT polices & strategies, which should be regularly revised;
- ❖ Government should start Green Computing/ICT Certificate course for all employees, learners and academicians and it should be made compulsory;
- ❖ The government should levy extra charges on those Companies, Industries and Institutes which are not following Green ICT rules as well as not producing and following Green ICT products and practices;
- ❖ Higher education regulatory bodies such as UGC, AICTE should make it mandatory for institutions to adopt green ICT tools and technology in their institutes and should encourage them by awards, scholarships, fellowships for academicians/researchers/ students who contribute in this field;
- ❖ Universities and Colleges must format Environmental Advisory committee, which should laid down norms. The committee should continuously monitor Green ICT polices & strategies and amend it as and when required;
- ❖ Universities and colleges must use renewable energy such as solar, wind, etc.
- ❖ Universities and colleges should create a Green–IT website to increase green awareness among its stakeholders;
- ❖ Universities/colleges must organize high level of promotion and awareness programme such as lectures, videos, posters etc. which may lead to behavioural changes in its stakeholders;
- ❖ Universities/colleges must introduce Green ICT subject a compulsory. Universities/colleges should revise their curriculum to introduce Green Computing and Green Information Technology Courses at BE, ME, MSc IT, BCA, MCA, MBA, etc. Short term courses regarding Green Computing and Green Information Technology should be introduced;
- ❖ Universities/colleges should give preference to webinar/video conferencing to reduce travel and at the end carbon footprint will reduce;
- ❖ Only energy star/energy certified ICT equipment's should be purchased.
- ❖ Students, faculties and staff must strictly follow government polices & strategies on Green ICT;
- ❖ Recycling and reusing computers, ink, cartridges and other IT components wherever possible in order to cause less harm to the environment; and
- ❖ Studies and Strategies should be continuously planned and monitored by the authorities for the awareness of Green ICT in India.

11. Conclusion

The students have moderate knowledge of Green ICT. The awareness and attitude level of Green ICT is not at satisfactory level. There is a strong need to give more attention for increasing Green procurement practices by professional institutes. The professional institutes and its libraries should introduce ICT in an effectively green manner and should act as a role model for IT students. Furthermore, the high level of Green ICT awareness programme will shape responsible attitude towards green ICT which will lead to the greener environment and sustainable development of the nation. The awareness of Green ICT in India is very low and need to be promoted continuously in order to achieve 40% reduction on CO_2 emission by 2020 (Samuri, 2014). This will ultimately make available clean and healthy environment to communities for their better quality life and lead to conserve global environment.

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