Entrepreneurship Opportunities in Green Computing

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ABSTRACT

Green Computing is the emerging computing technology. It is mainly used to save and protect the environment as well as optimize energy consumption and try to keep green environment. It also refers to environmentally sustainable computing. Saving energy or reduction of carbon footprints is main aspects of Green Computing. This research is mainly focusing on various opportunities which are available to entrepreneur in green computing by checking awareness and usage of green computing in management students of IMSCD&R, Ahmednagar. A questionnaire was prepared to check the level of awareness and usage of green computing. The questionnaires were given to IMSCD&R students.

Almost all students use computers for their study/ work. Only 17% of the students recycle their old computer and 59% resale their old computer. 65% of the students are aware about recycling paper but 14% only use recycled paper for printing. Less than 50% of all the students are aware about green computing it means most of the students are not aware about green computing. The research finding established that more awareness is required in order to make IT users to take greener approaches of using technology and associated gadgets. There are different opportunities for entrepreneur to start a new business as well as give rise to the employment as follows,

1. e-Waste recycle center.
2. e-Waste collection center.
3. Recycle paper manufacturing unit.
4. Recycle packaging manufacturing unit.
5. Efficiency Consulting: Offer business analysis of their data centers energy consumption and propose cost-saving changes.
6. Green Data Center Design and Construction.
7. IT Training: Enhance overall efficiency by teaching best practices to IT teams at large corporations.

Key words: Conservation, Energy, entrepreneur, e-Waste, Green Computing, IMSCD&R, Recycle, Recycle packaging unit, Recycle paper

Introduction

Entrepreneurship is the process of starting a new business venture which begins at a small scale & may grow into a successful small, medium, or large company. Entrepreneurs must be willing to take risks & possess the vision to embrace new ideas or business opportunities that transfer to the marketplace for a profit. To succeed entrepreneurs must exhibit or develop a variety of skills which include business know-how, innovation, creativity & good technology skills. Many new opportunities are available for entrepreneur in Green Computing. Starting a small business that gets cash for e-waste removal, disposal and reuse is a good way of becoming an entrepreneur on a shoestring budget. For example, major corporations like Wal-Mart & Clorox are leading the way with sustainability initiatives and the development of successful green products that are less toxic and reduce impacts on human and environmental health. Google and Intel launched the Climate Savers Computing Initiative, which brings industry and government leaders together with consumers and conservation groups to help drive efficient computing practices and innovations in hardware design.

Computers and other IT products (e.g., data switches, routers and servers) are essential to many businesses operating in the world today. Many medium and large businesses dedicate significant space to this equipment, creating data centers in centralized, secure, temperature-controlled conditions. Most companies are looking to save money by reducing the costs associated with their data center operations, which have significant power requirements, without sacrificing quality or security. This creates a number of green business opportunities for IT specialists. It is also an excellent opportunity for those looking to start a new career in the IT field. IT careers also provide good wages.

Now a day's the biggest and major problem faced by the whole world is Global Warming. In the day to day life from students to businessmen all are using computer for their daily works. Due to internet, usage of IT applications is increasing tremendously in daily life. IT has become an integral part of our lives. Due to the large amount of usage of IT applications, the impact has made significant change on the environment. Use of computer increases the level of carbon dioxide (CO_2) in the atmosphere. CO_2 is the green house gas. An increase in the carbon dioxide (CO_2) content in the atmosphere would cause more heat to be retained by the atmosphere and leads to global warming.

What is Global Warming?

Global warming is the rise in the average temperature of Earth's atmosphere and oceans. It happens when carbon dioxide, water vapour, nitrous oxide etc. trap heat and light from the sun in the earth's atmosphere, which increases the temperature.

It affects environment as well as health of human, animals and plants. Similarly at the time of manufacturing computers, many toxic elements are commonly used like Lead, Cadmium, Mercury, Nickel, Zinc, Phosphorus powder, Chromium, Barium and Black Carbon etc .We know that for example ,

1. Cathode-Ray Tubes (CRTs) contain lead,

2. Liquid Crystal Display (LCD) monitors contain mercury,

3. Batteries and Semiconductors contain cadmium.

Green expert says that each computer contain 4 to 8 pounds of lead alone. List of hazardous e-Waste are CRT monitor glass, Television, Power transistor, Part of electronic equipment, Fluorescent tubes, Power Capacitors, Transformers, wiring insulators, Parts of computers like CPUs, Computer Monitors etc. What will happen with defunct computers and electronic devices?

What is e-Waste?

e-Waste is called as electronic waste. e-Waste is a waste consisting of any broken or discarded electronic devices. Only 15-20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators. Landfill sites are patches of land, where e-Waste materials are dumped for disposal.

An improper handling of discarded electronic devices such as dismantling (taking apart) without any proper controls or simply tossing the materials in the trash which exposes hazardous chemical compounds. These compounds are known for their negative effects on human body, animals, plants and environment also. This will also affect the coming generations. The fact is that very small amount of discarded computers are being recycled. To counter this growing pollution threat all over the world due to the growing use of electronic devices and computers.

There is a need to look for to find the solution on problem as well as need to look for an eco-friendly computers and electronic devices.

We see that the environmental pollution is avoided every time. All the current IT applications and products have impacts on human life as well as environment also. Following table 1 shows Local and Global impact of IT on human health and environment.

Table 1: Local and Global impact of IT on human health and environment

Local Effects	Global Effects
e-Waste	Global Warming
Health Disease	Climate Change
Air Pollution	Level of Ocean raising
Water Pollution	Average Temperature Increase
Land Pollution	Ice Cap to Shrink

Some of the findings by the United Nations Environment Program as follows: -

1. Global e-waste generation is growing annually by 40 million tones.

2. Next 10 years, India's e-waste (cell phones), is likely to grow by 18 times.

Some of the findings by Waste Pollution Control Board in India follow:

1. In India e-waste market reach up to 110 billion.

2. In India 100 tones e-Waste collected from city every year (behind 1 lakhs population).

 e-Waste consists of electronic machinery that is either broken, outdated or near the end of its predefined usefulness. Under this umbrella there are household electronics, such as televisions and car stereos, as well as office and industrial machinery. It is interesting to note that consumers are somewhat uncertain what to do with their electronic waste.

Recycle estimates that about 75 percent of unused electronics are now in storage, simply because consumers do not know what to do with them. This is a potential money-maker for a savvy entrepreneur.

What is Green Computing?

Green Computing is the term used to denote efficient use of resources. If we use all these resources efficiently it will reduce pollution and all environment problems. Green computing refers to environmentally sustainable computing. Key issues are energy efficiency in computing and promoting environment friendly computer technologies. Green computing is the study and practice of using computing resources efficiently. It reduces the use of hazardous materials, maximizes energy efficiency during the product's lifetime, and promotes recyclability of defunct products and e-Waste.

Green computing is required to protect environment and save energy along with operational expenses in today's competitive world. That's why in 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labeling program which is designed to promote and recognize energy efficiency in monitors, climate control equipment, and other technologies. ENERGY STAR is a joint program of the U.S. Environmental Protection

Agency and the U.S. Department of Energy helping us to save money and protect the environment through energy efficient products and practices [3].

If everyone applies green computing concept at the time of daily work then it will help to reduce all above mentioned environment problems. Green computing has a significant impact in green environment because modern societies depend on IT for work and operations. Production and disposal of computer wastes would directly affect on green environment. This problem has been realized and measures are being taken which help in minimizing the power usage of computer. Green Computing is the study which lays stress on the operation of computer and related peripherals in order to minimize the carbon footprint. Green computing strategies can help us to build a safe place for us to live [9].

Always try to implement the mantra of 3'R "**Reduce, Reuse, Recycle**". Reduce, reuse and recycle is a good option to minimize the impact of information technology on the environment. Recycling reduces the need for landfill space. It helps to conserves energy, save natural resources and help to protect our environment.

Every person using IT should be aware about green technologies and they should start to demand more environment friendly products.

Computer and Monitors

1. Desktop computer consume more power than Laptop
2. 90% of PCs have energy saving option disabled

Printer

1. Waste more energy than PCs
2. Most of the printers are not used in duplex printing mode
3. Not aware about recycled paper and recycle center [4]

This paper is concerned with conducting the research to check the level of awareness and usage of green computing amongst IMSCD&R students and suggest various opportunities which are available to entrepreneur in green computing. The questionnaire as instrument is used to measure the awareness level of computer users.

Background

Green colour of nature is identity of purity and serenity of nature. Nature has given life to man but man has damaged the nature. That's why now earth is dying because these damages are irreversible. In Ahmednagar city we face the problems like Load shedding, less rainfall, climate change, temperature increased, etc. Season cycle has been changed.

Green computing is an active research area which studies an efficient use of computing resources. It will help the next generation computer users to think "Green." Hence we

decided to see awareness and usage of Green Computing in students of Ahmednagar city. In Ahmednagar city there are many colleges who run computer Bachelor and Master Degree courses. These students use computer and various devices for their daily work. So for the study we restricted the study to area as IMSCD&R. Institute of Management Studies, Career Development & Research (IMSCD&R) is the leading institute which provides management education in Ahmednagar under University of Pune. IMSCD&R runs various management courses like MBA, MCA, MCM, MPM, MBS and PGDBM. In 2012-2013 academic year total 638 students are taking management education in IMSCD&R. These students use computer/ laptop and various electronic devices for their study/ work. Students spend on an average 4 hrs a day on computer.

Literature Review

Intended Belief and Actual Behavior in green computing in Hong Kong, *Wing S. Chow Yang Chen*

This paper has examined IT users' perception of their intended belief and actual green computing behavior. By applying the Theory of Reasoned Action and Theory of Planned Behavior, we verify that attitude subjective norm, and perceived behavioral control over green computing all have a direct effect on intention. This paper determines the most critical factors that contribute to the belief and behavior of green computing. These findings enable green computing researchers and practitioners to firstly concentrate the most important event so that higher priority of understand IT users' belief and behavior about green computing can be enhanced.

International Journal of Combinatorial Optimization Problems and Informatics, Vol. 2, No. 3, Sep-Dec 2011, pp. 39-51, ISSN: 2007-1558. Appasami.G and Suresh Joseph.K

Optimization of Operating Systems towards Green Computing

It is mainly used to protect environment, optimize energy consumption and keeps green environment. Green computing also refers to environmentally sustainable computing. Operating System (OS) Optimization is very important for Green computing, because it is bridge for both hardware components and Application Software's. The important Steps for green computing user and energy efficient usage are also discussed in this paper. If public and private sectors takes more interest in green computing, definitely we can save our environment and maintain green environment. Now a day's advanced operating system developers are very much interested towards green computing to attract customer as well as to protect environment by saving power energy.

Green Computing: Students, Campus Computing and the Environment- A Case for Botswana

This paper was motivated by the rising cost of energy in Botswana, depletion of natural resources, increasing concern for the environment by the Botho College population. The main aim of this paper was to measure awareness levels of students and staff at Botho College with regards to Green Computing. The research established that the awareness levels are low hence most users are oblivious to energy saving techniques. The research also established that they are no explicit green computing and sustainability policies at the institution.

Research methodology

This subject of creating entrepreneurs using green computing was taken into consideration because everyone use computer and its peripherals, if it is not disposed properly after defunct it can have many side effects. So the aim of study is to see whether management students are aware about the green computing, how do they dispose the e-waste and can it be used to create new employment opportunities.

Presently we face the problems like Load shedding, less rainfall, climate change, temperature increased etc. Green computing is an active research area which studies an efficient use of computing resources. It will help the next generation computer users to think "Green." It helps to reduce the problems some extent. Hence we decided to see awareness and usage of Green Computing in students of Ahmednagar city. These students use computer and various devices for their daily work. So for the study we restricted the study of area as IMSCD&R. Data was collected using questionnaire. A questionnaire was designed and issued to 105 students of IMSCD&R according to proportion in population.

Objective:

Primary Objective:

1] To find and suggest various opportunities which are available to entrepreneur in green computing.

Secondary Objective:

1] To check the awareness of green computing among management students.

2] To check the usage of green computing among management students.

 Hypothesis:

1] To test awareness about green computing depends on student's gender.

Ho: Students Gender & awareness of green computing are independent

H1: Students Gender & awareness of green computing are dependent

2] To test whether majority of students are aware about green computing.

P stands for the proportion of students who are aware about the green computing.

H0: P = 0.5

H1: P < 0.5

Types of data

*Primary data***:** Primary data was collected from 105 students of IMSCD&R according to proportion in population using questionnaire.

*Secondary data***:** Website, Internet, Research Magazines, Magazines.

Source of data

IMSCD&R, Ahmednagar.

Research instrument

The questionnaire designed contains closed end questions. The aim of questionnaire was to measure the awareness level and usage of green computing in students for their daily work. The questionnaire was divided in two parts. First part of questionnaire contains questions related to awareness and usage of computer system and green computing concept. Second part of questionnaire contains questions related of awareness and usage of printer and printing paper. All questions of questionnaire are multiple choice questions with two or five options. The questionnaire included questions on Green Computing, Computer, Monitor, Printer, Printing Paper, e-Waste , power management etc.

Scope of Study

The scope of study is restricted to IMSCD&R, Ahmednagar.

Sample Size: 105

Data Collection Method

To study this population, it was divided in 6 strata MCA, MBA, MCM, MBS, MPM and PGDBM. From each strata sample was collected randomly according to proportion in population. Thus stratified random sampling method is used for data collection.

Statistical tools for complete analysis: For statistical testing researcher used Chi square test because the variables under study are attribute, Z test for testing proportion of students about their awareness. Descriptive statistics such as frequency, relative frequency, mean, mode, proportions and percentage bar graph & pie chart are used whenever required.

Limitations: The scope of Green Computing is very large, present paper concentrates only on awareness and usage of green computing.

Data Analysis and Findings

Note:

1] The respondents have not marked all the options of questionnaire so the total may not match.

2] Sometimes students may select more than one checkbox.

Testing of hypothesis

I] To test awareness about green computing depends on gender of students:

Ho: Students gender & awareness of green computing are independent

H1: Students gender & awareness of green computing are dependent

Table 2: Gender wise awareness about Green computing

Gender	Aware about green computing	Not aware about green computing
Male	22	33
Female	15	25

Table 3: Conclusion

Cal χ^2	Tab χ^2 for degree 1	Conclusion
0.06	3.841 at 5% level of significance	Accept Ho

Awareness about green computing does not depend on gender of students.

II] To test whether a majority of students are aware about green computing:

P stands for the proportion of students who are aware about green computing.

H0 : P = 0.5

H1: P < 0.5

P=0.389

Cal Z= $p\_P0/\{P0Q0/n\}^{1/2}$

0.389-0.5/0.05129=-2.164

Cal Z=-2.164

Table 4: Test about majority of student's awareness about green computing

calz	Tab z	Conclusion
-2.164	-1.64 at 5% level of significance	Reject Ho

Table 4

Less than 50% of all the students are aware about green computing it means most of the students are not aware about green computing.
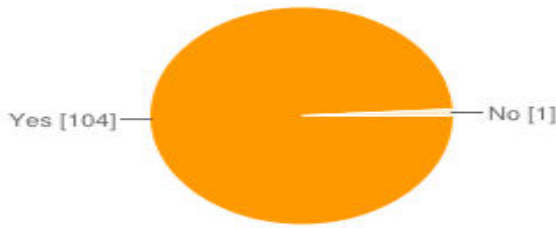
Q. Do you use Computer for your study/work?

Chart 1: Use of Computer for your study/work

Table 5: Use of Computer for your study/work

Yes	104	99%
No	1	1%

99% of the students use computer for their study/ work.

Q. What type of Computer you have?
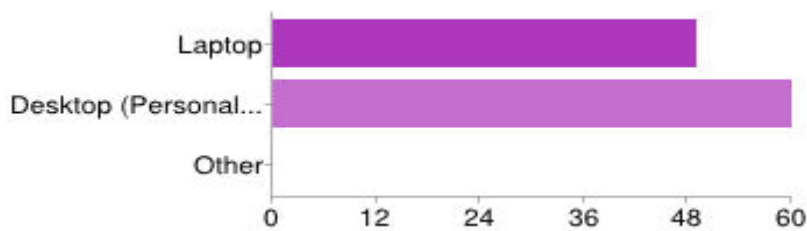
Chart 2: Type of Computer

Table 6: Type of Computer

Laptop	49	45%
Desktop (Personal Computer)	60	55%
Other	0	0%

55% of the students use desktop computer and 45% of the students use laptop.

Q. Do you switch OFF energy-intensive peripherals such as printers, speakers, scanners etc when they are not in use?
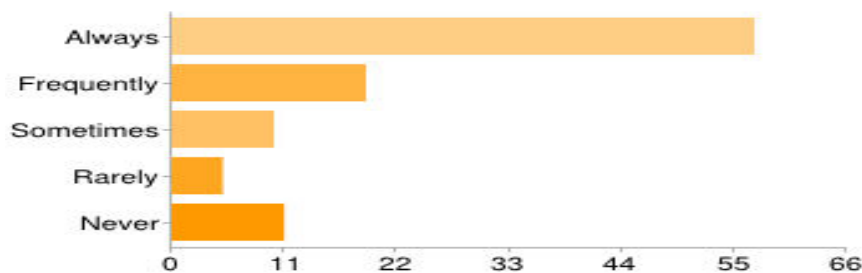
Chart 3: Switch OFF energy-intensive peripherals

Table 7: Switch OFF energy-intensive peripherals

Always	57	56%
Frequently	19	19%
Sometimes	10	10%
Rarely	5	5%
Never	11	10%

56% of the students always switch OFF energy-intensive peripherals, 19% of the students frequently switch OFF energy-intensive peripherals, 10% of the students sometimes switch OFF energy-intensive peripherals, 5% of the students rarely switch OFF energy-intensive peripherals and 10% of the students never switch OFF energy-intensive peripherals

Q. Are you aware automatic sleep mode setting?
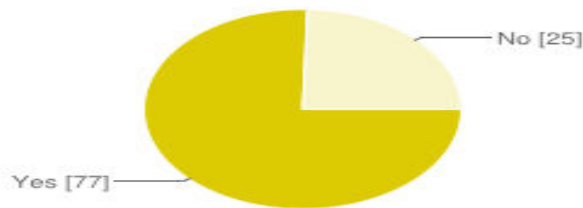
Chart 4: Awareness of automatic sleep mode setting

Table 8: Awareness of automatic sleep mode setting

Yes	77	75%
No	25	25%

75% of the students are aware automatic sleep mode setting and 25% of the students are not aware automatic sleep mode setting.

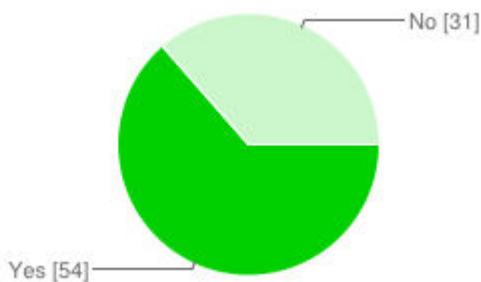*If yes, is automatic Sleep Mode setting for your Computer enabled?*

Chart 5: Automatic Sleep Mode setting enabled

Table 9: Automatic Sleep Mode setting enabled

Yes	54	64%
No	31	36%

Though 75% of the students are aware automatic sleep mode setting but only 64% students enabled automatic Sleep Mode of their computer.

Q. Do you check the number of stars on the energy label when you buy a new appliance?
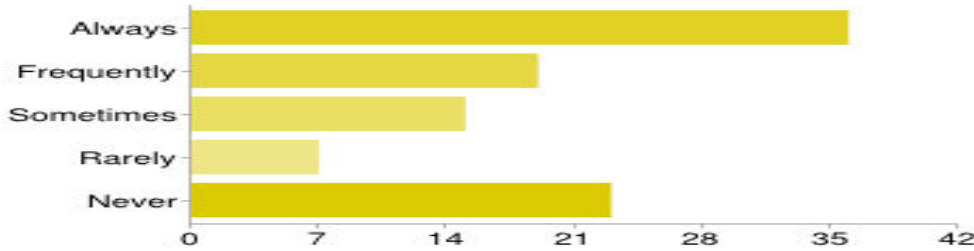

Chart 6: Check for the number of stars on the energy label

Table 10: Check for the number of stars on the energy label

Always	36	36%
Frequently	19	19%
Sometimes	15	15%
Rarely	7	7%
Never	23	23%

36% of the students always check the number of stars on the energy label, 19% of the students Frequently check the number of stars on the energy label, 15% of the students sometimes check the number of stars on the energy label, 7% of the students rarely check the number of stars on the energy label and 23% of the students never check the number of stars on the energy label.

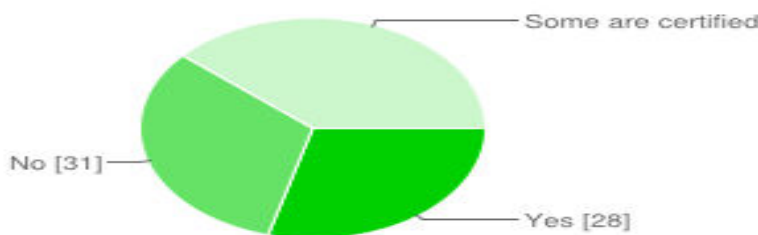*Q. Are All equipments of your computer Energy Star Certified?*

Chart 7: Check of equipments of computer Energy Star Certified

Table 11: Check of equipments of computer Energy Star Certified

Yes	28	29%
No	31	32%
Some are certified by Energy Star	37	39%

29% of the students have all equipments of their computer Energy Star Certified. 32% of the students have no equipments of their computer Energy Star Certified. 39% of the students have some equipments of their computer Energy Star Certified. From all the above question we can conclude that students are not aware about the power consumption use, star energy program. So this gives an opportunity for an entrepreneur to start at,

1. Efficiency Consulting**:** Offer business analysis of their data centers energy consumption and propose cost-saving changes.

2. IT Training**:** Enhance overall efficiency by teaching best practices to IT teams at large corporations.
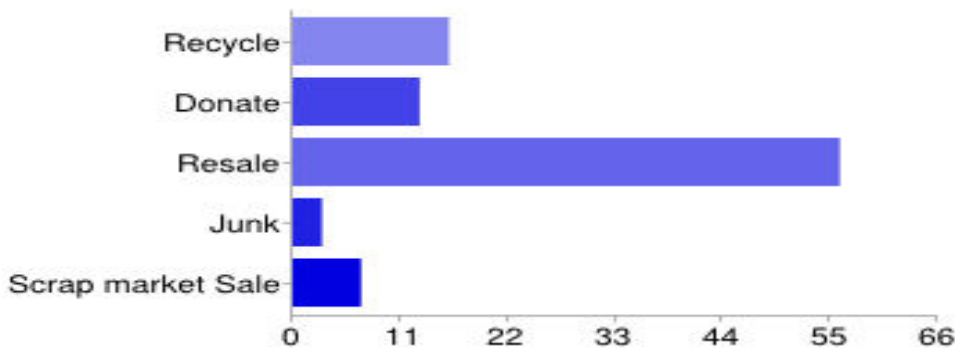
Q. What do you do with your old computer?

Chart 8: Usage of Old Computer

Table 12: Usage of Old Computer

Recycle	16	17%
Donate	13	14%
Resale	56	59%
Junk	3	3%
Scrap market Sale	7	7%

We can conclude that many students are not aware about e-waste, recycle center. Only 17% of the students recycle their old computer, 14 % of the students donate their old computer,

59% of the student's resale their old computer, 3% of the students junk their old computer and 7% of the students give their old computer to scrap market. So this gives an opportunity for an entrepreneur to start,e- Waste Collection Center and e-Waste Recycle Center .
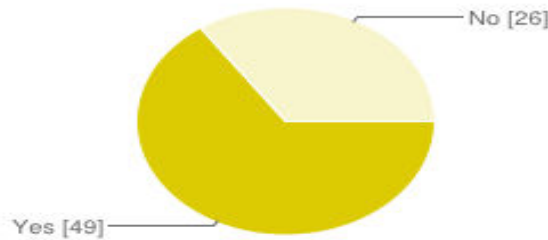
Q. Are you aware about recycle paper?

Chart 9: Awareness about recycle paper

Table 13: Awareness about recycle paper

Yes	49	65%
No	26	35%

65% of the students are aware about recycle paper and 35% of the students are not aware about recycle paper.
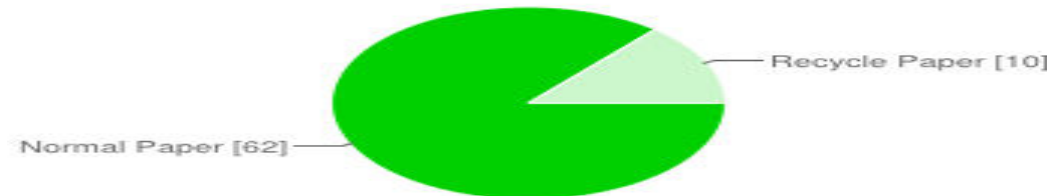
Q. What paper do you use for printing?

 Chart 10: Use of Paper for printing

Table 14: Use of Paper for printing

Normal Paper	62	86%
Recycle Paper	10	14%

86% of the students use normal paper for printing. 14% of the students use recycled paper for printing.   We can conclude that awareness about recycle paper is very less. Almost all students use normal paper for printing. So this gives an opportunity for an entrepreneur to start

Q. Do you repair broken parts of electronic devices as often as possible instead of replacing the item?

The weighted average is 3.85 so we can say that on an average student frequently repair broken parts of electronic devices as often as possible instead of replacing the item.

Q. When buying a product, do you consider the recyclable packaging?

The weighted average is 3.34 so we can say that on an average student sometimes consider the recyclable packaging when they buy a product. So this gives an opportunity for an entrepreneur to start

Conclusion

1] Most of the students use computer for their study/work. In all management students most of them are not aware about green computing.

3] 59% of the student's resale their old computer and 17% recycle their old computer. 65% of the students are aware about recycle about recycle paper but only 14% of the students use recycle paper for printing.

Recommendation

More awareness about green computing is required to increase among students. The students are aware but does not practically implement.

There are different opportunities for entrepreneur to start new business as well as give rise to the employment as follows,

1. e-Waste recycle center.
2. e-Waste collection center.
3. Recycle paper manufacturing unit.
4. Recycle packaging unit.
5. Efficiency Consulting: Offer businesses analysis of their data centers' energy consumption and propose cost-saving changes.
6. Green Data Center Design and Construction.
7. IT Training: Enhance overall efficiency by teaching best practices to IT teams at large corporations.

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