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AN EVALUATION OF THE LEVEL OF AWARENESS AND KNOWLEDGE OF STUDENTS OF UNIVERSITY OF CAPE COAST ON E-WASTE

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ABSTRACT

Electronic waste (e-waste) has become the main contributor of toxic chemicals such as lead (Pb) to landfills in the U.S. (EPA 2000). According to UNEP and UNU report in 2008, e-waste is a major problem in countries such as China and India, where there are mountains of e-waste to be dealt with. This important subject is not regularly discussed in both the print and electronic media in Ghana, as it ought to. Therefore this paper seeks to find out the level of e-waste awareness and knowledge of students of the University of Cape Coast, Ghana. The main finding is that majority of the respondents have not heard of e-waste and for that matter they are unaware of its effect on their health and the environment. Annual "e-waste awareness week" and a liberal online course on e-waste were recommended as means to reverse this unfortunately situation, which will go a long way to minimise its impact on the Ghanaian populace.

Keywords: Attitude, awareness, perception, e-waste, e-waste management, recycle, reuse, disposal

1 INTRODUCTION

Waste in most cities, municipals, and metropolis in all nations is a major problem and headache to authorities, whose improper management has consequences that are countless. The situation is not difference in Ghana, where waste are dumped everywhere such as gutters, on the street, etc.. Managing this waste is expensive and difficult while improper management of it will also affect both the present and future generation. Consumer electronic devices (CEDs) are everywhere. In fact, most households in the developed nations have many of these while increasing number of households in the developing nations have these either bought as brand-new or second-hand. How shall we live in the twenty-first century without theses gadgets? That is it may be difficult to imagine houses in most places in Ghana without any or most of these appliances-TVs, refrigerators, sound systems, microwave ovens, mobile phones, personal computers, printers, battery-powered toys and others. In fact houses in urban centres, cities, municipalities and metropolitans find CEDs very useful and depend on it for their survival. The usefulness of CEDs is seen all areas of human endeavours such as education, information and communication technology (ICT), health, entertainment, mobility, food supply, security, and environmental protection.

Schmidt (as cited in Saphores; Nixon; Ogunseitan; & Shapiro, 2006) said, “the growing accumulation of used and obsolete CEDs is the largest toxic waste problem of the 21st century”. This is because CEDs contain toxic materials that would be discussed later in this paper. Waste from CEDs is a problem, which is not abating but rather becoming more complex as the day goes by due to three trends. The first trend is that more consumers around the world are using CEDs in an increasing number; the second trend is that the average life span of the typical CED has dropped significantly in the past several years and lastly due to continuous technological advancement, many electronic products become obsolete within a very short period of time. The result of these trends is creating a large surplus of unwanted electronic products, which are discarded as waste.

Therefore urgent action must be taken by all and sundry if we want to address the e-waste problem. All over the world, universities occupy unique position of bringing about positive change to the society especially their catchment areas. That is why if the e-waste problems of nations are to be kept in check, then the universities have a role to play. Students of the universities such the University of Cape Coast are microcosms of Ghana since they come from every tribe, region, district or town in Ghana. Hence their level of knowledge of e-waste is an indication of that of the Ghanaian society. It is known that the first step of controlling the e-waste menace is to create awareness thus this study.

2 THE PURPOSE OF THE STUDY

The main purpose of the study is to find out the level of awareness and knowledge that students of the University of Cape Coast hold on e-waste. Specifically, we shall find out the following:

1. The extent of knowledge of students on e-waste
2. Whether gender differences exist among students on the awareness and knowledge of e-waste
3. Whether there are statistical differences in the awareness and knowledge of e-waste among students pursuing environmental-related degrees and those pursuing non-Environmental-related degrees

The import of this study is that students who are the future leaders of the nation should be aware of dangers posed by e-waste and adopt practices that would minimize e-waste in Ghana. This is so since there are alarming and increasing reports on the e-waste situation in Ghana (UNEP & UNU, 2009). Furthermore, Ghana is considered to be one of the major e-waste destinations in Africa.

3 LITERATURE REVIEW

The waste from consumer electronic devices that are either loosely discarded or surplus or obsolete or broken is known as electronic waste or e-waste, e-scrap. Electronic waste is only a sub-set of WEEE (Waste Electrical & Electronic Equipment). According to the Organization for Economic Cooperation & Development (OECD), any appliance using an electric power supply that has reached its end-of-life would come under WEEE. Thus you are right if you say that e-waste is the name for electronic products nearing the end of their "useful life." E-waste can come from CEDs such as desk and laptop computers, printers, mobile phones, pagers, digital photo and music devices, refrigerators, toys and televisions, VCRs, stereos, copiers, and fax machines. It is worthwhile to note that many of the waste from the above-mentioned products can be reused, refurbished, or recycled but in most cases they are discarded instead.

Modern electronics can contain up to 60 different elements such as metals, plastics and other substances; many of theses elements are valuable, some are hazardous or both (UNEP &UNU, 2009;p. 6). Iron, aluminium, plastics and glass account for over 80% of the weight of most electronic appliances. The five most widely used metals are iron, aluminium, copper, zinc and lead (EMPA, 2009). The most complex mix of substances is usually present in the printed wiring boards (PWBs) or circuit board, which contain both valuable and toxic metals (FourR E-waste project, 2013)). Though

the valuable and toxic materials of electronic appliances form a smaller percentage, these are still of high importance. Different electronic appliances may have similar material composition but with varying percentages. It is the valuable materials of electronic appliances such as gold, silver, copper, platinum etc. that attract people to recycle e-waste but as they do so, the hazardous materials such as lead, arsenic, lithium, mercury, nickel, etc are released, which pose serious health risks and environment dangers if not properly handled.

Problems of e-waste

Unfortunately, electronic discard is one of the fastest growing segments of nations' waste stream. Electronic waste now makes up 5% of all municipal solid waste worldwide, nearly the same amount as all plastic packaging, but it is much more hazardous (Greenpeace.,2010). When marking the 20th anniversary of the Basel Convention,a global treaty signed by 172 countries which regulates international movements of hazardous and toxic wastes in 2009, Katharina Kummer Peiry, its Executive Secretary told journalists in Geneva that:

> E-waste did not even exist as a waste stream in 1989 and now it's one of the largest and growing exponentially," "I'd say it's something in the region of six billion tons, it's a rough estimate." The United Nations estimates that up to 50 million tons of electronic goods are discarded globally each year. In Europe e-waste is increasing at three to five per cent a year – almost three times faster than the total waste stream. Developing countries are also expected to triple their e-waste production over the next five years (Mathias, 2009).

Water drank or food ate from such land is linked to cancer and developmental disorders. According to Veuthey (2010), "in US, the Natural Resources Defense Council has stated that electronic waste accounts for 70 percent of the heavy metals found in municipal landfills".

Electronic products from developed nations that are obsolete, used, not needed or at the end of life are donated or sold to developing nations. According Puckett(2009), "50 to 80% of e-waste collected for recycling in the United States is exported to developing nations- with China, India, Pakistan, Philippines, and Vietnam as primary destinations in Asia whilst Ghana and Nigeria are primary destinations in Africa- where it may be dumped or burned. E-waste is expensive to re-cycle in the developed nations thus its being dumped in developing nations. It cost of a fraction of the amount to pay for recycling e-waste in most developed nations than to ship them to Ghana. On the average 75% of computer scrap that arrive from the US in such port cities as Lagos, Nigeria are unusable junk, which ends up being burned in dumps, sending fume of very dangerous pollutants into the local environment (Schmidt, 2006).

E-waste problem in Ghana

According to Africa Business Page, "Ghana is making rapid strides as a new market for consumer goods in West Africa. Demand for CEDs- computers, mobile phones, consumer electronics and home appliances- have been on the increase in Ghana at an average of 20 per cent since 2002". Most of the CEDs in Ghana were manufactured in China and Dubai, hence affordability with shorter life span. The availability and affordability of electronic goods in Ghana has increased with a corresponding increase in ownership of electronic products. A look at the rate at which Ghanaians are subscribing to mobile phone indicates that within a shorter period, we shall have millions of mobile phone to be discarded. The question is where will these mobile phones to be kept? Most of them will become e-waste. The same fate awaits all other electronic appliances. Hence sometime must be done else sooner than later, we shall have mountain of e-waste that cannot be moved or removed all over the place.

Everyone must be made aware of the menace of e-waste. All things being equal, awareness brings about change attitude and behaviour. Public awareness of e-waste is very low even in developed

nations. In UK, 72% of firms in the e-waste industry say they expect poor public awareness to remain one of their biggest challenges for the year ahead, according to a survey by the European Recycling Platform (ERP). Low public awareness of the Waste Electrical and Electronic Equipment (WEEE) Directive has been an issue over the past year (Young, 2010). Again, Hubpages(2011) says the average American has no idea about e-waste and the problems it is causing to the environment.

In Sodom and Gomorrah a suburb of Accra, Ghana, e-waste are disassembled and burned in the open air by men, women and children-who are not aware of the poisonous metals accompanying the valuable metals they are extracting. These people expose themselves to large amounts of heavy metals and carcinogenic fumes. Soil and river analysis conducted in 2008 by a Greenpeace scientist found extremely high levels of lead, cadmium, arsenic, dioxins, furans and polychlorinated biphenyls (Parson, 2009; Mathias, 2009). Again Hahm (2009) said, "As one edges closer to the world's fastest-growing e-waste dumping site at Agbogbloshie, it is the smell that hits hardest. A blend of burning rubber and chemicals clogs the nostrils, stings the eyes and hangs at the back of the throat."

4 METHODS AND DATA SOURCES

This study was conducted through a survey questionnaire, which was randomly distributed among students of the University of Cape Coast in the 2010/2011 academic year with a student population of 18,600. Three experts from Population and Health, Industrial Chemistry and Environmental Science departments of the University ensured the content validity of the questionnaire. Each questionnaire is divided into background information and awareness/knowledge. In all 1,200 questionnaires were distributed out of which 1,154 were returned indicating a response rate of 96.2% was deemed adequate for the study. The data of the survey were analysed using the SPSS 20.0 forming the primary data source used to create the tables from this section onwards.

Background of respondents

With regards to gender of the respondents, the male respondents were 710(61.5%) whiles 444(38.5%) were female. Table 1 shows the faculty/school where the respondents come from. The faculty of Education has the largest number of respondents, which is 248(21.5%). 30(2.6%) respondents did not indicate their faculty/school.

Table 1: Faculties/Schools of the respondents

Faculties/Schools	Frequencies	Percentages
Agriculture	96	8.32
Arts	170	14.7
Biological Sciences	98	8.49
Business	94	8.15
Education	248	21.5
Medical Sciences	76	6.59
Physical Sciences	186	16.1
Social Sciences	156	13.5
No response	30	2.6
Total	1154	100

Programme	Frequencies	Percentages
Yes	474	41.1
No	680	58.9
Total	1154	100

Table 2: Programme that deals with the environment pursued by respondents

474(41.1%) of the respondents indicated that the programmes they are pursuing in UCC have something to do with the environment. On the other hand, 680(58.9%) said their programmes do not deal with environmental issues.

5 FINDINGS AND DISCUSSION

Waste in general

Table 3: Respondents' most important environmental problem

Problems	Frequencies	Percentages
Air pollution	296	25.6
Inadequate water supply	264	22.9
Inadequate solid waste collection	220	19.1
Unsafe drinking water	160	13.9
e-waste	72	6.2
Noise	42	3.6
Traffic congestion	14	1.2
No response	86	7.5
Total	1154	100.0

It is a good thing that the respondents are concerned of the environment, which is indicated by only 86(7.5%) of them not responding to any of the issues raised as shown in Table 3. Though E-waste now makes up 5% of all municipal solid waste worldwide (Globalsmtindia, 2009), only 72(6.2%) of the respondents considered e-waste as their most important environmental problem. Jim Puckett, Coordinator at the Seattle-based non-governmental organization Basel Action Network, said, "e-waste is one of the biggest waste streams of concern, alongside obsolete ships" (Mathias, 2009).

Table 4: Respondents' assessment of the garbage situation in their neighbourhood

Garbage problem	Frequencies	Percentages
Extremely serious	330	28.6
Quite serious	468	40.6
Not serious	238	20.6
Not at all serious	72	6.2
Don't know	18	1.6
No response	28	2.4
Total	1154	100.0

Table 5: Respondents' prior knowledge of e-waste

Response	Frequencies	Percentages
Yes	528	45.8
No	626	54.2
Total	1154	100.0

From table 4, majority of the respondents, that is 798(69.2%) think that the garbage situation in Ghana is a serious one. E-waste component in the waste stream is increasing all over the world. Therefore the garbage situation in all nations if not checked, would be compounded in the nearest future with e-waste.

Extent of knowledge of students on e-waste

From the table 5, less than half of the respondents representing 45.8% had heard of e-waste. This implies that a greater number of the students have not heard of e-waste. This confirms that the assertion that e-waste is not a common issue to the average person ((Young, 2010; Hubpages, 2011).

Table 6: Year respondents first heard of e-waste

Year	Frequencies	Percentages
1995	4	0.8
1996	2	0.4
1997	4	0.8
1998	8	1.6
1999	8	1.6
2000	30	6.1
2001	4	0.8
2002	16	3.3
2003	12	2.4
2004	22	4.5
2005	12	2.4
2006	16	3.3
2007	42	8.6
2008	74	15.1
2009	114	23.3
2010	118	24.1
2011	4	0.8
Total	490	100.0

Table 7: Where respondents first heard of e-waste

Source	Frequencies	Percentages
Friend	66	13.1
News paper	40	8.0
Ghanaweb	58	11.6
TV	90	17.9
Radio	102	20.3
Primary school	2	0.4
JSS	2	0.4
SHS	42	8.4
Lecturer	22	4.4
UCC	52	10.4
Relative	8	1.6
Seminar	18	3.6
Total	502	100.0

Table 6 reveals that some of the respondents heard of e-waste as far back as in 1995. However, the number who had heard about it is relatively small. Majority of the respondents 348(71.1%) indicated that they heard of e-waste in the period 2007-2010. This period coincide with the period Ghanaian media and government started talking about e-waste. Dogbevi (2008a) raised the red flag on e-waste with the very first article to be written on the subject in the Ghanaian media in the Daily Graphic issue of June 5, 2007. At the United Nations Climate Change Talks in the Accra, in August 21, 2008, the then Local Government and Environment Minister, Kwadwo Adjei Darko, said old computers are being imported into Ghana and these importations have resulted in hazardous e-waste in the country (Dogbevi, 2008b). Again in April 14, 2009, Ghana's Communications Minister- Haruna Iddrisu said, "we have taken a serious view of the e-waste situation and we are considering the passing of anti-dumping legislation, particularly of used computers" (Dogbevi, 2009). Lastly, Mrs. Sherry Ayittey, Ghana's Minister for Environment, Science and Technology, on 28 March 2009 urged the European Union (EU) to regulate the flow of e-waste into the country (GNA, 2009).

From table 7, we see that 290(57.8%) of the respondent heard of e-waste from the media. This shows the role both the electronic and print media play in the dissemination of e-waste. Again it is worth noticing that, 120(23.9%) of the respondents heard of e-waste at school indicating the complementary role the education system can also play. The flipside of this is that not much of e-waste is heard or taught through our educational system.

In table 8, the respondents were made to identify which of the CEDs listed above will become e-waste at the end of life or when it is no more useful. Out of the 24 CEDs listed, for 14 CEDs (electronic toys, hi-fi system, microwave oven, play station, printer, LCD projector, TV set, Vacuum cleaner, VCR, video camera, video game player, video recorder, walkman, and washing machine), more than 50% of the respondents could not identify whether or not they can become e-waste. Again, the number of respondents who said computer, refrigerator, deep freezer, TV sets and microwave oven can become

e-waste were more than those who said they cannot. Nevertheless, these numbers were less than 50% except computer where the number was 66%. Hence the only CED that the respondent said can become e-waste is computer. Like any other CEDs, all the CEDs listed in table 8 will become e-waste one day. The identification of computer as e-waste may be due to what the Ghana's Minister, Mr. Haruna Iddrisu said, "we have taken a serious view of the situation and we are considering the passing of anti-dumping legislation, particularly of used computers" (Dogbevi, 2009). When a comparison of tables 5 and 8 is made, one could deduce that most of the respondents who said they have heard of e-waste could not identify e-waste item. This is because 528(45.8%) respondents said they have heard of e-waste in table 5 whereas in table 8, on the average 194 (17%) could identify e-waste item.

Table 8: Identification of items whose end-of-life will be e-waste

Consumer electronic devices (CEDs)	Yes		No		No response		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Air Conditioner	104	9	616	53	434	38	1154	100
Cellular phone	144	13	674	58	336	29	1154	100
Computer	756	66	106	9	292	25	1154	100
DVD player	114	10	686	59	354	31	1154	100
Electric Fan	150	13	694	60	310	27	1154	100
Electric Iron	146	13	700	61	308	27	1154	100
Electronic toys	100	9	442	38	612	53	1154	100
Refrigerator	516	45	98	9	540	47	1154	100
Hi-Fi system	80	7	370	32	704	61	1154	100
Microwave Oven	492	43	68	6	594	51	1154	100
Play station	126	11	362	31	666	58	1154	100
Printer	92	8	436	38	626	54	1154	100
LCD Projector	86	8	390	34	678	59	1154	100
Radio set	112	10	502	44	540	47	1154	100
Deep freezer	518	45	84	7	552	48	1154	100
Telephone	104	9	468	41	582	50	1154	100
TV set	446	39	56	5	652	56	1154	100
Vacuum cleaner	80	7	296	26	778	67	1154	100
VCR	70	6	324	28	760	66	1154	100
Video camera	100	9	322	28	732	63	1154	100
Video game player	86	8	316	27	752	65	1154	100
Video recorder	80	7	306	27	768	67	1154	100
Walkman	98	9	312	27	744	64	1154	100
Washing machine	56	5	340	30	758	66	1154	100
Average	194.0	17.0	373.7	32.4	586.3	50.8		

Table 9: Do e-waste contains metals that are harmful to our health and the environment if not properly disposed of at the end of life?

Response	Frequencies	Percentages
No response	410	36.0
Yes	400	34.7
No	344	29.8

Total	1154	100

Table 9 shows that 400 (34.7%) of the respondents said CEDs contain metals that are harmful to our health and the environment. This number is less than 528(45.8%), which represents those who said they have heard of e-waste in table 5. The indication is that 128(11.1%) of those who said they have heard of e-waste could not identify harmful metals in e-waste.

Table 10: Examples of harmful metals found in e-waste that respondents could identify

Metal	Frequencies	Percentages
No response	1014	87.9
Lead	110	9.5
Cadmium	6	0.5
Mercury	20	1.7
CFC	4	0.3
Total	1154	100.0

Table 10 is a list of harmful metals the respondents indicated to be found in e-waste. From table 10, majority of the respondents 1014(87.9%) could not identify any metal in e-waste that can pose health hazard to us and/or harmful to the environment. Of the 140(12.1%) respondents who could identify some of these metals, 110(9.5%) listed lead. Though chlorofluorocarbon (CFC) is not a mental but substance found in e-waste from cooling and freezing systems, 4(0.3%) of the respondents erroneously listed hazardous mental. Finally, comparing tables 5 and 10, we could deduce that 388 (33.6%) of those who said they have heard of e-waste could not identify any metal in e-waste that is hazardous or harmful to human and environment.

Table11: Do e-waste contains metals that are valuable?

Response	Frequencies	Percentages
No response	446	38.6
Yes	242	21.0
No	466	40.4
Total	1154	100

From table 11, we find that only 242 (21%) of the respondents said CEDs contain metals that are valuable to both our health and the environment. Again this number is less than the 528(45.8%) that represent those who said they have heard of e-waste in table 5. The indication is that 286(24.8%) of those who said they have heard of e-waste could not identify the valuable and /or non-hazardous metals contained in e-waste.

From table 12, majority of the respondents 960(83.2%) could not identify any valuable metal in e-waste. Of the 194(16.8%) who could do so, 56(4.9%) identified aluminium and copper as the non-hazardous metals. When we again compared the tables 5 and 10, we could deduce that 334(29%) of those who said they have heard of e-waste could not identify any valuable and/or non-hazardous metal in e-waste.

Table 12: Examples of valuable mental found in e-waste that respondents could identify

Response	Frequencies	Percentages
No response	960	83.2
Aluminium	56	4.9
Gold	32	2.8
Silver	4	0.3
Copper	56	4.9
Platinum	2	0.2
Iron	32	2.8
Tin	2	0.2
Zinc	10	0.9
Total	1154	100.0

Table 13: Is e-waste a problem in Ghana and do we have e-waste law in Ghana?

Responses	e-waste a problem		e-waste law	
	Frequencies	Percentages	Frequency	Percentages
No response	436	38.0	416	36
Yes	144	12.5	60	5.2
No	574	49.7	678	58.8
Total	1154	100	1154	100

On the issue of e-waste being a problem in Ghana, 574(49.7%) said it is not. In comparing tables 5 and 13, we can deduce that 384(33.3%) of those who indicated that they have heard of e-waste think e-waste is not a problem in Ghana. Combining the responses for no and no response, we deduce that 1010(87.8%) said e-waste is not a problem in Ghana. This may be due to the fact that even in industrialized nations such as USA, e-waste is less than 5% of the waste stream (US-EPA, 2011). With regards to e-waste law in Ghana, majority of the respondents, 678(58.8%) who say 'No' are right since there is now law governing the importation, dumping and recycling of e-waste in the country at the moment.

Table 14: Respondents' assessment of the e-waste situation in Ghana

Responses	Frequencies	Percentages
No response	144	12.5
Extremely serious	36	3.1
Quite serious	94	8.1
Not serious	234	20.3
Not at all serious	248	21.5
Don't know	398	34.0
Total	1154	100

From table 14, it is evident that 482(41.8%) of the respondents are of the view that the e-waste situation in Ghana is not serious. In fact Ghana is one of the primary destinations of e-waste in Africa ((Parsons, 2009) and Agbogbloshie- a suburb of Accra, Ghana- is considered one of the world's e-waste dumping grounds. Again, the amount of e-waste in waste stream all over the world is increasing at an alarming rate and in the next six to eight years, developing countries will produce twice as much

WEEE than developed countries (Econo-Compliance Limited, 2011). This makes the e-waste situation in Ghana extremely serious. We can also deduce that an appreciable large number of the respondents who said they have heard of e-waste think that in Ghana, the e-waste situation is not serious.

Table 15: Will respondents have opted for a liberal course in e-waste in UCC?

Responses	Frequencies	Percentages
No response	524	45.0
Yes	438	38.0
No	192	16.6
Total	1154	100

In table 15, more respondents 524(45%) did not respond to the question "Assuming that UCC had a liberal course on e-waste in UCC, will they have opted for it?" 438(38%) said they would have chosen that liberal course in e-waste. This is encouraging since so liberal courses currently being run do not attract that number of students who are will to study it.

Assessing their knowledge

The first objective of this paper was to test the respondents' general knowledge of e-waste. The assessment was in two forms-objective (multiple choice and true/false) and written (fill-in/short answer) tests. Tables 16-18 depict their performance.

Table 16: Respondents' performance in e-waste objective test

Mark	Freq	%	Mark	Freq	%	Mark	Freq	%	Mark	Freq	%	Mark	Freq	%
1	40	3.5	6	44	4	11	28	2	16	22	2	21	8	1
2	28	2.4	7	100	9	12	30	3	17	46	4	22	24	2
3	36	3.1	8	46	4	13	34	3	18	24	2	23	30	3
4	32	2.8	9	34	3	14	36	3	19	14	1	24	26	2
5	26	2.3	10	24	2	15	28	2	20	12	1	25	140	12

Table 16 is the result of the objective test on e-waste the respondents took, though 242(21%) of them did not take part in this exercise. Out of the 25 marks, 140(12%) of the respondents had all their answers correct. Table 17 shows the respondents' written performance on e-waste. Majority of the respondents that is 914 (79.2%) did not past the written exercise.

Table 18 is the total score of both the e-waste objectives and written test the respondent took. Since the total score was 30 marks, table 18 is a scale down version of the university's grading system. That is whereas the university's grading system is out of 100; table 19 was out of 30. Ignoring the 187(16%) of the respondents who did not participate in the both tests, 576(50%) of those who partook in the test had E, which is not good. Thus more respondents failed 576(50%) than past 391(34%) indicating lack of knowledge in e-waste, which is not encouraging. This is because 474(41.1%) of the respondents are pursuing programmes related to the environment and 528(45.8%) had prior knowledge of e-waste. We conclude being aware of the existence of e-waste does not mean one have knowledge of the intricacies about e-waste.

Table 17: Respondents' performance in written e-waste

Mark	Freq	%
0	914	79.2
1	144	12.5
2	86	7.5
3	4	0.3
4	4	0.3
5	2	0.2
Total	1154	100

Table 18: Respondents' grades

Marks	Grades	Freq	%
30.0-23.5	A	173	15
23.4-22.5	B+	29	3
22.4-20.5	B	30	3
20.4-19.5	C+	10	1
19.4-17.5	C	42	4
17.4-16.5	D+	49	4
16.4-14.5	D	58	5
14.4-0	E	576	50
No response		187	16
Total		1154	100

Testing of hypotheses

Awareness of e-waste by Gender

The first objective was to evaluate the respondents' awareness of e-waste with respect to gender. An independent samples *t*-test analysis using SPSS version 20 was used to compare the mean responses of participants on awareness of e-waste issues in relation to gender. The hypothesis below was therefore tested at 95% confidence level ($\alpha = 0.05$).

H_o: There is no significant difference in the mean rating of male and female students regarding their awareness of e-waste.

H_i: There is a significant difference in the mean rating of male and female students regarding their awareness of e-waste.

Table 19: Comparison of Mean Responses of Participants on awareness of e-waste according to gender

	Gender	N	Mean	Standard. Deviation	Standard Error of Mean	*Sig.*	*t*
E-waste Awareness	Male	670	1.39	0.497	0.019	.014	2.45
	Female	428	1.31	0.500	0.024		

Before the analysis, a Levene's test for equality of variances was conducted and the result showed no difference in the variances between the male and female respondents. Upon this basis, the actual test was run. As showed from Table 19, there is indeed a significant difference in awareness of students with regard to gender ($t(1096) = 2.45$, $p = 0.014$). This suggests that participants responses on e-waste awareness was influenced statistically by gender thus $t(1096) = 2.45$, $p < 0.05$ (or: $t(1096) = 2.45$, $p <$ .014. The probability value is less than the alpha level and therefore there is enough evidence to reject the null hypothesis and conclude on the alternative hypothesis that significant differences exist between male and female students regarding their awareness on the subject of e-waste. In other words, there is a significant difference in students' awareness of e-waste based on gender.

Knowledge of e-waste by Gender

The second objective was to find out if there was a significant difference in responses of male and female respondents' regarding their knowledge of e-waste. An independent samples *t*-test analysis was used here also to compare the mean responses of participants on awareness of e-waste issues in

relation to gender. The hypothesis below was therefore tested at 95% confidence level ($\alpha = 0.05$).

H_0: There is no significant difference in the mean responses of male and female students regarding their knowledge about e-waste.

H_1: There is a significant difference in the mean responses of male and female students regarding their knowledge about e-waste.

Table 20: Comparison of Mean Responses of Participants on knowledge about e-waste according to gender

	Gender	N	Mean	Standard. Deviation	Standard Error of Mean	*Sig.*	*t*
Knowledge	Male	670	3.015	3.80	0.33	0.26	1.12
	Female	428	2.48	2.87	0.42		

A Levene's test for equality of variance was done and the result showed no difference in the variances between the male and female respondents upon which the actual *t*-test was conducted. As showed from Table 20, there is no significant difference in knowledge of students with regard to gender ($t(1096) = 1.12$, $p = 0.26$). This suggests that participants knowledge on e-waste is not influenced by gender thus: $t(1096) = 1.12$, $p < 0.05$ (or: $t(1096) = 1.12$, $p < 0.26$. The probability value is greater than the alpha level and therefore we fail to reject the null hypothesis thus concluding that there is no significant difference in the mean responses of male and female students regarding their knowledge about e-waste. By implication, the outcome suggests that there is no variation between male and female students' knowledge about e-waste. That is, gender does not determine ones' knowledge level about e-waste. In other words, there is no difference in knowledge of students on e-waste based on gender.

Awareness of E-waste According Programme

The third hypothesis was aimed at finding out whether significant differences exist in e-waste awareness between students studying environmental-related degrees and those studying non-environmental-related degrees. An independent samples *t*-test analysis was used to compare the mean responses of these two categories of students. The hypothesis below was tested at 95% confidence level ($\alpha = 0.05$).

H_0: There is no significant variation in the mean awareness responses of students on e-waste between students pursuing environmental-related degrees and their counterparts pursuing non-environmental-related degrees.

H_1: There is a significant variation in the mean awareness responses of students on e-waste between students pursuing environmental-related degrees and their counterparts pursuing non-environmental-related degrees.

Table 21: T-test on Students' Awareness of e-waste with Respect to Programme of Study

	Programme	N	Mean	Standard. Deviation	Standard Error of Mean	*Sig.*	*t*
Awareness	Related	443	2.22	1.51	0.07	0.75	0.33
	Non-related	626	2.25	1.53	0.06		

The t-test required a Levene's test for equality of variances whose result was not significant. Upon this basis, the actual t-test was conducted. As showed from Table 21, there is no significant variation in the mean awareness responses of students on e-waste between students pursuing environmental-related degrees and their counterparts pursuing non-environmental-related degrees. ($t(1069) = 0.33$, *p*

= 0.75). This suggests that participants responses on e-waste awareness was not influenced by students' programme of study, By extension, $t(1069) = 0.33$, $p > 0.05$ (or: $t(1069) = 0.33$, $\alpha < 0.75$. The probability value is greater than the alpha level and therefore we fail to reject the null hypothesis and thus conclude on it that no significant variation exists in awareness responses of students on e-waste between students pursuing environmental-related degrees and their counterparts pursuing non-environmental-related degrees. In other words, students' awareness of e-waste is not statistically determined by whether they pursue environmentally related and non-environmentally related programme. The finding may perhaps mean that studying environmental-related programme does not earn a student the advantage to be abreast of or be aware about e-waste issues. In other words, there is no difference in students' awareness of e-waste between the two programme areas.

Knowledge of E-waste According to Programme of Study

The fourth objective was to evaluate respondents' knowledge of e-waste in respect of their programme. Here again, since testing required comparison of mean responses of students regarding their knowledge about e-waste in the two programme groups: environmental-related and non-environmental-related programmes, the independent samples *t*-test was used to test the hypothesis and to compare the mean responses of the two categories of programme areas of students. The hypothesis which is a two-tailed non-directional one was tested at 0.05 alpha level (95% confidence level).

H_0: There is no difference in the knowledge of e-waste among students pursuing environmental-related degrees and those pursuing non-environmental-related degrees.

H_1: There is a difference in the knowledge of e-waste among students pursuing environmental-related degrees and those pursuing non-environmental-related degrees.

Table 22: T-test on Students' Knowledge of e-waste with Respect to Programme of Study

	Programme	N	Mean	Standard. Deviation	Standard Error of Mean	*Sig.*	*T*
Knowledge	Related	473	2.52	1.01	0.27	0.18	-1.3
	Non-related	679	2.65	1.23	0.16		

The t-test required a Levene's test for equality of variances whose result was not significant. Based on this outcome, the actual t-test was run. As showed from Table 22, there is no significant variation in the mean knowledge responses of students on e-waste between students pursuing environmental-related degrees and their counterparts pursuing non-environmental-related degrees. ($t(1150) = -1.30$, $p = 0.18$). This suggests that students' knowledge on e-waste is not influenced by their programme of study, By extension, $t(1150) = -1.30$, $p > 0.05$ (or: $t(1150) = -1.30$, $\alpha < 0.18$. The probability value is greater than the alpha level and therefore we fail to reject the null hypothesis and thus conclude on it that there is no difference in the knowledge level of students on e-waste among those pursuing environmental-related degrees and those pursuing non-environmental-related degrees. In other words, students' knowledge of e-waste is not statistically determined by the degree programme they are pursuing. The finding means that studying environmental-related programme does not earn a student the advantage to have knowledge about e-waste. In other words, there is no difference in knowledge of students regarding e-waste between the two programme areas.

6 CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to identify the level of awareness and knowledge of students of the UCC on e-waste. It also solicits their views on what should be done to minimize the threat of e-waste.

The study arrives at the following conclusions:

1. The level of e-waste awareness of students of the University of Cape Coast is very low. This may be better than that of the nation as a whole since lack of awareness and/or knowledge of e-waste is related to the level of education. There is therefore the need to start an e-waste campaign on campus as a means of increasing e-waste awareness.

2. The respondents were divided into three categories, which are: a) the unaware group i.e. those that are not aware of e-waste, b) the negative aware group i.e. those that are aware of e-waste but think it is fuss, and c) the positive aware group i.e. those that are aware of e-waste and think something drastic must be done.

3. Respondents wanted a liberal course on e-waste awareness and management to be taught in UCC as a means of raising the awareness of e-waste and its management.

The study would like to make the following recommendations:

1. There is the urgent need for the university to increase e-waste awareness among the students. Increase in awareness has the ultimate goal of empowering students to take up active roles of implementing solutions to the e-waste problem. In pursuing this agendum, we strongly recommend that a week to be known as “e-waste week” should be set aside discuss problems of e-waste discussed. During such week, obsolete and unused CEDs are collected for refurbishment or recycle. Also e-waste ambassadors should be appointed and clubs formed for the sole purpose of creating awareness in UCC and the Cape Coast Metropolis.

2. There should be an introduction of interdisciplinary course on e-waste management as a liberal course that must effect change in behaviour towards nature and environment. Due to the tight nature of the timetable, we recommend that the course be a self-paced e-learning one where students could be requested to complete it before graduation.

3. The current situation of lack of e-waste management policy is not encouraging. At the moment, whenever an ICT device gets to its end of life, the Boarding Committee of the Estate Section inspects it and then expunged that equipment’s information from the Asset Register of the university after which it is discarded. The said device either ends up at the dumpsite or scavengers collect such as scrap metals for disassembled. As a higher educational institution, the university of Cape Coast should have an e-waste management policy. This policy should set out how the university would be managing her own old and unused equipment especially ICT devices. Finally, the said policy should establish how equipment donations from other organizations to UCC are processed. When this is done we shall be discouraging disposal of e-waste being labelled as “donations”.

4. The significant difference in the knowledge of e-waste among students pursuing environmental-related programmes and those studying non-environmental programme that favours the later is very serious. Departments such Chemistry and Environmental Studies-whose programmes are geared towards environment- to include e-waste management as a course.

5. All over Ghana, one can see growing mountains of e-waste due to the disposal of CEDs from Ghanaians and those being dumped daily from containers arriving into the country from the developed nations as second-hand goods. Thus Ghanaian Parliament should enact laws banning the important of and cruel/ non-scientific re-cycling of e-waste. Lack of such law was has created a field day in the country in this regards.

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