

Level of Environmental Awareness about the Electronic Wastes

Mohammad Said Damanhour and Hind Khaled Al Sarayrah
Department of Applied Sciences, Princess Alia University College,
Al-Balqaa' Applied University, 11194 Amman, Jordan

Abstract: Electronic Wastes (EW) contain many toxic elements. These toxic elements will be infiltrated into the food-chain then into the human body. This toxicity causes many diseases such as cancer. In order to protect the environment and human being from the negative effects of the electronic wastes accumulation, a high level of cautiousness is required. This study aims to detect the level of environmental awareness regarding the electronic wastes. This study will evaluate the awareness for a selected sample of 120 students from Balqaa' Applied University in terms of the electronic wastes cognitive definition, causes and ingredients, harmful effects and the procedure to mitigate its negative impacts. Some scientific and socio-economic variables have been taken into consideration while doing the research. The 19% only from the targeted sample had a level of awareness on the topics of electronic wastes definition, sources and ingredients. The 17% of the sample had awareness on the harmful effects of the electronic wastes. The 12% of the sample had an awareness level on the procedures needed to decrease the amounts of electronic wastes. The 26% of the sample had an obvious awareness on the methods of electronic wastes disposal to avoid their negative effects. We can refer this strictly low level of awareness to the academic background for the selected sample; 65% of the students are from literature and humanitarian sciences academic backgrounds. Those owned a limited number of electronic devices. The increase of awareness for the students sample from scientific colleges compared to those with literature and humanitarian colleges can be observed. On the other hand, the average monthly income is directly proportional to the level of awareness on the electronic wastes. The environmental awareness on the fields of electronic wastes may be raised by including more cognitive concepts about electronic wastes terms and their negative effects. This inclusion should target the literature academic curriculums. Putting strict environmental laws that manage the electronic wastes and their disposal to decrease their amounts and negative effects. Activate the role of environmental awareness in several media. This increases the level of environmental awareness about the problem of electronic wastes.

Key words: Electronic wastes, electric and electronic devices, socio-economic variables, toxic materials, Jordan

INTRODUCTION

Industrial and technological development has been providing the world with many electric and electronic devices. These had made human's life easier and more comfortable in many fields of life such as telecommunications, learning, health, security, etc. Some of these devices are: computers, mobile phones, faxes, microwaves, televisions, refrigerators, photocopiers and their assemblies.

The use of these devices has been increased due to the human's continuous motivation to buy new technical devices, considering the old ones as garbage materials. Due to "market penetration" of these devices in the developing countries and its existence as a "replacement market" in addition to the shortage of obsolescence rate,

a huge number of electric and electronic devices has become as discarded consumable devices. This created a new environmental problem called electric and electronic waste. e-Waste is a global term used to describe waste of old end of life. Neglected electronic and electricity devices and all components. All those have been disposed by their original users (Bokhorre and Kowlessen 2008).

This kind of waste contains many different toxic materials which are classified in to hazardous and non-hazardous waste. Non-hazardous types include fractions of: copper, nickel and some valuable materials such as gold, silver and platinum. This has led some people to extract the valuable substances from electric and electronic disposable devices either to sell them or to re-use them. On the other hand, electronic waste contains

toxic materials such as mercury, lead, arsenic, selenium and cadmium in addition to the chromium and high quantities of flame radiation. This is why the electronic wastes are classified as hazardous waste.

Toxic materials have the ability of soil, air, water and agricultural products pollution. Toxics in these wastes will find their path to be absorbed or infiltrated into food chain and then into human's body. This accumulation in the human's body causes many health problems such as cancer, diabetic, heart-disease, congenital malformation, prematurity, fetal loss, low birthday, abnormal thyroid function, lungs damage, liver damage, kidneys damage, visual disturbance, osteoporosis, low immunity, headache, drowsiness, nausea, vomiting and diarrhea (Babu *et al.*, 2007). The people who take care of waste administration give this kind of waste more attention. Such wastes are either disposed in land fill sites or recycled, especially the precious metals. This task requires high cautiousness to protect the environment and human safety from dangerous impacts of e-Waste. In the developing countries, there were home practices for good e-Wastes administration particularly the recycling through an integrated management system the conservation of human and environment should be kept always in mind. In poor societies to the valuable fractions extraction process is done using non-scientific methods. This is done without paying attention to the negative impact and harm of e-Waste disposing to the environment and the society.

MATERIALS AND METHODS

Many studies have evaluated the e-Waste problems such as Noel-Brune *et al.* (2013), Afroz *et al.* (2012), Chibunna *et al.* 2010), Pinto (2008), Leung *et al.* (2006), Rochate *et al.* (2007) and Terazono *et al.* (2006). These studies have dealt with e-Waste in terms of identifying it, generating it, its sources and its growth. The previous studies discussed the electronic wastes management, refrying, reusing, recycling and disposing it in land fill sites. Few studies dealt with discussing recycling systems and materials recovery. They reuse in other studies the valuable elements and sold them. Sometimes they evaluate these materials as anew raw materials. Previous studies focused on the trans-boundary trade and hazardous toxics of electronic wastes. This kind of trade causes environmental pollution and health problems for human being. Other studies have also investigated the public awareness of electronic waste. They recommended to spread awareness through the different types of societies. This awareness will avoid the negative impact of such dangerous waste.

Table 1: Description of study sample

Description	Number	Percentage
Gender		
Male	65	43
Female	85	57
High school path		
Science	52	35
Literature	98	65
High school avg. score		
50-70	83	55
70-84	42	28
>85	25	17
Age		
18-29	88	59
30-40	42	28
>41	20	13
Level of income		
<500	80	53
500-1000	45	30
>1000	25	17

This study aims to explore the level of environmental awareness about the electronic wastes with respect to its cognitive definition, causes and ingredients, its harmful effects and the procedure to mitigate its negative impacts. The study sample was applied on 120 students of Al-Balqaa' Applied University. Taking into consideration some variables such like; academic specialization, high school average, gender, age, level of income and number of electronic devices in house (Table 1). Special questionnaire was designed to evaluate the awareness with respect to the mentioned variables a database was built from the questionnaire before it runs into statistical analysis through a simple description statistical approach.

RESULTS AND DISCUSSION

Analysis of the study sample questionnaire showed that 7% of the students can define the electronic wastes term correctly while 17% can define it partially correct. The 24% of the students have acceptable thoughts about this kind of wastes and its sources. The 5% of them are highly agreed that the electronic waste source is the electrical and electronic devices that are either damaged or unused. In addition, 14% of the students moderately to slightly agreed on that.

However, the student's knowledge about the electronic waste ingredients is as follows; only 5% are highly agreed on its healthy ingredients while 15% moderately to slightly agreed that the electronic wastes have a healthy knowledge. For the toxicity of the electronic waste ingredients, the percentage of those who strongly knew about it was no >2%. On the other hand, 8% agreed that the electronic wastes are toxic but in average levels. The 5% strongly supported the fact that

the electronic waste includes precious elements like gold, platinum and silver. The 16% of the students agreed on that to some extent. The 13% of the sample thought that the development of manufacturing technologies for the electronic and electrical devices contributes in shortening their hypothetical age. Hence, increasing their production rates. The 18% of the students agreed on that to some extent. From the above mentioned data, it is shown that 19% only from the sample had an acceptable level of awareness regarding the definition, sources and ingredients of the electronic wastes (Table 2).

For the awareness level on the harmful effects of electronic waste, especially on the human body, the study results showed that 7% of the students strongly believed that burning the electronic wastes in the open air caused harmful emissions and pollute the air, soil and water. The 10% are moderately agreed on that. The 7% of the students supported the fact that the toxic elements result from this process might enter the human body by breathing or by food. The 15% agreed on that to some extent.

The 9% of the sample believed that mercury element exists in the electronic wastes might harm the kidneys and the brain of the human if entered the human body. The 10% agreed on that to some extent. The 3% only realized that the children (of age <6 years) whom are playing with these wastes will face an increase in lead level in their blood. The 10% agreed on that to some extent.

Only 4% of the sample believed that these wastes cause abortion for women who work in disassembling and categorizing the wastes for recycling goals. The 7% of them are moderately agreed on that.

The 2% of the sample believed that the electronic waste weaken the immune system and causes osteoporosis in addition to destroying the brain cells especially for the men who work in recycling these wastes. Generally, the level of awareness about the harmful effects of the electronic wastes reached 17% (Table 3).

In the field of awareness level about decreasing the amounts of these wastes, the result of 12% showed that most people do not know much about reducing the wastes (Table 4). The 5% of the sample strongly believed that the electronic waste should be decreased by humans. While 5% of them agreed on that to some extent. The 8% of the sample supported the idea of selling the destroyed and the unused devices. These should be sold with lower prices for the recyclers which might decrease the amount of the electronic wastes. The 7% agreed on that to some extent.

Table 4 shows that 6% of the students saw that recycling the destroyed and unused devices contributes in decreasing the amounts of these wastes. The 6% of the sample agreed on that to some extent.

Regarding the awareness on the electronic waste dispose methods 26% of the sample have this knowledge (Table 5). The 24% of the sample thought that the wastes could be disposed by throwing them along with the municipal wastes. The 17% agreed on that to some extent. In addition, 14% preferred dumping the wastes underground without any considerations for the environmental safety. The 8% agreed on that to some extent. The 12% of them suggested burning the wastes in the open air. The 10% agreed with that to some

Table 2: Percentages for the awareness level about the definition , resources, ingredients of the electronic wastes

Domain of environmental awareness	Percentage				
	High degree	Medium degree	Little degree	Total	Uncertain
Definition of electronic wastes	7	9	8	24	76
Resources of electronic wastes	5	11	3	19	81
Electric and electronic devices (contain electric boards)	5	7	8	20	80
Electric and electronic devices (contain toxic elements)	2	3	5	10	90
Electric and electronic devices (contain precious metals)	5	5	6	16	84
Developing manufacturing techniques for these devices increased its waste	13	6	5	24	76
Average	6	7	6	19	81

Table 3: Awareness level about the harmful effects of electronic wastes

Domain of environmental awareness	Percentage				
	High degree	Medium degree	Little degree	Total	Uncertain
Burning electronic wastes emits gases that harms human body and pollutes the environment	7	5	5	17	83
Toxics of the electronic wastes enter the human body via food and air	7	5	10	22	78
Mercury (as a toxic substance) harms the kidney and brain	9	5	5	19	81
When children of age <6 years play with electronic wastes, the lead element levels might increase in their blood	3	5	5	13	87
Pregnant women who work on electronic wastes are exposed to abortion	4	5	2	11	89
Males who work on electronic wastes are exposed to osteoporosis, brain cells destroy and immune system weakening	2	3	3	8	92
Average	6	5	6	17	83

Table 4: Awareness level for the procedures to decrease the electronic wastes amounts

Domain of environmental awareness	Percentage				
	High degree	Medium degree	Little degree	Total	Uncertain
Increasing number of devices	5	3	2	10	90
Selling electronic devices to others with a lower price	8	3	4	15	85
Recycling some pieces of unused electronic devices	6	3	2	11	89
Average	6	3	3	12	88

Table 5: Awareness level for the electronic wastes disposal methods

Domain of environmental awareness	Percentage				
	High degree	Medium degree	Little degree	Total	Uncertain
Dumping electronic wastes with municipal wastes	24	6	11	41	59
Dumping electronic wastes underground without considering environmental safety	14	3	5	22	78
Burning electronic wastes in open air	12	5	5	22	78
Keeping electronic wastes in house	11	4	3	18	82
Average	15	5	6	26	74

Table 6: Relationship between the academic path (science/literature) and the level of awareness

Academic specialization	High degree		Medium degree		Little degree		Total		Uncertain	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Literature	16	11	12	8	22	14	98	65	48	32
Science	30	20	18	12	2	1	52	35	2	1

extent. However, 11% believed in keeping the wastes at home. The 7% agreed on that to some extent.

We can refer this strictly low level in the awareness for the sample to the academic background, 65% of them having literature and humanitarian sciences academic backgrounds. Table 6 shows that 20% are of the science background agreed with high levels on the questions related to the electronic waste definitions, sources, ingredients and disposal methods.

The 12% of them agreed on the previously mentioned fields in moderate level. Both percentages reached no more than 11 and 8%, respectively for the literature backgrounds. The percentage of those who do not know about these wastes was 32% for the literature background while it did not exceed 1.5% for the scientific background students.

On the other hand, the low level of the families monthly income might be a cause of the low level of awareness. This is obvious from the 53% of the sample families which are categorized with the low income families (Table1).

This finding declines the possibility of the family to own too many electric/electronic devices. The percentage of those who own <4 devices in house reached 60% while those who own 8 devices of high income families, reached 17% (Table 7).

According to gender, the high percentage of females in the sample of 57% (Table 1), whom have an educational level, compared to the males might contribute in the lowering of the awareness level. Although, 60% of the sample individuals are of the youth category, the awareness level is not affected by this. This concludes

Table 7: Percentage for number of electronic and electric devices in houses

Categories	No. of frequency	Percentage
1-4 devices	90	60
5-8 devices	35	23
>8 devices	25	17

that the young students do not care about getting knowledge about the electronic wastes in all investigated fields.

CONCLUSION

- The level of awareness for the sample study with respect to electronic wastes definition, resources and ingredients did not exceed 19%
- The level of awareness for the sample study with respect to electronic wastes harmful effects reached 17%
- The level of awareness for the sample study with respect to decreasing electronic wastes amounts was 12, 26% of them knew how to dispose this kind of waste
- The general awareness for all electronic waste fields is 19%
- The increase for the awareness level for the sample with scientific academic backgrounds compared to those with literature and humanitarian sciences academic backgrounds has been observed
- The level of awareness is directly proportional to the number of electric and electronic devices in the house
- The level of awareness is directly proportional to the monthly family income

RECOMMENDATIONS

The study recommends the following suggestions that might contribute in decreasing the electronic wastes amounts. It may also decrease their harmful effects and increase the level of environmental awareness about them:

- Increase the environmental awareness concepts in the literature and humanities colleges curriculum
- Activating the role of the environment protection associations and the environment friends clubs to positively contribute in managing these wastes and increasing the level of awareness about them
- Activating the role of environmental awareness in the several media means to increase the level of environmental awareness about the problem of electronic wastes

REFERENCES

- Afroz, R., M.M. Masud, R. Akhtar and J.B. Duasa, 2012. Public environmental awareness and performance in Kuala Lumpur city, Malaysia: A case study on household electrical and electronic equipment. *Environ. Urbanizat. Asia*, 3: 385-396.
- Babu, B.R., A.K. Parande and C.A. Basha, 2007. Electrical and electronic waste: A global environmental problem. *Waste Manage. Res.*, 25: 307-318.
- Bokhorre, C. and R. Kowlessen, 2008. e-Waste classification and characterization for Mauritius. University of Technology, Mauritius.
- Chibunna, J.B., C. Siwar, R.A. Begum and A.F. Mohamed, 2010. Awareness towards e-Waste management: A case study of UKM Malaysia. *J. Solid Waste Technol. Manage.*, 36: 548-554.
- Leung, A., Z.W. Cai and M.H. Wong, 2006. Environmental contamination from electronic waste recycling at Guiyu, Southeast China. *J. Mater. Cycles Waste Manage.*, 8: 21-33.
- Noel-Brune, M., F.C. Goldizen, M. Neira, M. van den Berg and N. Lewis *et al.*, 2013. Health effects of exposure to e-Waste. *Lancet Global Health*, Vol. 1, No. 2. 10.1016/S2214-109X(13)70020-2.
- Pinto, V.N., 2008. E-waste hazard: The impending challenge. *Indian J. Occup. Environ. Med.*, 12: 65-70.
- Rochat, D., C. Hagelucken, M. Keller and R. Widmer, 2007. Optimal recycling for Printed Wiring Boards (PWBs) in India. Proceedings of the R07 World Congress-Recovery of Materials and Energy for Resource Efficiency, September 3-5, 2007, Swiss Federal Institute for Material Science and Research.
- Terazono, A., S. Murakami, N. Abe, B. Inanc and Y. Moriguchi *et al.*, 2006. Current status and research on e-Waste issues in Asia. *J. Mater. Cycles Waste Manage.*, 8: 1-12.