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Electronic waste management of undergraduate students – The Case of a Philippine Sectarian University

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Abstract

Electronic waste (e-waste) refers to defective or obsolete electronic appliance and devices. This study was conducted to determine the knowledge, disposal method, recycling options, and alternative handling of e-waste among undergraduate students in a sectarian university in Cagayan, Philippines. A total of 150 respondents, with age range of 16-26 years old were randomly chosen to answer the survey. The results showed that each student owns at least one (1) unit of each electronic product classification and more than half of the respondents(55%) do not have appropriate knowledge about e-waste. The 59% of the respondents disposed e-waste through recycling facilities whereas 41% practiced appropriately recycling. Overall surveyed respondents were willing to segregate their e-waste through recycling facilities.

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Introduction

Electronic industry grows customer inclination towards electronic goods and services making it the largest and fastest growing manufacturing industry (Gopalan, 2000). This trend leads to the rapid replacement and disposal of products before reaching the end of functional cycles. The electronic industry is a business of creating, designing, producing, and selling electronic devices. On the contrary environmental ill effects associated to electronic waste (e-waste) generation are investable if e-waste is poorly managed.

The e-waste is the term referring to electronic appliances that have been disposed by their former users. It covers waste from all electronic and electrical appliances which comprises computers, mobile phones, televisions, iron, and many other household consumer items. Many of these electronic and electrical appliances can be reused, reduced, or even refurbished. Unfortunately, increase in affordability of these products made purchasing new ones easier to access rather than repair. Thus, electronic discards became one of the fastest growing segments of the waste stream. Worse, e-waste is one of the largest sources of heavy metals and organic pollutants in municipal waste in China and other Asian developing nations, making it more hazardous both to human health and environment (Bertram *et al*., 2002).

These problems led to studies focusing on assessing the knowledge and management practices of e-waste in the world. Among 300 staffs and 200 students within the University Kebangsaan Malaysia (UKM), both were found to have low level of awareness on e-waste management (Chibunna *et al*., 2010). On the other hand, a survey of businesses and institutions in Wisconsin revealed more of the respondents were familiar with e-waste (86%) and only 14% were not (Franklin, 2011). Additionally, a study conducted on college-going students (professional stream and non-professional stream) from Noida Cityrevealed all the students were aware of the existence of e-waste irrespective of their stream but both streams were not aware if e-waste management was being implemented (Sindhu and Laxmi, 2013).

It was also found out that male college students are more aware about e-waste than female college students; science stream than humanities stream college students; and high socio-economic status college students than low socio-economic status college students. In the Philippines, studies about e-waste focus mostly on generation (Peralta and Fontanos, 2006) and its environment and health implications (Mañalac, 2011).

This study aims to determine the awareness, perception, and practices of sectarian university-undergraduate students in Cagayan de Oro on electronic waste and to identify the management practices adapted by these students.

Materials and methods

Framework of the study

The survey questionnaire was structured to determine the knowledge, disposal method recycling options, and perceived alternative e-waste management systems among students. The study was anchored from literature (Kalana, 2010; Licy *et al.,* 2013; Galarpe and Parilla, 2014; Lara *et al*., 2017) with modifications to fit the local respondents. The results of the study were the basis to recommend for policy on e-waste management in the university. Fig. 1 presents the framework of the study.

Conduct of survey and data analysis

Qualitative data was collected through a survey questionnaire, composed of 10 questions. The knowledge questions of this study highlights the nature of electronic materials used at home and electronic devices often disposed upon damaged.

The disposal method questions sought to determine the perceived and preferred disposal method of e-waste. The recycling option questions included practices on e-waste recycling. Lastly, the perceived alternative on e-waste management covered questions on segregation and reutilization. Surveyed students responses were interpreted descriptively.

Respondent's demographics

The respondents were 150 students of a sectarian university in Cagayan de Oro, Philippines. The respondents' ages ranged from 16-26 years old. About 95 of the respondents were females and 55 males. Most of the respondents were pursuing BS Business Administration and BS Biology. The demographics of the respondents are summarized in Table 1 and 2.

Results and discussion

Knowledge on e-waste

The 55% of the surveyed students were knowledgeable about e-waste while 45% were unaware (Fig. 2). This presents that large portions of university students lack specific knowledge about e-waste despite their usage of electronic devices. The present result is in agreement with the study of Ritu and Shalini (2013) on young adults in Lucknow City, India.

Table 1. Age and gender distribution of the surveyed students.

Age	Frequency (f)		Percent (%)	
	Male	Female	Male	Female
16-18	16	33	10.67	22.00
19-21	36	61	24.00	40.67
22-24	3	0	2.00	0
25-26	0	1	0	0.007
	55	95	36.67	63.33
Total	150		100	

Table 2. Course distribution of the surveyed students.

Course	Frequency (f)	Percent (%)
BS Biology	40	27
BS Nursing	14	9
BS Business Administration	56	37
BS Agriculture	12	8
BS Electronics and Communications Engineering	28	19
Total	150	100

The quantity and type of electronic products used by the students were also surveyed aiming to identify their potential e-waste stream. Majority of the electrical and electronic materials found in their households comprised of appliances (41%), peripherals (26%), printers (17%), and computer monitors (16%) (Table 3).

Table 3. Electronic products found in households of respondents.

Category	Quantity(units)	Percent (%)
Appliances	1388	41.15
Peripherals	878	26.03
Phones	586	17.37
Computers	203	6.02
Monitors/LCD	197	5.84
Printers	121	3.59
Total	3,373	100

Table 4. Categories of electrical and electronic equipment (EEE) (Popescu, 2015).

Type	Description
Category 1	Large household appliances
Category 2	Small household appliances
Category 3	IT and telecommunications equipment
Category 4	Consumer equipment
Category 5	Lighting equipment
Category 6	Electrical and electronic tools

Primarily, appliances like washing machines, refrigerators, and mobile phones (Yusof *et al.*, 2011; Wang *et al.*, 2013) ranked first given its significant use at home. Peripherals which included computer mouse, keyboards, earphones, and hard drives ranked second among utilized electronic devices. Printers and monitors were considered separately from peripherals because these devices were relatively larger. Overall, present result confirms the dependence of the surveyed students' households to electronic devices. Upon damage these electronic materials becomes primary contributors to the e-waste pile (Rani *et al.*, 2012).

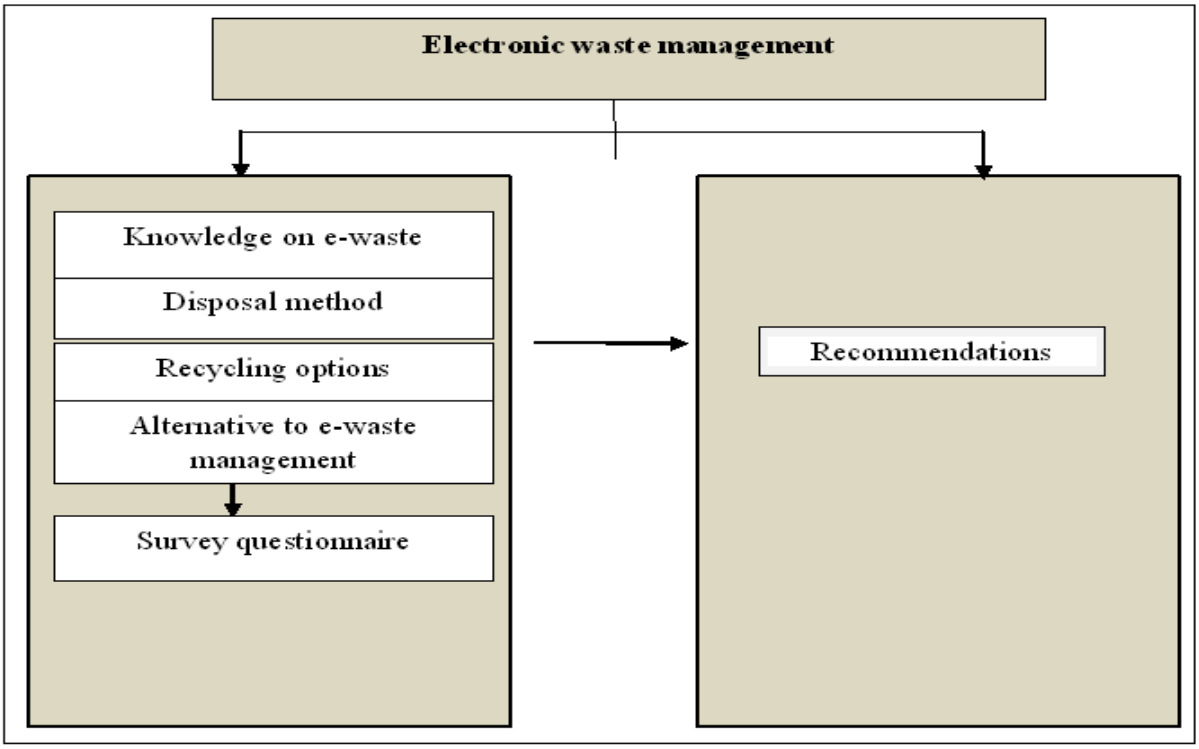

Fig. 1. The conceptual framework employed in the study.

On the other hand the perceived e-wastes generated mainly included peripherals like computer mouse, keyboards, earphones, and phones (USEPA, 2011) The lack of skills and management knowledge (Ritu and Shalini, 2013) to recycle and fast technological turnover were tributaries for disposal while other options were available (Fig.3). Overall, most electronic devices generated as wastes are Category 1-6 (Table 4).

Disposal method

Disposal of electronic devices by the students were surveyed (Fig. 4). Damage was the primary reason for disposal along with other household wastes (Kalana, 2010).

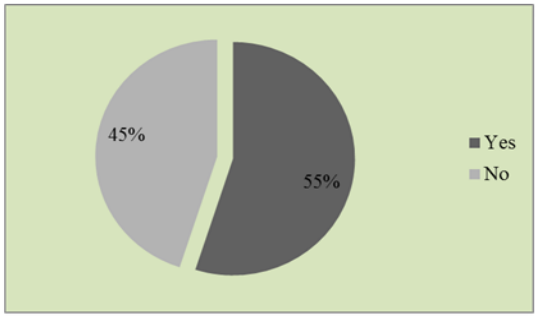

Fig. 2. Knowledge of surveyed students on e-waste.

Arrival of new products prompted surveyed students (29%)to discard their existing electronic devices. Mainly this was attributed as a consequence of current lifestyle trend (Yusof *et al.,* 2011), technological changes (Gurauskiene, 2008), and upgrading (Wilson *et al.*, 2017).A fast product innovation consequently entails more e-waste production (Nnorom and Osibanjo, 2008) as consumers tend to buy new models of electronic devices.

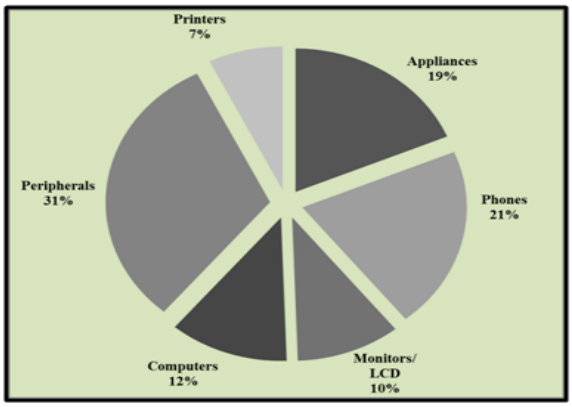

Fig. 3. Electronic devices disposed upon damaged.

Fig. 5 further presents a summary on the practices of the surveyed students regarding e-waste disposal. In this study, the word "disposed" was used to mean products to be thrown away. A total of 59% of the students preferred disposing of e-wastes. Present findings were in agreement by the study of Wang *et al.* (2013) that 36.79 %studied respondent's preferred e-waste disposal with municipal wastes. Upon disposal most e-wastes were disposed together with other waste streams (Kalana, 2010).

About 41% of surveyed students practiced recycling which can be associated to access of knowledge due to recycling programs (Kang and Schoenung, 2005) in the university.

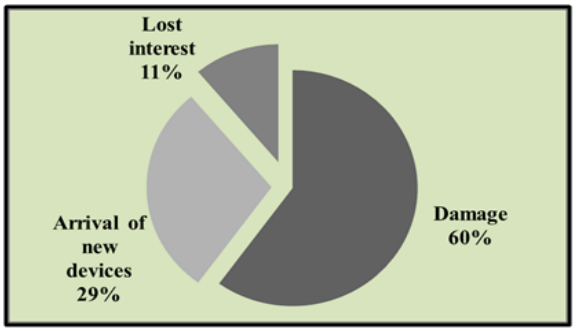

Fig. 4. Reasons for disposal of electronic devices.

Recycling options

In addition, 53% of the respondents dispose their e-wastes directly to trash bins while about 47% disposed e-waste to recycling facilities (Fig. 6). Disposal to recycling facilities was less preferred owing to absence of efficient take-back scheme for consumers (Kalana, 2010; Yusof *et al.*, 2011).

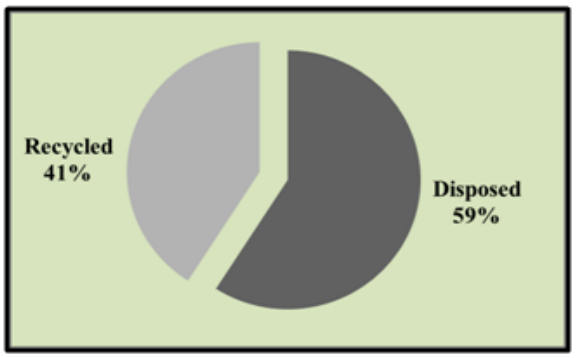

Fig. 5. Preferred disposal method of e-waste.

Consequently, dumped e-wastes often mixed with municipal wastes ends up in dumpsites and landfills (Galarpe and Parilla, 2014) comprising of 2% waste streams (USEPA, 2011). Overall, the ranked of recycled e-wastes at home were appliances (31%), 'phones (22%), peripherals (14%), computers/monitors/LCD (12%), and printers (9%).

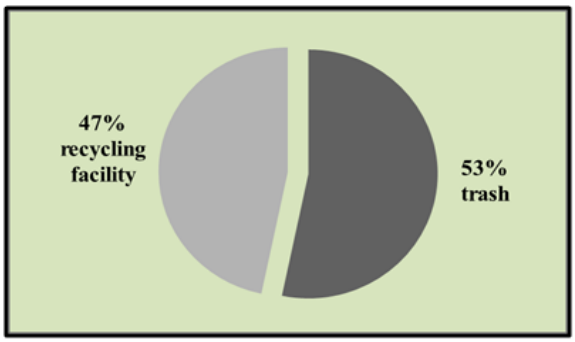

Fig. 6. Options utilized in E- product disposal.

Appliances were often recycled owing to accessibility to repair shops. Due to the phones small size and proper storage area it is often forgotten by consumers and less likely thrown (Yusof *et al.*, 2011).

Alternative to e-waste management

Recycling of e-waste in household of respondents primarily involved repair (65%) (Fig.8).The 29% of the respondents take out the usable parts such as copper wires for reuse while sparingly 6% take out these usable parts to be used to make other devices.

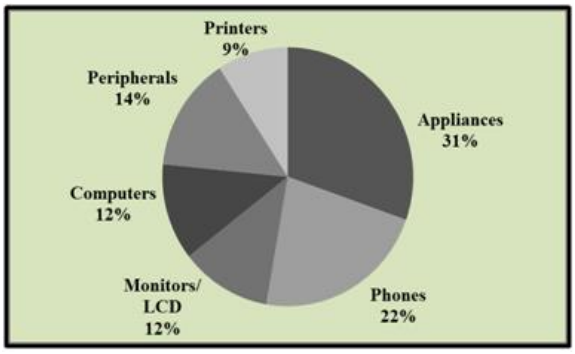

Fig. 7. E-waste recycled in households.

These results were understandable since not all of the respondents have thorough knowledge on (i) what components still have potential use, (ii) how to take parts of the electronic to salvage usable parts, and (iii) how to use these parts to fix or make other devices.

The reuse, refurbishment or repair of electronic products was emphasized to be the most desirable option for it increases the lifespan of the electronic product in order to achieve greater resource efficiency (Namias, 2013).

In addition, presence of precious metals such as gold and silver in e-waste makes it a profitable business particularly in developing countries (Chatterjee and Kumar, 2009).

Practice and willingness of the respondents on e-waste segregation were as well considered. Only 42% of the respondents practice e-waste segregation at their homes (Fig. 9). This may be due to the lack of knowledge of the consumers on proper e-waste segregation. Another scenario could be due to lack of discipline on the part of the consumers. A similar study in Kerela, found out that people were aware of the importance of waste management but there was lack of proper waste management practice (Licy*et al.*, 2013). Despite this, almost all of the surveyed respondents are willing to segregate their e-wastes.

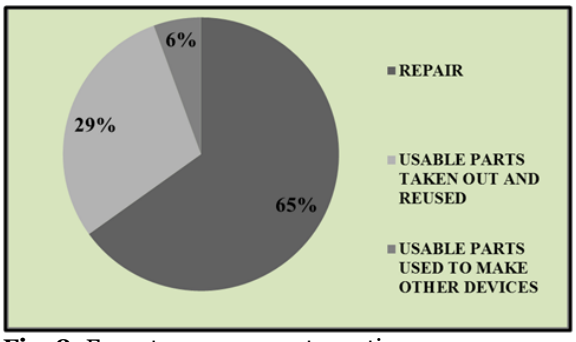

Fig. 8. E-waste management practices.

The city dumpsite collects the waste generated by all the Barangays of Cagayan de Oro and some Barangays of Misamis Oriental with wastes not segregated. Electronic waste were part of the wastes being dumped; however, estimates for its presence were not available for the segregation program was yet to start despite how Republic Act No. 9003 or the Ecological Solid Waste Management Act of 2000 was enacted since January 2001. Nonetheless, e-wastes like mobile phones found on the dumpsite were being bought by single buyers while home appliances like air conditioners and refrigerators were bought by another buyer.

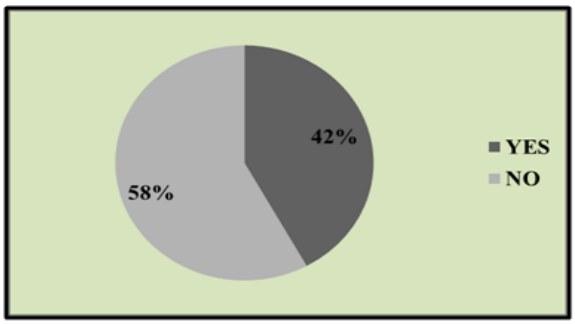

Fig. 9. E-waste management practices of students at home.

Discarded home appliances collected were dismantled into its component parts. Cords were cut off while metals parts were separated to be resold to other buyers. Junkyards near the landfill, however, do not do repairs. Materials collected usually stay on these junkyards for about 1-3 months and are kept outside on the ground or under a roofed structure. This scenario results to a more difficult gathering of information for these secondary or waste products are not considered in national statistic (Nnorom and Osibanjo, 2008).

Conclusion

Overall surveyed undergraduate students had minimal knowledge on e-waste management. Disposal methods were mainly trashing e-waste (53%) and marginalized recycling options (47%). Common recycled e-wastes were appliances (31%) and phones (22%) intended for making other devices (65%). The study was preliminary and may not conclusively suggest e-waste management among sectarian university elsewhere.

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