

The New Millennium and Emerging Concerns

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Abstract- Environment Protection and its preservation is today the major concern all over the world. The changes in environment prove that all human activities are inter-connected. While the scientific and technological progress of man has invested him with immense power over nature, it has also resulted in the reckless use of the power, and endless encroachment of nature. Some of the environmental issues of concern a decade ago were acid rain, stratospheric ozone layer depletion and global warming. Today, electronic waste (E-waste) is becoming an issue of greatest concern. Electronic waste consists of hazardous material, which causes damage to the environment resulting in environmental problems. The worst nightmare of this helpless situation is the growth of electronic waste (e-waste) in India. Solid waste management, which has already been a mammoth task in India, is now becoming more complicated by the invasion of e-waste. There exists an urgent need for a detailed assessment of the current and future scenario of e-waste materials and their recycling in India, particularly in Gujarat which is a fast growing industrial State.

This Study on e-waste and recycling including quantification, characteristics, existing disposal practices, environmental impacts etc. would be helpful not only to the country and its people but to the field of education as a whole. The present Study was carried out in the area of awareness of e-waste and recycling on higher secondary students of English medium schools of Anand city, Gujarat, India. On the basis of analysis of data it can be said that the awareness of e-waste among students, who are future citizens, is indeed in a positive direction. However, awareness regarding their recycling was only satisfactory.

The Study concluded that the education system alone is a powerful medium to ensure environmental protection. It should reach most parts of the population at a young age, and more e-waste friendly behavior should be practiced on daily basis. Government should introduce such topics related to disposal of e-waste materials and its recycling and adverse effects of e-waste in Environmental Education as a compulsory subject in view of its future benefits.

Index Terms- Environmental Protection, E-Waste, Adverse Effects, Recycling, Environmental Education

I. INTRODUCTION

The present millennium is grappling with major human made catastrophes - environment degradation, rising sea levels, global warming and the gradual depletion of the ozone layer. Survival of all living species including humans has increasingly become very difficult as land, water and air have been polluted as never before. The current markers of contemporary world

scenario i.e. globalization, industrialization, liberalization and consumerism have eroded the delicate balance between human activity and nature.

We come across nowadays a number of buzzwords like environment pollution, climate change, global warming, rising sea water levels, knowledge explosion and information & communication technology (2G, 3G and now 4G) revolution, globalization, industrialization, consumerism, sustainable development etc. As scientific inventions started, it appears that man has got license to exploit nature in his attempt to conquer it. In support of this, Bhandare (2010) rightly observed, "Globalization has created both interrelated and interlinked world generating opportunities and also throwing up challenges". The imbalanced and reckless over utilization of the natural resources of the earth have started as a result of scientific and industrial revolutions, new technology, modernization and urbanization. It would be worthwhile to quote here a report by the World Wildlife Fund for Nature. WWF put together a Report "The Living Planet Report" (LPR). The LPR uses an ecological footprint to measure peoples' natural resource use. The LPR (2004) Report estimated that people were presently using 20% more natural resources than the world could produce (Srivastava, 2010). Hence, sensitivity towards economic use of Natural Resources and Environment Awareness is the prime concern of the present Education at global level and in particular in India. Students who are the future citizens of this globe should be aware of their responsibilities and duties towards protection of social, cultural, ecological, natural environments and their heritage.

Role of Technology in Our Lives - The present age is described as the age of information and knowledge explosion, an age of information and communication technology revolution. According to Bhatnagar (2004) "Globalization and technological change processes that have accelerated in tandem over the past fifteen years, have created a new global economy powered by technology, fueled by information and driven by knowledge". Due to globalization, modernization, industrialization and scientific inventions, there are rapid developments taking place in every walk of our lives. Technology is both a boon and a curse. Technology can be boon for business, trade, travelling and other activities of welfare of human society. Technology provides an understanding and an appreciation of the world around us. Technology can bring the world closer and make it a global village. Various media of mass communication like radio, television, movies etc. provide not only entertainment but also education and general awareness of social issues.

Educational Technology in Schools - Technology plays a crucial role in the field of Education in general and School Education in particular. Educational technology, the incorporation of information technology into the classroom or

distance and open learning experience, is a term that continues to evolve alongside technological advancements in the field. The issue of Educational Technology has played a major part in improving the learning outcomes of individuals by personalizing the learning experience. NPE (1986) as well as the revised NPE (1992) has laid emphasis on the use of educational technology [ET] for improving both the quality and access to education. The immediate responsiveness of computer based programs, and the self-paced private learning environment that Educational Technology warrants, seeks to promote higher levels of motivation among students worldwide. It has also provided greater access to Education such as in the case of increased accommodation for students with severe physical disabilities and for students living in remote locations.

The Gadget Savvy Learner Of Today - Today the average children of teenage in semi-urban and rural area have exposure to radio, television, mobile and internet computer technologies. SMS, Video calling, Email, Face book, Twitter, and Orkut are some examples with which an average teen is said to be hardly unfamiliar. Teens are more technologically savvy. Today's 6 to 12-year-olds are laden with gadgets their older siblings could only have dreamed about; two-thirds of them own mobile phones and iPods.

II. FALLOUTS OF TECHNOLOGY – HAZARD OF E-WASTE

In today's high paced modern world where technology is moving at an unbelievable pace, due to very high redundancy, there are new gadgets to replace the earlier ones – and that too at an incredible pace!

Despite their obvious benefits, each wave of technology creates a set of waste previously unknown by humans: toxic waste, radioactive waste, electronic waste. Most modern technological processes produce unwanted byproducts in addition to the desired products, which is known as industrial waste and pollution. While most material waste is re-used in the industrial process, many forms are released into the environment, with negative environmental side effects, such as pollution and lack of sustainability. Some technologies are designed specifically with the environment in mind, but most are designed first for economic or ergonomic effects

Electrical and electronic equipment are made up of a multitude of components, some containing toxic substances which can have an adverse impact on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes used. For example, Cathode Ray Tubes (CRTs) have high content of carcinogens such as lead, barium, phosphor and other heavy metals. When disposed carefully in a controlled environment, they do not pose any serious health or environmental risk. However, breaking, recycling or disposing CRTs in an uncontrolled environment without the necessary safety precautions can result in harmful side effects and release toxins into the soil, air and groundwater.

'E-waste' includes computers, entertainment electronics, mobile phones and other items that have been discarded by their original users. While there is no generally accepted definition of e-waste, in most cases e-waste consists of expensive and more or less durable products used for data processing,

telecommunications or entertainment in private households and businesses. Despite its common classification as a waste, disposal of electronics are a considerable category of secondary resource due to their significant suitability for direct reuse (for example, many fully functional computers and components are discarded during upgrades), refurbishing, and material recycling of its constituent raw materials. Re-conceptualization of e-waste as a resource thus pre-empts its potentially hazardous qualities.

E-waste is both valuable as source for secondary raw material, and toxic if treated and discarded improperly. Rapid technology change, low initial cost and even planned obsolescence have resulted in a fast growing problem around the globe. Uncontrolled burning and disposal are causing environmental problems due to the methods of processing the waste. E-waste is of concern largely due to the toxicity of some of the substances if processed improperly. The toxicity is due in part to lead, mercury, cadmium and a number of other substances. A typical computer monitor may contain more than 6% lead by weight.

E-waste is a global concern because it contains components which are toxic in nature and are non-biodegradable. In the past few months the studies conducted about e-waste give an insight into the realities the existence of e-waste in unimaginable quantities emerging in the form of donations and reuse and acquiring more place, and taking a serious toll on the health of humans and also on the environment - 20-50million tons of scrap / yr worldwide of which Asia estimates 12 million tons/ yr, Only 11% of e-waste gets recycled!

In India, e-waste is mostly generated in large cities like Delhi, Mumbai and Bangalore. Some of the recycling processes are extremely harmful and have negative impacts on the workers' health and the environment. A Study on the burning of printed wiring boards that was conducted 2004 showed an alarming concentration of dioxins in the surrounding areas in which open burning was practiced. These toxins cause an increased risk of cancer if inhaled by workers and local residents or by entering the food chain via crops from the surrounding fields. They also result in health hazards like brain disorder, asthma, skin diseases, cancers, liver and heart problems, kidney and spleen damages, etc.

Policy and legislative context of environmental protection and sustainability: Policies and laws regarding environmental protection and sustainability have been introduced in India. The National Environment Policy of India was announced on 18 May, 2006 as an umbrella policy for a range of environmental problems. The National Environment Policy works as a guide to action on several fronts, such as regulatory reform, programmes and projects for environmental conservation, and the review and enactment of legislation by Central, State and local Governments. The Ministry of Environment and Forests has drafted e-waste rules (dealing with the management and handling of e-waste) that were posted for comment on its website this year. The Hazardous Waste Management and Handling Rules were regulated in 1989 and amended in 2000 and 2003. They are focused on the import of hazardous waste from any part of the world into India. Electronic waste was not, however, emphasized in existing regulation.

The Ministry of Environment and Forests came up with the Guidelines for the Environmentally Sound Management of E-waste on 12 March 2008. These specify that India has no specific

environmental laws or guidelines for e-waste and none of the existing environmental laws have any direct reference to e-waste or refer to its handling as hazardous in nature. However, several provisions of these laws may apply to various aspects of e-waste. Environmentally sound recycling of e-waste requires sophisticated technology and processes, which are not only very expensive, but also need specific skills and training for the operation. Proper recycling of complex materials requires the expertise to recognize or determine the presence of hazardous or potentially hazardous constituents as well as desirable constituents (i.e. those with recoverable value), and then be able to apply the company's capabilities and process systems to properly recycle both of these streams. Appropriate air pollution control devices for the fugitive and point source emissions are required. Guidelines are to be developed for environmentally sound recycling of E Wastes.

Electronic products ultimately lead to E-waste of components which have reached their end-of-life stages, like televisions, PCs, mobile phones, electrical appliances, etc. and this constitutes a serious threat to the environment. Thus, their proper recycling is a must! Each individual should not only know how to use such latest electronics gadgets but must also know how to discard it properly without harming oneself or environment.

Thus, this Study was considered necessary to sensitize students, the inhabitants of this planet and in future its decision takers, to the threat of e-waste and its recycling.

Statement of the Problem: A Study of Awareness of E-Waste Materials among Students of Standard XI of English Medium Schools in Anand City of Gujarat, India.

Definition of The Terms: Awareness here refers to the knowledge of the students regarding e-waste materials and how it creates problems related to environment and related to health.

E-Waste here includes computers, entertainment electronics, mobile phones and other items that have been discarded by their original users.

Recycling here refers to discarded machines that contain usable parts which could be salvaged and combined with other used equipment to create a working unit.

Objectives of the Study:

- To study the awareness regarding e-waste materials among students of standard XI in English medium schools of Anand city of Gujarat
- To study the views of students regarding recycling of e-waste materials.

Review of Related Literature.

The investigator reviewed related literature and studies conducted in the area of awareness and recycling of e-waste materials. The Studies reviewed were classified under two categories -

Studies carried out abroad; Studies carried out In India

From the comprehensive review of related studies and literature, it was found that most of the studies had been carried out on either surveying the present status of awareness for environmental pollution or making people aware about it through experiments. Very few researches had been found related to the present status of awareness of e-waste materials and its recycling among the students of secondary and higher secondary schools in

India. Also, very few studies were carried out for specific aspects of awareness of e-waste materials and its recycling. Hence, the researcher was convinced to take up the study on awareness of e-waste and recycling.

III. DESIGN OF THE STUDY

Population: The population of the study comprised of all the students of Standard XI of Anand city in the academic year 2010-11.

Sample: From the population, 258 representative samples were randomly selected of the six English medium schools of Anand city.

Anand is the administrative centre of Anand District in the state of Gujarat, India. It is administered by Anand Municipality. It is part of the region known as "Charotar", consisting of Anand & Kheda Districts. Anand is also known as the "Milk City" or "Milk Capital of India". It has become famous for Amul dairy and its "white revolution", lead by Tribhuvandas Patel and Dr. Varghese Currien. This city hosts the National Dairy Development Board of India and Anand Agricultural University. Another well-known part of the city is Vallabh Vidhyanagar, an educational town and Vallabh Udyognagar - an industrial town and nearby to it, the birth place of Iron man of India: Sardar Vallabhbhai Patel i.e. Karamsad, an educational suburb of Anand.

Sampling Techniques: For the present study the researcher selected XI standard students using random sampling technique. For the selection of school, researcher visited some of the schools which are following GSHSEB and CBSC syllabus and obtained permission from the schools to carry out her Study. Thereafter the researcher selected six schools randomly which was having manageable number of students and minimum facilities for conducting the Study.

Delimitation of the Study: The present Study was delimited to

- Anand city only
- Some electronic gadgets like cell phone, computer and television
- E-waste materials and recycling awareness only.

Tools Used For the Study: In order to obtain the relevant data as required for the Study, the following tools were prepared by the investigator herself for data collection:

- Check list
- Questionnaire

The first tool was check list, to meet the first objective which was 'To study the awareness regarding E-Waste materials among students of Standard XI in English medium schools of Anand city of Gujarat'. The tool had 16 questions, covering awareness of e-waste materials in students of Standard XI. The data will reflect awareness of e-waste materials in students of standard XI.

The second tool, 'Open ended Questionnaire for students' dealt with the second objective 'To study the views of students regarding the recycling of E- Waste materials'. The tool had six open ended questions. This tool was prepared to find out the views of students regarding the recycling of e-waste materials. The investigator validated her tools from five different experts in their subjects. All the five Experts were 'Teacher Educators'.

The Experts were requested to give their opinion and suggestion regarding the tools. They were requested to check for relevance, simplicity, content validity and language of the tools. Appropriate modifications were made as per the suggestions of the Experts.

Quantification Of Data: For the present type of study both quantitative and qualitative data were required, so they were collected using two tools to achieve the objectives. Quantitative data included the response of the English medium higher secondary students given on close ended items in Checklist. Qualitative data included the response of the English medium higher secondary students given on open ended items in Questionnaire.

Analysis of Data: The data collected using Checklist and Questionnaire were analyzed through simple statistical techniques like frequencies and percentages with respect to objective 1 for quantitative data; whereas content analysis was employed for analysis of qualitative data with respect to objective 2. Survey method was adopted and for it, sample of

258 students were drawn randomly. The Study was delimited to Anand city, English medium schools and chosen gadgets under e-waste materials and recycling. Check list for quantitative factual information and Questionnaire for descriptive open ended response were used as data collection tools. The tools were finalized and administered finally on students after getting them validated by five experts. The tools were administered on students of higher secondary English medium schools by personal visit paid by investigator. The data was analyzed using simple statistical techniques like frequencies and percentage and content analysis technique.

IV. SECTION WISE ANALYSIS

Objective 1: To study the awareness regarding E-Waste materials among students of standard XI in English medium schools of Anand city of Gujarat

TABLE 1

Sr. No	Question	Yes%	No%	Not sure%
1	Are you aware of the harmful components of a cell phone?	80.23%	10.08%	6.69%
2	Is lead contained in the battery dangerous to human body?	77.52%	3.1%	19.38%
3	Would you immediately discard or dispose the battery of cell phone when it is not functioning?	37.6%	47.29%	15.11%
4	Do you know about the harmful components of television?	56.98%	30.62%	12.4%
5	Do waste materials of television create pollution?	56.98%	11.24%	31.78%
6	Is cathode ray tube of the television set harmful to environment?	46.12%	4.27%	49.61%
7	Is mercury contained in cathode ray tube of television harmful to human body?	51.55%	6.98%	41.47%
8	Do you know about the harmful effects of computer on the environment?	47.67%	37.21%	15.12%
9	Will you throw away the printed circuit board of your computer which is not functioning well?	23.26%	58.53%	18.21%
10	Will you give back the computer wastes to the Company?	50%	28.68%	21.32%
11	Does cartilage ribbon used in printer create environment pollution?	34.11%	6.98%	58.91%
12	Do you throw your CD's and DVD's in garbage, when not functioning?	50.39%	44.57%	5.04%
13	Do you store your pen drive at home, when not functioning?	50%	41.47%	8.53%
14	Do you know that plastic used in electronic gadgets can be recycled?	65.89%	20.93%	13.18%
15	Do you know about the official recycling centers of particular electronic companies nearby your home or in your city?	22.48%	63.95%	13.57%
16	Do you think second hand electronic items are dangerous to use?	36.82%	33.72%	29.46%

The following are the graphical representation of the data.

Figure: 3
Awareness of harmful components of Cell Phone

In response to the first question whether the students were aware of harmful components of cell phone, 80.23% students responded that they were aware of harmful components of cell phone, while 10.08% students were not aware of harmful

components of cell phone and 6.69% students were not sure about it.

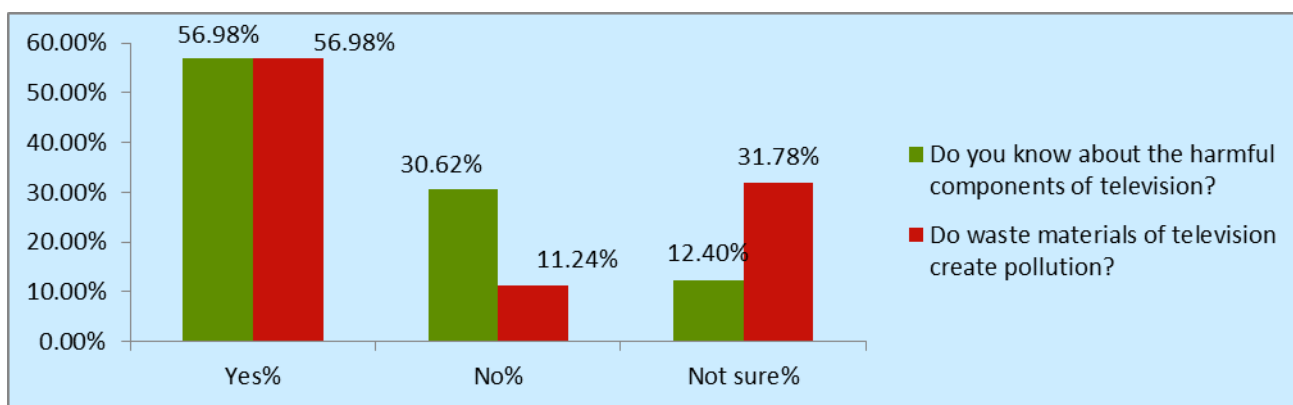
This shows that majority of the students were aware about the harmful components of cell phone, very few number of students were not aware of any harmful components of cell phone.

To the question posed by the researcher whether the lead that was contained in battery was dangerous to human body, 77.52% students said that lead contained in battery was dangerous to human body, while 3.1% students said lead contained in battery was not dangerous to human. 19.38% students were not sure about it.

To the question posed by the researcher whether one should immediately discard or dispose the battery of cell phone when it is not functioning, 37.6% students were in favor to discard or dispose the battery of cell phone immediately when it was not functioning. 47.29% students were not ready to discard or dispose the battery of cell phone when it was not functioning. 15.11% students were not sure about it.

This shows that not maximum number of students were in favor to discard or dispose the battery of cell phone. Majority of the students were not ready to discard or dispose the battery of cell phone, while less number of students were not sure about discard or dispose of the battery of cell phone.

FIGURE 4
Awareness of harmful components of television and adverse effect on environment



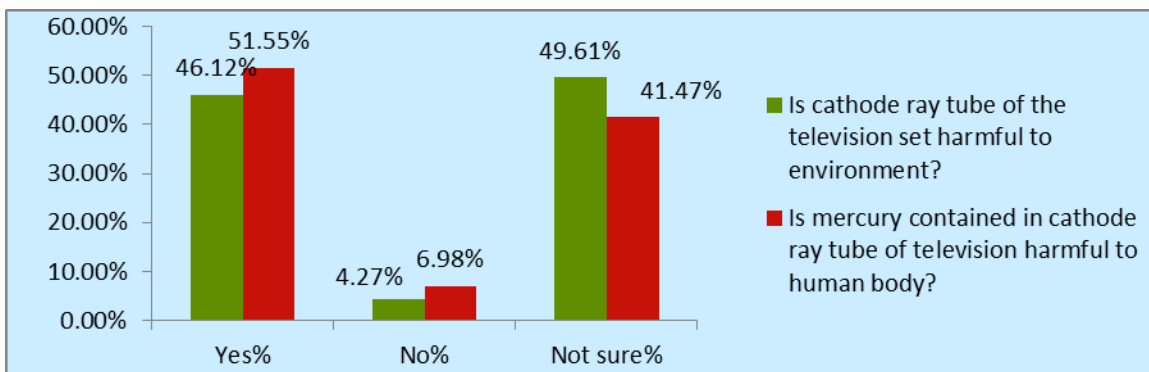
To the question posed by the researcher whether they knew about the harmful component of television, 56.98% students said that they were aware of the harmful components of television, 30.62% students said that they did not know the harmful components of television. 12.4% students were not sure.

This shows that majority of the students were aware of harmful components of television, while less number of students were not aware of harmful components of television. Very few students were not sure about the harmful components of television.

To the question posed by the researcher whether the waste material of television created pollution, 56.98% students agreed that waste materials of television could create pollution, 11.24% students said that waste materials of television did not create pollution, while 31.78% students were not sure whether waste materials of television created pollution.

This shows that majority of students agreed that waste materials of television could create pollution. Very few students did not agree with the answer that waste materials of television could create pollution.

FIGURE 5
Regarding the harmful effects of cathode ray tube and mercury contained in cathode ray tube



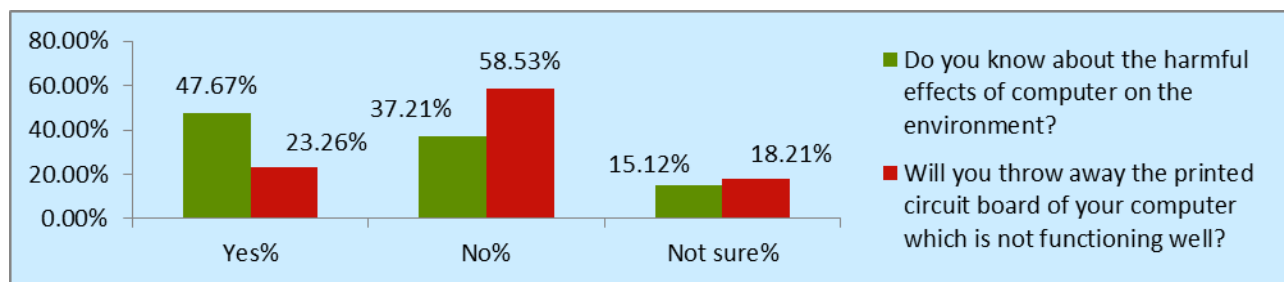
The responses regarding the sixth question whether the cathode ray tube of the television set was harmful to environment. 46.12% students responded that cathode ray tube of the television set was harmful to environment, 4.27% students responded that it was not harmful to environment. 49.61% students were not sure about the harmful effects of cathode ray tube of the television on environment.

This shows that maximum number of students were aware of harmful effects of cathode ray tube of the television. Very few students did not agree with harmful effects of cathode ray tube, while majority of students of were not sure about the harmful effects of cathode ray tube.

The response regarding the seventh question whether mercury contained in cathode ray tube of television harmful to human body, was distributed among two extremes. 51.55% students said that the mercury present in cathode ray tube was harmful to human body, 6.98% did not agree with it while 41.47% student were not sure about the harmful effects of the mercury present in cathode ray tube on human body.

This shows that majority of students were aware of harmful effects of mercury contained in cathode ray tube on human body. Very few students did not agree with the answer harmful effects of mercury on human body. A large number of students were not sure about the harmful effects of mercury contained on cathode ray tube on human body.

FIGURE 6
Regarding harmful effects of computer and disposal of printed circuit board of computer



The above responses related to the question whether they knew about the harmful effects of computer on the environment. 47.67% students were aware of the harmful effects of computer on the environment. 37.21% students did not agree with it. 15.12% students were not sure about it.

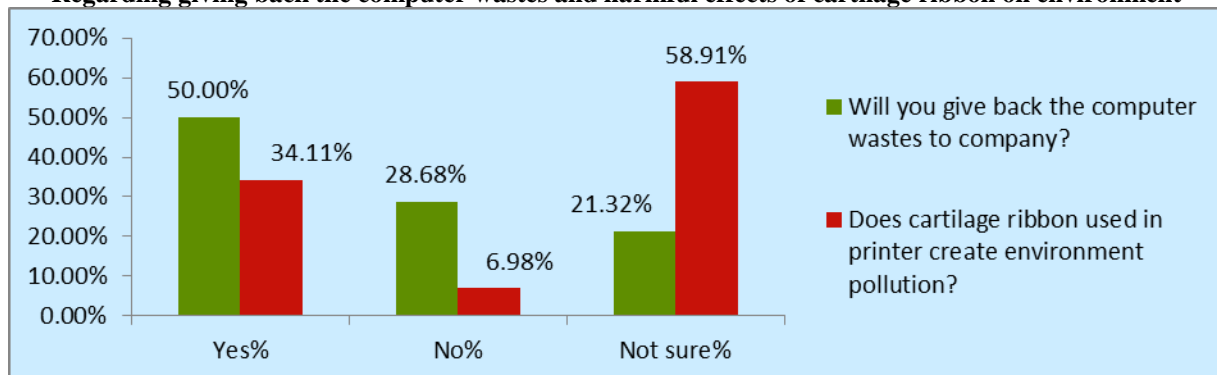
This shows that majority of students were aware of harmful effects of computer on the environment, while more students were not aware of harmful effects of computer on the environment. Few students were not sure about the harmful effects of computer on the environment.

The responses related to the question, whether they would throw the printed circuit board of computer when not functioning

well. Very few students (23.26%) would throw away the printed circuit board of computer when it was not functioning well. Most of students (58.53%) would not throw it, while few students (18.21%) were not sure about it.

This shows that majority of the students were not aware of harmful effects of the printed circuit board of computer when it was not functioning well. Very few students were aware of harmful effects of the printed circuit board and less number of students were not sure about the harmful effects of the printed circuit board of computer

FIGURE 7
Regarding giving back the computer wastes and harmful effects of cartilage ribbon on environment



To the question regarding whether they would give back the computer wastes to the company, the responses were as follows, 50% students said that they would give back the computer waste to company. 28.68% students would not give

back the waste of computer to company. 21.32% students were not sure.

This shows that majority of students were aware of harmful effects of waste materials of computer which created pollution of

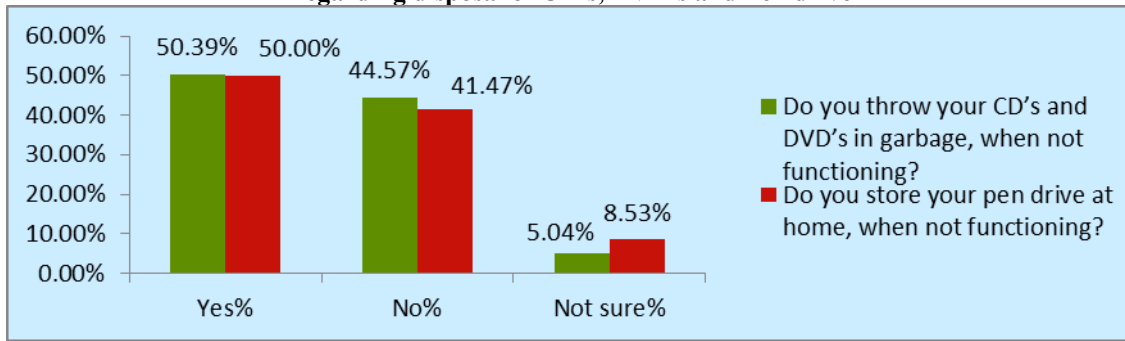
environment. Few students were not aware of harmful effects of waste materials of computer on environment. Very few students were not sure about the harmful effects of waste materials of computer on environment.

To the question regarding whether cartilage ribbon used in printer could create environment pollution - 34.11% students responded that cartilage ribbon used in computer created environment pollution, 6.98% students said that they did not

agree with it, while 58.91% students were not sure that cartilage ribbon used in computer could create environment pollution.

This shows that majority of students were not sure that cartilage ribbon used in printer created environment pollution. Large numbers of students were aware that cartilage ribbon used in printer created environment pollution and very few students were not aware that cartilage ribbon created environment pollution.

FIGURE 8
Regarding disposal of CD's, DVD's and Pen drive



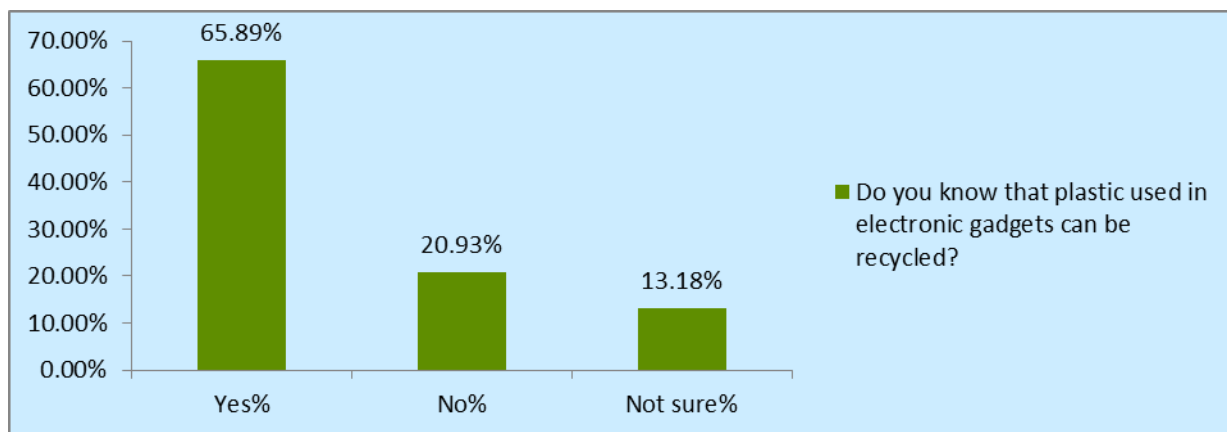
To the question regarding whether they would throw CD's and DVD's in garbage, when not functioning, the responses were as follows, 50.39% students responded that they would throw their CD's DVD's in garbage, when not functioning. 44.57% students would not throw them in garbage. Very few 5.04% students were not sure what they did with their CD's and DVD's, when not functioning.

This shows that majority of students were not aware of the correct disposal method of CD's and DVD's when not functioning. A Large number of students were aware of correct disposal method of CD's and DVD's. Very few students were not sure what to do with CD's and DVD's when not functioning.

To the question regarding whether they would store their pen drive at home, when not functioning - 50% students wanted to store their pen drives at home, when not functioning. 41.47% students did not want to store it at home, 8.53% students were not sure.

This shows that majority of students were not aware how to dispose their pen drive with proper method. Most of the students would not store their pen drive at home, while very few students were not sure what to do with pen drive when not functioning.

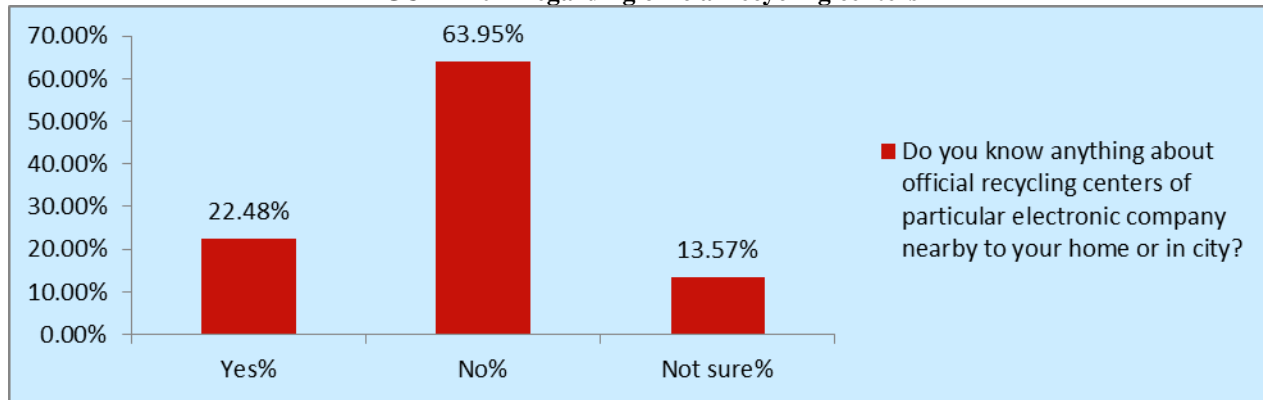
FIGURE 9 - Regarding plastic used in electronic gadgets



From the above figure it can be observed that 65.89% students knew that plastics used in electronic gadgets could be recycled. 20.93% students did not know, whereas only a few i.e. 13.18% students were not sure that plastics used in electronic gadgets could be recycled.

This shows that the majority of students were aware of recycling of plastic used in electronic gadgets. Few students were not aware of recycling of plastic, while very few students were not sure that plastic used in electronic gadgets could be recycled.

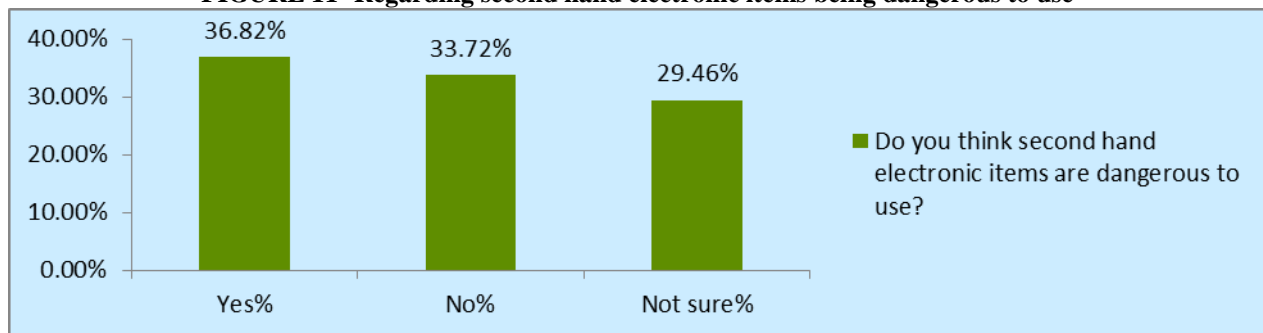
FIGURE 10 - Regarding official recycling centers



Regarding the response to the question whether they knew about official recycling centers of particular electronic companies nearby their homes or in city, 22.48% students responded that they knew about official recycling centers, 63.95% students said that they did not know anything about any official recycling centers, while 13.57% students responded that they were not sure about official recycling centers.

This shows that majority of students were not aware about official recycling center of particular electronic company nearby their home or city. Only few numbers of students were aware about any recycling center nearby their home or city. Very few students were not sure about the recycling center nearby their home or city.

FIGURE 11- Regarding second hand electronic items being dangerous to use



In response to the sixteenth question whether they thought that second hand electronic items were dangerous to use, 36.82% students thought that second hand electronic items were dangerous to use. 33.72% students did not agree with it, while 29.46% students were not sure about use of second hand electronic items.

This shows that majority of students thought that use of second electronic items were dangerous, while a large number of students thought that use of second hand electronic were not dangerous and least number of students were not sure about use of second hand electronic items were dangerous.

The investigator had prepared a check list to check the awareness of students regarding e-waste materials. But it was also important to know their views regarding recycling of e-waste materials. So investigator had prepared open ended questionnaire to know the different views of students regarding recycling of e-waste materials.

The following is the data analysis and interpretation of Objective 2 which was "To study the views of students regarding the recycling of e-waste materials".

The views of students were taken regarding the recycling of e-waste materials. Different questions were asked in the Questionnaire by the investigator and the different views in descriptive form were received. The qualitative data received were analyzed using content analyses technique which is as follows. (The following section has been written in the form of questions posed and responses given).

Q1. Why do you think e-waste material should be recycled?

In response to this question, majority of the students said that e-waste could create more harmful effects to environment. According to them, it was hazardous to environment and it was one of the major pollutants of the day. Also, majority of students said that e-waste was harmful to living creatures. A significant number of respondents replied that e-waste caused several diseases and was dangerous to health. According to them, there were very less resources available on mother earth and we could reuse some part of e-waste materials. Very few students said that e-waste should be recycled to save our earth for future generation because e-waste materials were non-degradable.

Hardly any respondent replied that recycling centers could create an opportunity for employment.

Q.2: How can youngsters be sensitized to this crucial problem?

The most common view shared by students was that youngsters could be sensitized by bringing awareness in them through different activities, charts, newspapers, magazines, seminars, debates, speeches, street play, drama, public meetings, different media like Television, Internet, Facebook, Orkut. Also, a majority of students said that youngsters could be sensitized through lectures. A significant number of students said that youngsters should minimize the use of different electronic gadgets. Few students opined that youngsters should not throw their e-waste in open place and they should give e-waste materials for recycling. Very few students said youngsters can be sensitized by (1) extra curriculum activities in school and colleges, organizing competitions. (2) Bringing social awareness in the youngsters

Hardly one or two respondents responded that (1) topics regarding awareness of e-waste should be inserted in the curriculum/syllabus (2) consumers should not use second hand gadgets (3) awareness should be inculcated via documentary film, videos or live telecast of e-waste.

Q.3 What will be your personal contribution in this respect?

Majority of the students replied positively and suggested to create or spread awareness among people/society. Also many of them recommend not dumping or disposing e-waste in open places. Average number of students said that they would try to minimize the use of electronic gadgets or use judiciously and carefully. Minimum or very less number of students replied that they would give back their waste gadgets to company in exchange. They showed readiness to use those gadgets which could be recycled. Some of them accepted that they need to enhance their own knowledge regarding e-waste and its recycling.

Different views came from very few students regarding their personal contribution towards recycling. They replied that they were ready to use very less harmful products. They showed readiness to establish awareness clubs. Few students replied that they would not give e-waste materials to children to make toys. They would also first enhance their own knowledge regarding the problem related to recycling of e-waste materials. They would conduct awareness programs. They would collect e-waste materials from friends and follow 3Rs i.e. reuse, recycling and reducing. They could organize drama for public awareness

Q. 4 What efforts will you put forward to make others aware about recycling of e-waste materials?

Most of the students replied that they would like to bring awareness by using newspaper, magazines, television, radio, sms, internet, Facebook, camps, seminars, speeches. Also majority of students said that they would try to bring awareness by arranging lectures, exhibiting posters, giving advertisement, arranging group discussion, and they would give information to others regarding recycling of e-waste. Many students said that they would stop people from throwing e-waste and they would collect all e-waste from friends, family, relatives and give it back to recycling centers. Few students said that they would help in

campaigning and join social institute/networking site. Also they said that they would pay door to door visit and they would take out rallies, do street plays, drama and do conversation with friends. A single student said through education, he would try to bring awareness about recycling of e-waste materials.

Q.5 Give your opinion about the role of government, NGOs and pollution control board towards recycling of e-waste materials.

Responding to this question, majority of the students replied that Government should pass law/rules/acts/policies on recycling. Also they said that government, NGOs and pollution control board could launch some social awareness programme on television, give information of recycling of e-waste in newspapers, and arrange seminars. Also they could use posters, pictures to bring awareness about recycling of e-waste materials. Many students felt that NGOs could go in villages and urban areas and give information regarding recycling of e-waste. The government could collect e-waste materials and establish recycling centers. A significant number of respondents said that government was not doing anything regarding recycling of e-waste. Also they said that government could arrange public meetings, drama and rallies to bring awareness among people – they could establish a department for e-waste recycling. Very few students replied that government could create funds, start movement, encourage people for recycling e-waste, and organize fair related to recycling of e-waste. Government could use research and find disposal methods. Pollution control board should check e-waste dumping.

Q.6 State your views on what type of role the company should play in recycling of e-waste materials.

Maximum students replied that the Company should collect e-waste materials or make provision for exchange offer and recycle e-waste material. Majority of students said that the Company should provide recycling centers/system. The Company could give compensation/discount to all who return their e-waste back. Company should make non-harmful and less pollutant products. Less number of students said that the Company should use recycled materials, Company should give detail about gadget to use and give detail about the disposal of e-waste. They also replied that the Company should provide the information about harmfulness of e-waste. From their views Company could give advertisement regarding recycling of e-waste and Company should know negative impact of e-waste materials. Very few students said that Company should make environment friendly gadgets. Company should make a policy to recycle. Company should regularly check their gadgets and collect back discarded materials so that they could be recycled.

V. MAJOR FINDINGS OF THE STUDY.

Based on the analysis of the data collected on two tools i.e. checklist and structured questionnaire, it was observed that the highest response for “Yes” was 80.23 % on item no.1 i.e. Are you aware of harmful component of cell phone? ; whereas the lowest response for “Yes” was 22.48 % on item no.15 i.e. Do you know anything about official recycling centers of particular electronic company nearby to your home or in city?

Similarly, item no.15 had the highest response for “No” that was 63.95 % whereas the lowest response for “No” was 3.1 % on

item no.2 i.e. Is lead contained in battery dangerous to human body?

It was quite interesting to note that on the third category i.e. "Not sure", the highest response was 58.91 % for item no.11 i.e. Does cartilage ribbon used in printer create environment pollution?; whereas the lowest response was 5.04 % on item no.12 i.e. Do you throw your CD's and DVD's in garbage, when not functioning?

Based on the above observations, it was very much clear that whilst the students were aware of the e-waste materials, they really required to know and were not aware of many things about the recycling of the e-waste materials. It was also noteworthy from the responses that most students were reluctant to throw or discard the e-waste materials that they made use of in their daily lives.

When compared, some of the responses on particular items given on checklist with that of the descriptive answers on open ended questions in order to cross check and validate the responses; it was found that majority of the students were aware of the hazardous effects of e-waste materials on human body as well as on earth or nature but did not know much about the process of recycling. However, they did show a positive inclination to learn it.

The present Study was carried out on a small scale, using sample of 258 and the methodology employed for the present Study was survey method.

The Study has major implications for course or syllabus designers of science and technology, for education policy makers and decision makers, for curriculum designers for school and college level. For example, based on the present Study, it can be thought to implement or introduce "Environment Education" as a core subject at school and/or college level education.

In order to arrive at major findings and conclusion for the scope of generalisation of the present Study to the theory and practice of education field, first and foremost the investigator grouped the collected data according to the nature of the data and analyzed as per the two objectives of the Study. The analysis of data suggested significant awareness towards e-waste materials. The awareness of e-waste in students of standard XI was found positive. Analysis of the responses on the checklist by the students showed that the students of all streams were aware of e-waste products and its harmful effects.

Based on the analysis, interpretation of the collected data and inferences drawn, the following were the major findings of the Study:

As per the first objective related to the awareness regarding e-waste materials, the following were the major findings:

- Majority of students were aware of e-waste materials in cell phone (80.23%), television (56.98%), computer (47.67%), printer (34.11%), CDs and DVDs (50.39%) and pen drive (41.47%)
- Less than average numbers of students were aware of the micro electrical gadgets used in various electronic equipments.
- While comparing the data, it was found that students were aware of the harmful effects of e-waste materials to human body and environment, but at the same time majority of students were reluctant to discard them away, as in case of e-waste equipments like cell phone battery (47.29%), printed circuit board of computer (58.43%), CDs and DVDs (44.57%), pen drive (50%).

More than average numbers of students were aware of recycling of some e-waste materials i.e. 65.89%, but it was quite noteworthy that most of them (63.95%) were unaware regarding the existence and whereabouts of such recycling centers for e-waste materials.

The second objective related to the views of students regarding the recycling of e-waste materials, the following major findings were found from the data analysis.

Majority of students were aware about the harmful effects of e-waste to environment and also to all living beings on earth. Majority of students knew that E-waste could create various diseases to human body and they realized the fact that e-waste materials were non-degradable. Majority of students viewed recycling of e-waste materials as a must in present times. Some students opined that Recycling could offer employment also. Such views expressed by higher secondary students, show that students were not only aware about e-waste and recycling, but also identified recycling as an effective field of trade and commerce or for entrepreneurship.

It was found that majority of students gave wonderful suggestions like bringing awareness in youth regarding recycling through different activities, preparing charts and posters, arranging seminars debates, speeches, and different media can also bring awareness like Television, Internet, Facebook, Orkut. Most of the students were also in favor of some legislative steps to be taken by Government and Electronic Companies in disposing of e-waste materials and its recycling. Most of the students opined that NGOs and pollution control board should also play an important role to reduce adverse effects of e-waste on environment as well as human beings.

Suggestion for Future Research:

- Similar study on awareness of e-waste materials (focusing on household appliances like electric switches, radio, torch, torch-battery, microwave oven, refrigerator, hand blender, electric stove, electric shaver, electric toys for children, etc) and its recycling process among Gujarati Medium School Students or/and Hindi medium schools students can be carried out.
- Using the same tools and methodology of the present Study, another Study can be carried out with schools having CBSC, ICSC, IB syllabi
- A Study on awareness of e-waste and recycling among students from primary to university education can be carried out for entire Gujarat for all kinds of schools i.e. purely government, grant- in -aided, granted, privately managed and self aided
- A Study on the same topic can be carried out at larger scale taking large sample from entire India.
- Comparative Study of awareness among boys and girls of urban, semi-urban and rural background and Comparative study of awareness of e-waste among students of Gujarati medium school to students of other medium can also be carried out with the same topic.
- The present Study can be further enriched with combination of newer methodology. A Study with similar topic can have a different methodology like developmental, experimental research design. One can make use of CAL, CIA, CALL, CAI etc. computer related PLM Packages, and its

effectiveness for developing awareness among variety of sample like students, teachers, principal, administrators, dealers or distributors of electronic equipments and even manufactures of such electronically goods can be investigated.

- Another Study with same topic can focus on teachers, principal, administrators of schools/colleges.
- A large scale project can be taken up including more electrical items and awareness regarding other electrical equipments and their recycling can be done.

VI. CONCLUSION

Environment Protection and its preservation is today the major concern all over the world. The changes in environment prove that all the human activities are inter-connected. An environmental damage within the boundaries of one State has trans-border ramifications. While the scientific and technological progress of man has invested him with immense power over nature, it has also resulted in the reckless use of the power, and endless encroachment of nature. Some of the environmental issues of concern a decade ago were: acid rain, stratospheric ozone layer depletion and global warming. Today, electronic waste (E-waste) is becoming an issue of greatest concern.. The electronic waste consists of hazardous material, which causes damage to the environment resulting in environmental problems. The worst nightmare of this helpless situation is the growth of electronic waste (e-waste) in India. Solid waste management, which has already been a mammoth task in India, is now becoming more complicated by the invasion of e-waste. There exists an urgent need for a detailed assessment of the current and future scenario of e-waste materials and their recycling in India, particularly in Gujarat which is industry friendly and business oriented community. The present status of awareness about e-waste among Indians, especially among people of Gujarat is the need of the hour. The study on e-waste and recycling including quantification, characteristics, existing disposal practices, environmental impacts etc. would be helpful to not only country and its people but to the field of education as a whole.

The present Study was carried out on the area of awareness of e-waste and recycling using Survey method. The Study was conducted on higher secondary students of English medium schools of Anand city of Gujarat. As compared to the earlier Studies carried out in the area of awareness about e-waste and recycling, the present Study was in itself a new one and had no resemblance with the earlier Studies.

The present Study was carried out on the area which was less familiar in the field of education especially among school going adolescents in India. The Study was more significant in terms of the locality and sample as English medium higher secondary students of a small town of Gujarat were taken. Such Studies on the area of e-waste and recycling were very less in quantity in India and not a single Study in Gujarat. Hence, the investigator had studied a crucial and most important area of problem which is in reality a global one.

The present Study was significant in terms of its contribution to the field of educational research and to the area of science and technology and social science.

On the basis of analysis of data it can be said that the awareness of e-waste in students of standard XI is in a positive direction. However, awareness regarding recycling of e-waste among the higher secondary school students was only satisfactory.

Government should introduce some topics related to disposal of e-waste materials and its recycling and adverse effects of e-waste on health of human body in Environmental Education as a compulsory subject from lower to higher grades.

It has been realized recently that the education system alone is a powerful medium to ensure environmental protection. It should reach most parts of the population at a young age, and more e-waste friendly behavior should be practiced on daily basis.

India faces significant challenges in protecting the environment from further damage. Population growth and consumerism make the task all the more difficult for the Indian Government. The Indian Government's ability to safeguard the country's environment depends on policies and educational systems. (R. Sahaya Marry, I Paul Raj, 2005) .Disposal of e-waste is one of the major challenges facing the world. Hence, human beings are asked to reduce, reuse and recycle their e-resources. Even the learned people do not know which objects are to be reduced, reused and recycled. These three words if followed by each and every person would be helpful to protect our environment.

REFERENCES

- [1] Adelaar, T.(2005). Explaining variations in the use of the Internet to support inter-or-ganizational exchange: The cas of the recycling industry. (PhD thesis, Michigan State University). In Dissertation Abstracts International, vol.(67). No .2.
- [2] Bandyopadhyay, A. (2010). Electronics waste management: Indian practices and guidelines. *International Journal of Energy and Environment*, vol (1) Iss. 5 pp. 793-804. Retrieved from <http://www.doaj.org/doi/jfanc=abstract&id=558429>
- [3] Beard, C. (1932). In Bhall, B. D. & Sharma, S. R. (2005). *Educational Technology concept Technique*. Kanishka Publishers: New Delhi. Best, J. W. & Kahn, J. V. (1999). *Research in Education*. Prentice- Hall of India Private Limited: New Delhi.
- [4] Bhandare, M. (2010). *Technology, Innovation and Leadership: Essential Requirements for Progress of the Nation*. University News, vol 48(52).
- [5] Bhatnagar, S. (2004). *ICT and Education*. Retrieved March 2011 from http://www.unescobkk.rog/fileadmin/user-upload/apeidlConference/13th-conference/Papers/5.D.2.-Ict_and_Education_Sudhir_Bhatnagar_.pdf.
- [6] Buddha, G. (563-483 BC). Buddha quotes. Retrieved April,2011 from http://thinkexist.com/quotation/to_a_pure_unselfish_life_one_must_count/200497.html
- [7] Dalal, P. (2008). *E-Waste in India*. Retrieved March 2011 from
- [8] <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN029841.pdf>
- [9] Davis,G. & Wolski, M. (2009). E-waste and the sustainable organization: Griffith University's approach to e-waste. *International Journal of Sustainability in Higher Education*, vol 1055:1, pp. 21-32. Retrieved March 2011 from <http://www.emeraldinsight.com/journals.html?articleid=1769153&show=html>
- [10] Dixit, S., Agarwal. V. (2009). Environmental Awareness among Prospective Elementary Teachers. *EDUTRACKS*, 8(5), 30-34.
- [11] Einstein, A. (1917). Albert Einstein quotes. Retrieved February 2011 from http://thinkexist.com/quotation/technology_is_a_gift_of_after_the_gift_of/206235.html
- [12] Electronic waste. Retrieved October 21, 2010, from http://en.wikipedia.org/wiki/Electronic_waste

- [13] Gohsinern (2010). How Does Advanced Technology Influence Our Life And Community? Retrieved February 2011, <http://www.oppapers.com/essays/How-Does-Advanced-Technology-Influence-Our/415337>
- [14] Green Computing: How to Use Home Electronic Gadgets the Green Way. Retrieved December 12, 2010 from <http://www.situt101.com/content/green-computing-how-to-use-home-electronic-gadgets-the-green-way-a23632#ixzz1llgJAitl>
- [15] Ifegbesan, A. (2009). Exploring secondary school students' understanding and practices of waste management in Ogun State, Nigeria. *International Journal of Environmental & Science Education*, vol. 5, no. 2. Pp.201=215. Retrieved February 2011, from http://www.ijese.com/IJESE_v5_n2_Ajodeyi.pdf
- [16] Jaikumar, R. (2009). Economic Solution to the Electronic Waste. *University news*, 47(38), 27-29.
- [17] Jatindra, P. & Sudhir, K. (2009). E-waste Management: A Case Study of Bangalore, India. *Research Journal of Environmental and Earth Science*, 1(2) pp.111-115. Retrieved February 2011, from <http://www.doaj.org/doaj?func=abstract&id=503780>
- [18] Kalan, J.A. (2010). Electrical and Electronic Waste Management Practice by households in Shah Alam, Selangor, Malaysia. In *International Journal Of Environmental Sciences*. vol.1no.2. Universiti Putra, Malaysia. Retrieved January 2011 from <http://ipublishing.co.in/jesvol1no12010/EJES1013.pdf>.
- [19] Kang, Hai-Yong. (2005). Management of end-of-life electronic products ithin environmental benign manufacturing framework: Analysis of infrastructure, cost, materials flow, and decision making. Unpublished Ph.D. Dissertation. University Of California. Retrieved from February 2011, <http://wwwhttp://gradworks.umi.com/32/03/3203579.html>
- [20] Kothari, C. R. (2010). *Research Methodology; Methods and Techniques*. New Age International (P) Ltd.: New Delhi, India
- [21] Manzar, O. (2010). ICTs and Environmental Sustainability. Retrieved from <http://www.giswatch.org/country-report/2010-icts-and-environmental-sustainability/india#f1>
- [22] Merrill, D. (2006). Abject Americans: Waste, obsolescence, and strategies of recycling in twentieth-century American Literature. (Ph.D. thesis, University of Florida). In *Dissertation Abstracts International*, vol.(68). no.1.
- [23] McCauley, D. (2010). Tweens get savvy with gadgets. Retrieved February 2011, from <http://www.smh.com.au/technology/tweens-get-savvy-with-gadgets-20100828-13x1e.html>
- [24] Naisbitt, J. (1982). Jhon Naisbitt quotes. Retrieved January 2011, from http://thinkexist.com/quotation/the_most_exciting_breakthroughs_of_the_st_century/181930.html
- [25] NCERT. (1986). *National Policy on Education – 1986*. New Delhi: NCERT.
- [26] NCERT (2000). *National Curriculum for Elementary and Secondary Education : A frame work (Revised version)*. New Delhi: National Council of Educational Research & Training
- [27] Nixon, H. (2006). Electronic waste management in California: Consumer attitudes toward recycling, advanced recycling fees, “green” electronics, and willingness to pay for e-waste recycling. (Ph.D. thesis, University of California, Irvine). In *Dissertation Abstracts International*, vol.(67). no.7.
- [28] Oppenheimer, J. (1953). *Science and Technology Quotations*. Retrieved from <http://www.physics.udel.edu/~watson/scen103/quotes.html>
- [29] Pathak, r. (2008). *Methodology of Education research*. Atlantic publishers and distributors (p) LTD: New Delhi.
- [30] Paul, S. (2005). Elementary Education in Meghalaya. *Journal of All India Association for Educational Research*, vol 17 no. 3&4.
- [31] Peralta, G., Fontanos. (2005). E- waste issues and measures in the Philippines. *Journal of Material Cycles & Waste Management*, vol.8, 34-39. Retrieved February 2011, from http://www.http://ewasteguide.info/e_waste_issues_and_m
- [32] Schaffhauser, Dian (2009). The dirt on E-waste. *T. H. E. Journal*, vlo.36 no.3 pp20-25 Retrieved January 2011 from http://www.eric.ed.gov/ERICWebPortal/search/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=EJ842176&ERICExtSearch_SearchType_0=no&accno=EJ842176
- [33] Sherman, D (2004) Not here, not there, not anywhere: The federal, state and local politics United State, 1979-1999. (Ph.D. thesis, Cornell University). In *Dissertation Abstracts International*, vol.(65). no.10.
- [34] Shreshtha, D. & Agarwal, V.P. (2009). Environmental awareness among prospective elementary teachers. *University News*, 8(5), 30-34
- [35] Rochat, D, Hagelüken C, Keller M, Widmer R. (2007). Optimal Recycling for Printed Wiring Boards (PWBs) in India. R'07 Recovery of Materials and Energy for Resource Efficiency. Retrieved February 2011, from http://www.worldresourcesforum.org/biblio/author/719?sort=type&order=d_esc
- [36] Roy, R. (2006). *Environmental Education: Recent Research Trends*. *University News*, 44(12), 147-154.
- [37] Srivastava, G. (2010). Education and Awareness for Management of Global Climate Change. *University News*, 48(31), 17-21.
- [38] Tauscher, S. (2001). *Quotations about Children*. Retrieved from <http://www.quotegarden.com/children.html>
- [39] *Technology in Education*, Office of Educational Technology. Retrieved March 3, 2011 from <http://www2.ed.gov/about/offices/list/os/technology/round/table.html>
- [40] The Environmental Impact Of Electronic Waste. Retrieved February 21, 2011 from <http://www.oppapers.com/essays/Environmental-Impact-Electronic-Waste/109709>
- [41] The role of technology in education. Retrieved march 8, 2011 from http://www.businessknowledgesource.com/technology/the_role_of_technology_in_education_026222.html
- [42] Wang ,Z., Zhang, B., Yin, J. and Zhang, X. (2010). Willingness and behavior towards e-waste recycling for residents in Beijing city, China. *ScienceDirect - Journal of Cleaner Production*. Retrieved February 2011, from <http://www.science-direct.com/science>
- [43] Williams, E. (2004). International activities on E-waste and guidelines for future work. Retrieved February 2011, from <http://www.itenvironment.org/publications/international%20ewaste.pdf>
- [44] Zhy, Y. (2007). Three empirical essays on environmental economics. (Ph.D. thesis, Utah State University). In *Dissertation Abstracts International*, vol.(69).no.3.

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