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Research Article

Awareness of the Electronics Technology Students in Managing their E-waste: An Input for Developing an E-waste Management Policy

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ABSTRACT

This study seeks to gauge the degree of awareness of the VALPOLY Electronics Technology students on E-waste management. A total of 188 VALPOLY EST students enrolled in the academic year 2022-2023 were purposively selected to participate in the research. An adapted and modified survey questionnaire was used to assess VALPOLY EST students' level of awareness and the challenges they faced in managing their e-waste. Frequency counts, percentages, means, the Mann-Whitney U test, and the Kruskal Wallis test were used for statistical analysis and data handling. All questions were rated on a 4-point Likert scale with a 0.5 level of significance. Based on the findings, "Electronic Components" is the most common e-waste generated by the 188 VALPOLY EST students, while "CCTV", "Oven, Heaters, Cookware, Blender", "Washing Machines", and "Printers" are the least common e-waste generated during their technical training in their technical subjects. The majority of students also preferred "Resell to junkshops as scraps" as an e-waste disposal strategy, while "Take to the collection Centre" was the least preferred. The EST students' level of awareness in managing e-wastes was assessed with a grand mean of 2.62, showing that the VALPOLY EST students are "Aware" of managing their e-wastes. There is no significant difference in the degree of understanding of VALPOLY EST students on e-waste management based on age or gender, but there is a significant difference based on year level. The assessment of the VALPOLY EST students' concerns in managing their e-waste received a grand mean of 3.42, suggesting that the VALPOLY EST students "Strongly Agree" that there are challenges in managing their e-waste. Input through a set of recommendations was made to strengthen the institution's policy on controlling and treating waste and electronic waste.

Keywords: *Awareness, Disposal, E-waste, E-waste Management, E-waste Policy, Electronics Technology*

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Introduction

Today's globalized economy and society owe a great deal to the rapid advancement of technology. Electronic garbage, or "E-Waste," is becoming an increasing environmental concern as a result of the country's customer-focused economy, rapid product depreciation, and technological advancements (Mojite, 2013). The number of electronic gadgets in use in both homes and enterprises has increased in recent years (Tanskanen, 2013). This is due to the rapid advancement of information and communication technology, which has resulted in lower prices, more device versatility, and shorter development times. Even though the primary producers of E-waste are the modern IT sectors, consumer electronics nevertheless account for a significant portion of the overall waste stream. Considering EEE is so widely used in critical economic, financial, and educational sectors, its proper disposal is becoming an increasing issue (Borthakur & Sinha, 2013).

One of the fastest-growing waste streams in the world is electronic waste because of rapid technological progress, increasing wealth in developing countries, increased technological innovations, and rapid obsolescence (Takale, 2015). E-waste, often known as electronic rubbish, is one of the fastest-growing environmental challenges, with annual growth rates of 3-5% (Veit and Bernades, 2015). This is almost three times the pace at which communities' conventional solid waste increases. There is little thought given to the environmental impact of replacing millions of analog appliances with modern technology that would result in their disposal in landfills. Many electronic devices have quickly become obsolete as a result of the steady stream of innovative new designs, "smart" features, and technology over the past few decades. This is due to technological advancements, user-friendly designs, effective marketing, and compatibility concerns (Kiddee et al., 2014).

The rising reliance on electronic devices has resulted in a new environmental threat due to incorrect electronic garbage disposal. Higher education institutions (HEIs) in the region are unfamiliar with the policies, legal regulations, and advocacy actions required to educate and develop systems for managing and disposing of electronic waste. In light of technological advancements, the introduction of new designs and smart functions, alluring marketing, and compatibility issues, product life cycles are becoming shorter and obsolescence is happening quicker than ever before (Woldemikael, 2019). Similar issues have developed in the Philippines as a result of the introduction of online courses as a result of the country's K-12 and higher education sectors' increasing use of ICT tools and electronic gadgets. Severe human and environmental consequences have occurred, particularly in developing nations, which get an estimated 80% of discarded electronics from developed countries (Kitila and Woldemikael, 2019). This is due to a lack of facilities for properly disposing of electronic waste, as well as a lack of rules in existence. According to several studies, e-waste has been related to major health concerns in humans due to the discharge of hazardous metals and compounds (Kiddee et al., 2013).

The Philippines has a challenging e-waste management situation because the garbage comes from two different directions: local manufacturing and the unwelcome imports of foreign goods (Sasaki, 2021). As stated by Alam (2016), the bidding procedure for recyclers to purchase electronics from government agencies and institutional customers is long and stringent. As of 2018, the Philippines has 119 Treatment, Storage, and Disposal (TSD) facilities registered, as reported by Celestial et al. Of these facilities, however, only 20 are found in the National Capital Region. The Philippines, and maybe even the region, lacks the necessary infrastructure to handle the disposal of electronic waste. The vast majority of old electronics are either rapidly stowed, thrown out with ordinary waste, or given a new lease on life (Alam, 2016; Navarette, Rosete, and Valdez, 2018). The Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (Republic Act No. 6969) governs toxic substances but not wastes, and there are not enough recycling facilities or skilled staff to deal with them. Therefore, it is very improbable that HEIs or the rest of the nation would ever have a trustworthy system in place to manage their electronic waste. Efficient collection, sorting, and recycling of electronic waste (e-waste)

may help mitigate the environmental harm caused by e-waste. More and more computers, laptops, and printers are being purchased and deployed by HEIs in the Philippines to provide better service to their students. However, Due to their heavy usage and frequent need to replace electronic equipment, educational institutions like colleges and universities contribute significantly to the growth of electronic waste.

In light of the widespread failures in E-waste management in Philippine higher education institutions, this research seeks to assess how well students at VALPOLY EST grasp the importance of proper e-waste disposal. Not only may policymakers use the study's findings to better the city's e-waste management system by, for example, evaluating audit methods and constructing proper recycling facilities, but the expanding academic institutions in the city can benefit from them as well. This study's findings should prompt additional investigation into e-waste management in Philippine universities, which is currently lacking data.

Literature Review

The primary purpose of this research is to find out how much VALPOLY EST students value environmentally sound practices for disposing of electronic trash and how much they struggle to do so. The VALPOLY EST student body is a microcosm of the larger public that generates e-waste yet is woefully uninformed about safe disposal practices. Aboelmaged (2021) analyzed consumer e-waste disposal behavior using the Basic Psychological Need Theory and word of mouth, while Gilal et al. (2019) analyzed how to regulate e-waste generation, however, there has been little research analyzing people's levels of knowledge of e-waste. However, not one of these research efforts tried to determine whether or not consumers understood how to responsibly dispose of electronic debris. Recently, Gilal et al. (2021) conducted a systematic literature review (SLR) that addressed the scarcity of studies on consumers' understanding of e-waste and its disposal processes in developing countries, particularly South Asia.

According to Alam (2016), a considerable volume of e-waste in the Philippines has not yet been collected for recycling or disposal. Addressing the e-waste situation requires public education on proper methods of recycling and disposing of electronics (Debnath et al., 2016). There is less evidence that the general public is aware of electronic waste's dangers to both humans and the planet (Ooman, 2014). Mahesh (2014) asserts that most people in the community are either ignorant of or unconcerned about the risks posed by electronic waste to humans and the environment. Residents of Bhat and Patil's study region knew the correct way to dispose of electronic garbage, however, they did not do so. Health concerns, environmental threats, precise e-waste disposal, stakeholders' e-waste management, and the ease of recycling are the five main variables Sivathanu (2016) listed as influencing consumers' e-waste disposal. In a similar vein, teaching VALPOLY EST students about e-waste management will result in less e-waste in the VALPOLY community as a whole, creating a boomerang effect in which the students spread the word about e-waste management via the department's program and community extension services.

Okoye and Odoh's (2014) study, which aimed to do the same thing with the VALPOLY EST students, found that people in their country had very low levels of environmental consciousness. Similar research was published by Kumar et al. (2015), who found that students' knowledge of the dangers and proper disposal of e-waste is extremely inadequate and hence requires rapid assistance. However, despite the many advantages of electronic devices, their rubbish at the end of their useful life can be harmful to people, animals, and ecosystems if not disposed of properly. Students generally understood the necessity for e-waste management and control, as shown by the conclusions of the study by Azodo et al. (2017). These need to be enhanced so that more effective measures may be taken to reduce waste. Both the current study and the previous research studied a wide variety of populations to assess the people's knowledge and use it as a basis for improving the e-waste management policy of the communities.

According to Baoas et al. (2016), a major portion of the campus community has embraced garbage disposal procedures that are

legal, in line with university regulations, and safe for human health and the environment. The MIT or Mapua Institute of Technology and DLSU or De La Salle University are two of the country's most innovative educational institutions when it comes to both engineering and the responsible disposal of electronic trash. However, according to Morallo (2016), no e-waste management committee had been established in other universities to cope with the anticipated influx of electronics and make arrangements for their correct disposal. There was a small room where most of the facility's electronic trash was stored. There were also other forms of possibly dangerous electrical garbage kept there. At now, there is no infrastructure set up to manage electronic trash. Despite the growing number of people who are aware of the problem, not enough electronic waste disposal facilities have been constructed. This article argues for including instruction on the risks posed by electronic waste and its correct disposal in elementary, secondary, and even postsecondary education programs. There is now an agreement on Local Action for Sustainable Development to make sure sustainability is a part of all public programs and events (Navarette, Rosete, and Valdez, 2018). The work of HEIs to control their electronic waste was studied by Dayaday and Galleto (2022). The main obstacles to efficient e-waste management in the region include a lack of awareness, e-waste disposal facilities, priority, audit resolution and procedure, and special legislation or policies among HEIs. The findings of this study should help educate the public and persuade universities to adopt best practices for recycling electronic waste. The results of this research can be used to enhance state and regional programs for managing electronic trash.

The Objective of the Study

This study aims to gather information that may be utilized to provide input for policy recommendations resulting from determining the level of awareness among Electronics Technology (EST) students at Valenzuela City Polytechnic College (VALPOLY) with regards to E-waste management and segregation. Specifically, the study shall be able to describe the profile of the VALPOLY EST students in terms of Age, Sex, and Year Level. It also seeks to determine the electronic wastes the VALPOLY EST students typically generate and their method of disposal and assess the level of awareness of VALPOLY EST students on E-waste management. It also seeks to gauge if the VALPOLY Electronics Technology students' degree of understanding of E-waste management significantly differs when their demographic profile is considered and be able to boil down the challenges encountered by the VALPOLY EST students in managing their E-wastes. The result of the study will serve as input to propose a set of recommendations for the improvement of the e-waste management of the institution.

Methods

Research Design

The method used in this study was a quantitative descriptive research design. According to Shenmare and Vaidya (2023), quantitative research collects data from multiple respondents based on numerical figures and then analyzes the data using a variety of mathematical, statistical, and computational tools to draw conclusions. The students who participated in this study were surveyed regarding the various forms of electronic waste generated throughout their technical education. The quantitative section was also utilized to determine the degree of awareness held by EST students regarding the proper handling of E-wastes and the challenges they faced in managing their e-wastes. The quantitative method was also utilized to identify a statistically significant difference in EST students' awareness and understanding of E-waste management. The study's results will serve as the foundation for developing and enforcing an institution-wide strategy for managing electronic waste.

Respondents and Sampling Plan

The purpose of this research was to collect information on the 188 Electronics Technology (EST) students at Valenzuela City Polytechnic College currently enrolled in the academic year 2022-2023, both qualitatively and quantitatively. The official participants in the study were carefully chosen because of the relation of the Electronics Technology program

to E-waste management. The study's participants were selected using a purposive sampling technique.

Research Instrument

An adapted and modified survey questionnaire was utilized in this study to assess EST students' awareness of E-waste management. The survey questionnaire was adapted from the study of Navarette, Rosete, and Valdez (2018) that was utilized in their study titled, "Assessing the Level of Awareness of Electronic Waste Among the Business Economics Majors of the University of Santo Tomas College of Commerce and Business Administration". The instrument's structure is made up of four (4) major sections. (1) Respondent characteristics; (2) EST students' E-waste management awareness; (3) EST students' e-waste generation and disposal behaviors; and (4) EST students' E-waste management issues.

Statistical and Data analyses

Two methods were utilized for keeping track of and analyzing the data. Quantitative analysis made use of inferential statistics like the Mann-Whitney U test and the Kruskal Wallis test, whereas qualitative analysis relied on descriptive statistics like frequency, percentage and the computed mean. Frequency counts and percentages were utilized to more accurately depict the distribution of responders by profile. Students at VALPOLY who are majoring in Electronics Technology were polled to find out how well they understood E-waste management and what they found to be the most challenging component of managing their e-wastes. Using a 4-point Likert scale, the researcher analyzed and categorized the average evaluations that were collected. Data from the VALPOLY Electronics Technology students were not normally distributed, thus the Mann-Whitney U test and the Kruskal Wallis test were employed to compare student awareness. All statistical tests were performed using a.05 level significance.

Results and Discussion

Table 1. The Profile of the Respondents as to Age

Age	Frequency	Percentage
16-20	72	38.30%
21-25	105	55.85%
26-Above	11	5.85%
Total	188%	100%

Table 1 presents the profile of the respondents as to age.

As presented in the table, there were 72 or 38.30% EST student respondents from the age bracket ranging from 16-20, followed by 105 or 55.85% EST student respondents from the age bracket ranging from 21-25, or 30.32%, and there were 11 or 5.85% EST student respondents from the age bracket ranging from 26-above.

This implies that most of the student respondents were from the age bracket ranging from 21-25 with 105 or 55.85% while the least number of student respondents with 11 or 5.85% are from the age bracket ranging from 26-above.

Table 2. The Profile of the Respondents as to Gender

Gender	Frequency	Percentage
Male	145	77.13%
Female	43	22.87%
TOTAL	188	100%

Table 2 displays the profile of the respondents as to gender.

As displayed in the table, there were 145 or 77.13% male EST student respondents and 43 or 22.87% female EST student respondents.

This implies that most of the respondents were male with 145 or 77.13% EST student respondents while females have 43 or 22.87% EST student respondents.

Table 3. The Profile of the Respondents as to Year Level

Year Level	Frequency	Percentage
First-Year	60	31.91%
Second-Year	57	30.32%
Third-Year	27	14.36%
Fourth-Year	44	23.40%
TOTAL	188	100%

Table 3 shows the profile of the respondents as to year level.

As shown in the table, there were 60 first-year EST students, or 31.91%, followed by 57 second-year EST students, or 30.32%, there were 27 third-year EST students, or 14.36%, and 44 fourth-year EST students, or 23.40%, enrolled in the Bachelor of Vocational Teacher Education major in Electronics Technology Program at Valenzuela City Polytechnic College for the academic year 2022-2023.

This implies that most of the respondents were first-year EST students with a total of 66 students or 31.91% while third-year EST students have the least number of respondents with 27 students or 14.36%.

Table 4. The Distribution of E-waste Generated by EST students

E-waste generated by EST students	f	%
Televisions	14	7.45%
Electric Fans	28	14.89%
Washing Machines	3	1.60%
Power Supplies	19	10.11%
Electronic Circuit Boards	11	5.85%
Electronic Components	42	22.34%
Wires and Cables	17	9.04%
Cell phones and Tablets	11	5.85%
CCTV	3	1.60%
Laptops and Personal Computers	5	2.66%
Oven, Heaters, Cookware, Blender	3	1.60%
Speakers, earphones, and headphones	11	5.85%
Amplifiers	7	3.72%
Batteries/Power banks	11	5.85%
Printers	3	1.60%
TOTAL	188	100%

Table 4 illustrates the distribution of E-waste generated by VALPOLY Electronics Technology students.

As illustrated in the table, 22.34% or 42 of the EST student respondents answered that the most common E-waste they generate during their technical training is the "Electronic Components", followed by "Electric Fans" with 28 or 14.89% of the total number of EST student respondents. "Power Supplies" comes third chosen by 19 or 10.1% of the total number of EST student respondents, followed by "Wires and Cables" chosen by 17 or 9.04% of EST student respondents. Fifth on the list is

"Television" with 14 or 7.45% of the total number of EST student respondents while "Speakers, Earphones, and Headphones"; "Cell phones and Tablets"; "Electronic Circuit Boards"; and "Batteries and Power Banks" are all in the sixth list chosen by 11 or 5.85% of the total number of the EST student respondents. "Amplifiers" is eighth on the list with 7 or 3.72% of the total number of EST respondents and on the ninth spot is "Laptops and Personal Computers" with 5 or 2.66% of the total number of EST student respondents. With 3 or 1.60% of the total number of EST student responses, "CCTV," "Washing Machines," "Printers," "Oven, Heaters, Cookware, Blender," and "Washing Machines" all rank in the top 10.

This means that most of the VALPOLY EST students chose "Electronic Components" with a total of 42 or 22.34% as the most common e-waste they generate while "CCTV", "Oven, Heaters, Cookware, Blender", "Washing Machines", and "Printers" are the least common e-waste they generate with 3 or 1.60% of the total number of the EST student respondents.

Table 5. The Distribution of Methods of Disposal of E-waste of EST Students

Methods of Disposal	f	%
Resell to junkshops as scraps	169	89.89%
Handover to the garbage collector	143	76.06%
Stored or kept	98	52.13%
Resell (If still functioning)	110	58.51%
Thrown	148	78.72%
Given (to family or away)	57	30.32%
Recycled	48	25.53%
Swapped or Trade	20	10.64%
Return to Manufacturer	11	5.85%
Take it to the Collection Centre	7	3.72%
Overall Mean	**188**	**100%**

Table 5 demonstrates the distribution of methods of disposal of e-waste of VALPOLY Electronics Technology students.

As demonstrated in the table, "Resell to junkshops as scraps" was the most preferred option for getting rid of e-waste by 169 out of the total number of EST student respondents (89.89%). Followed by "Thrown" with 148 responses (78.72%), "Handover to garbage collector" is the third most popular option among EST student respondents. "Resell (If still functioning)" is in the fourth list with 101 or 58.51% of the total number of EST student respondents while "Stored or Kept" is on the fifth list with 98 or 52.13% of the total number of EST student respondents. On the sixth list is "recycled" with 48 or 25.53% of the total number of the EST student respondents followed by "Given (to family or away)" with 57 or 30.32% of the total number of EST student respondents and "Swapped or Trade" with 20 or 10.64% of the total number of the EST student respondents. "Return to Manufacturer" is on the ninth list with 11 or 5.85% of the total number of EST student respondents and on the tenth list is "Take to the Collection Centre" with 7 or 3.72% of the total number of EST student respondents.

169 or 89.89% of the total number of EST student respondents mostly chose the method "Resell to junkshops as scraps "as a method to get rid of their e-waste while the least chosen method of disposal is "Take to the collection Centre" with 7 or 3.72% of the total number of the EST student respondents.

Zangpo et al. (2016) stated that the problem of e-waste that isn't properly disposed of has worsened in recent years. The mountain of electronic garbage grows in proportion to the rate at which new electronic devices are manufactured. While there are certainly advantages to using electronic devices, Azodo et al. (2017) found that the inappropriate disposal of electronic trash at the end of its useful life might be harmful to people, animals, and ecosystems. It was clear from all of the research that students

understood the necessity of proper e-waste management and regulation. These need to be enhanced to allow for more effective waste reduction.

Table 6. The Assessment of EST Students on the Level of Their Awareness in Managing E-wastes

	Mean	VI
I am aware that one may buy eco-friendly items that can lessen the negative consequences of e-waste.	2.63	A
I am well-versed in the methods used to properly recycle obsolete electronics.	2.52	A
Reducing e-waste is essential because of its effect on global warming.	2.59	A
The potential greenhouse gas implications of e-waste are reduced through recycling	2.62	A
The environmental effects of toxic substances found in e-waste are catastrophic.	2.70	A
I am aware of Valenzuela City's rapidly increasing e-waste problem.	2.57	A
I am knowledgeable of the dangers that electronic waste poses to ecosystems and human well-being.	2.68	A
I am aware that electronic garbage has been recklessly thrown across the city.	2.63	A
I'm well aware of the fact that malfunctioning electronics are a major source of pollution in the world nowadays.	2.66	A
I am aware that e-waste contains toxic chemicals	2.61	A
I am familiar with the procedures for reusing and recycling electronic waste.	2.55	A
I am interested in eco-friendly purchasing and selling recycled products.	2.68	A
Before I throw away any electronic device, I research the best manner to do it.	2.53	A
I'm aware that several regulations, laws, rules, and guidelines have been enacted to regulate the careless disposal of electronic waste.	2.57	A
I am aware that there are establishments whose only purpose is to process or treat, recycle, and dispose of electronic garbage.	2.68	A
I am aware that there are several ways to dispose of e-waste	2.58	A
I am familiar with e-waste collection systems, recycling initiatives, and awareness-raising efforts.	2.66	A
As far as trash management goes, I am familiar with the three Rs (Reduce, Reuse, and Recycle).	2.60	A
I am familiar with EPR, or Extended Producer Responsibility, a kind of product liability insurance that places full responsibility for a product's use and disposal on the maker.	2.63	A
I am aware of the lifespan of gadgets and appliances and when and where to dispose of it	2.54	A
OVERALL MEAN	**2.61**	**A**

Table 6 presents the assessment of VALPOLY Electronics Technology students on the level of their awareness in managing e-wastes

As presented in the table, the item "The environmental effects of toxic substances found in e-waste are catastrophic" obtained the highest computed mean of 2.70 verbally interpreted as "Aware" while the item "Before I throw away any electronic device, I research the best manner to do it" attained the lowest computed mean of 2.53 verbally interpreted as "Aware". The assessment of the EST students on the level of their awareness in managing e-wastes attained a grand mean of 2.61 which indicates that the EST students are "Aware" in managing their e-wastes.

Okoye and Odoh's (2014) study found that residents of the communities demonstrated low levels of eco-consciousness. When asked how much they cared about the environment, several respondents acknowledged having discarded outdated electronics without giving it much attention. This is why strategies were devised to spread awareness. Kumar et al. (2015) found that warning students about the dangers and proper ways to dispose of

electronic trash was very important. If people don't want their old electronics to end up in a landfill, consider donating them to a local charity instead. Look for energy-consuming gadgets that can be readily updated or dismantled, as well as those that employ recyclable components. Successful user awareness programs rely heavily on public outreach initiatives.

Table 7. The Significant Difference in the Level of Awareness of the VALPOLY Electronics Technology Students on E-waste Management in Terms of Age

Pair	Difference	H-com	H-tab	p-value
16-20 21-25	0	0.112	5.731	0.739
16-20 26-Above	0.1	0.419	5.731	0.518
21-25 26-Above	0.1	0.154	5.731	0.695

H-computed	H-tabular	p-value	Decision	Verbal Interpretation
0.3831	5.9915	0.8257	Accept H_0	Not Significant

Table 7 shows the significant difference in the level of awareness of the VALPOLY Electronics Technology students on e-waste management in terms of age.

As shown in the table, when comparing how well EST students understand how to manage their e-waste according to age, the null hypothesis was accepted with a verbal interpretation of not significant since the p-value of 0.7385 is higher than the level of significance of 0.05, and the H value of 0.1115 is within the tabular value of 5.7308. the groups 16–20 and 21–25 have a p-value of 0.7385, which is higher than the level of significance of 0.05, and an H value of 0.1115, which is within the tabular value of 5.7308, which results in the acceptance of the null hypothesis with a verbal interpretation of not significant. The decision to adopt the null hypothesis with a verbal interpretation of not significant is made since the p-value of 0.5177 for the groups 16-20 and 26-above is greater than the threshold of significance of 0.05 and the H value is 0.4185 within the tabular value of 5.7308. The H value of 0.1538, which is within the tabular value of 5.7308, and the p-value of 0.6949, which is greater than the threshold of significance of 0.05 leads to a conclusion of accepting the null hypothesis with a verbal interpretation of not significant, for items 21-25 and item 26-above.

The VALPOLY EST students' level of awareness regarding the management of e-waste differs significantly according to their age, resulting in an H computed of 0.3831, which is within the H tabular of 5.9915, and acquired a p-value of 0.8257 higher than the level of significance of 0.05, which leads to the decision to accept the null hypothesis with a verbal interpretation of not significant. This suggests that there is no age-related significant difference in the level of awareness of e-waste management among the students at VALPOLY EST.

Table 8. The Significant Difference in the Level of Awareness of the VALPOLY Electronics Technology Students on E-waste Management in Terms of Gender

Pair	p-value	Decision	Verbal Interpretation
Male-Female	0.5799	Accept H_0	Not Significant
Z-comp	**Z-tab**	**U-comp**	**U-Tab**
-0.5536	±1.96	2944	2504.9743: 3730.0257

Table 8 displays the significant difference in the level of awareness of the VALPOLY Electronics Technology students on e-waste management in terms of gender.

As displayed in the table, Males and Females obtained a p-value of 0.5799 from the comparison of the EST students' awareness of managing their e-wastes according to gender, which is higher than the significance level of 0.05, z computed of -0.5536 which is within the z critical value of 1.96, and u computed of 2944 which is within u critical value of 2504.9743: 3730.0257 that leads to a decision of accepting the null hypothesis with a verbal interpretation of not significant.

This means that the level of awareness of e-waste management of the VALPOLY EST students does not significantly differ in terms of Gender.

Table 9. The Significant Difference in the Level of Awareness of the VALPOLY Electronics Technology Students on E-waste Management in Terms of Year Level

Pair	Diff	H-comp	H-tab	p-value
1st-2nd	0.2	10.485	6.9605	0.0012
1st-3rd	0	0.0014	6.9605	0.9706
1st-4th	0.15	0.6797	6.9605	0.4097
2nd-3rd	0.2	5.9147	6.9605	0.0150
2nd-4th	0.05	1.9725	6.9605	0.1602
3rd-4th	0.15	0.2986	6.9605	0.5847

H comp	H-tab	p-value	Decision	Verbal Interpretation
10.6003	7.8147	0.0141	Reject H_0	Significant

Table 9 demonstrates the significant difference in the level of awareness of the VALPOLY Electronics Technology students on e-waste management in terms of year level.

As demonstrated in the table, when comparing the level of awareness of EST students in managing their e-waste by Year Level, First Year and Second Year obtained a p-value of 0.001204, which is less than the level of significance of 0.05, and an H computed of 10.4846, which is within the H critical value of 6.9605. These results result in a decision to reject the null hypothesis, which is verbally interpreted as significant. The first and third years obtained a p-value of 0.9706, more than the significance level of 0.05, and an H computed of 0.001357, within the H critical value of 6.9605, leading to a decision to accept the null hypothesis, which is verbally interpreted as not significant. To accept the null hypothesis, which is verbally understood as not significant, the first and fourth years got a p-value of 0.4097, which is more than the threshold of significance of 0.05, and an H computed of 0.6797, which is within the H critical value of 6.9605. The null hypothesis was chosen to be rejected in the second and third years due to their p-values of 0.01501 and 5.9147, respectively, which are both below the threshold of significance of 0.05 and within the H critical value of 6.9605, respectively. This was vocally regarded as significant. To accept the null hypothesis, which is verbally understood as not significant, the second and fourth years produced a p-value of 0.1602, which is more than the threshold of significance of 0.05, and an H computed of 1.9725, which is less than the H critical value of 6.9605. A decision to accept the null hypothesis, which is verbally understood as not significant, was made after the third and fourth years obtained a p-value of 0.5847, which is more than the threshold of significance of 0.05, and an H computed of 0.2986, which is less than the H critical value of 6.9605.

In this case, the null hypothesis was rejected verbally because the H computed value was 10.6003, which was greater than the H critical value of 7.8147, and the p-value was 0.0141, which was less than the level of significance of 0.05. This indicates a significant difference in awareness of e-waste management among VALPOLY EST students by year level.

Table 10. The Challenges Encountered by the VALPOLY EST Students in Managing Their E-waste

	Mean	VI
1. Lack of Knowledge about e-wastes and its detrimental effects on human health and the environment.	3.28	SA
2. Lack of comprehensive waste and e-waste management policy of the institution and the department	3.61	SA
3. Lack of knowledge of the different e-wastes treatment facilities nearby	3.35	SA
4. Lack of knowledge about recycling of e-wastes	3.43	SA
5. Lack of knowledge about toxic substances present in e-wastes	3.41	SA
6. The local government doesn't have any ordinance about e-wastes management	3.48	SA
7. Lack of concerns about solid waste management and treatment of e-wastes	3.27	SA
8. Lack of intensive training in e-waste management	3.59	SA
9. Directives, laws, ordinances, policies, and guidelines in managing the e-wastes are not taught in the technical major subjects	3.56	SA
10. Lack of knowledge and skills in handling toxic substances	3.26	SA
OVERALL TOTAL	**3.42**	**SA**

Table 10 illustrates the challenges encountered by the VALPOLY Electronics Technology students in managing their e-waste.

As illustrated in the table, the responses to the statement *"Lack of comprehensive waste and e-waste management policy of the institution and the department"* obtained a computed mean of 3.61 with the verbal interpretation scale of "Strongly Agree," while responses to the statement *"Lack of knowledge and skills in handling toxic substances"* obtained a computed mean of 3.26 on the same scale.

The VALPOLY EST students "Strongly Agree" that there are hurdles in managing their e-waste, as shown by the mean score of 3.42 on an evaluation of the difficulties faced by the VALPOLY EST students in doing so.

UNESCO has acknowledged that governments, corporations, and individuals all share responsibility for the e-waste crisis. It also emphasizes the significance of environmental education in the school to motivate future generations to recycle and cut down on trash at home. The media has the potential to play a pivotal role in educating the public about the value of comprehensive e-waste management. Because of the threat that electronic waste poses to a knowledge-based society, UNESCO promotes eco-friendly methods of disposal.

Emerging economies like China rely heavily on informal recycling firms to process their used electronics and appliances. Recovery processes that are harmful to the environment (via polluting of the air, groundwater, and landfills, contributing to ozone layer depletion and other environmental issues) and human health include open burning, which is frequent in the informal sector of impoverished countries. Most developing countries only use crude methods to extract certain valuable metals from their e-waste (Awasthi et al., 2016). The informal e-waste recycling sector is dominated by China, India, Pakistan, Vietnam, and the Philippines, which together collect between 50 and 80 percent of the global total. "Backyard operations" often include the incineration, disassembly, and shredding of electronic waste (Kumar and Jain, 2014). The vast majority of Europe's e-waste is thrown into municipal trash streams and sent to incinerators or untreated landfills. In 1998, recycling rates in the US were just 11% for computers and 26% for computer parts and peripherals.

It's very improbable that higher education institutions (HEIs) or the rest of the nation would ever have a dependable process in place to deal with their electronic waste. If electronic trash is collected, processed, and recycled effectively, its negative effects on the environment may be mitigated. To better serve their students, HEIs in the Philippines are increasingly turning to the usage of computers,

laptops, and printers. However, the amount of electronic waste is quickly increasing, and institutions of higher learning are a key source due to their high levels of consumption and frequent electronic equipment replacement.

The Proposed Recommendations for the Development and Implementation of an E-waste Management Policy

Implementing Agenda 21 for Sustainable Development in Philippine schools, which involves including solid waste management into classroom curriculum, is primarily within the purview of the Department of Environment and Natural Resources and the Department of Education. Since almost none of the respondents had any exposure to the topic before high school, the study recommends incorporating education about the dangers of e-waste and the importance of its proper waste management specifically into the curricula as early as the elementary years. Jager (2015) suggests incorporating e-waste awareness into the curriculum as another way to ensure that genuine environmental concern is engrained in future generations. Due to the environmental education that is being offered to the next generation, proper e-waste management and disposal should become second nature to them.

Table 11. The Proposed Recommendations for the Development and Implementation of an E-waste Management Policy

Recommendations	Reason	Strategy	Person Involved
Integration of E-waste management in the curriculum and instruction	1. Lack of Knowledge about e-wastes and its detrimental effects on human health and the environment. 2. Lack of knowledge of the different e-wastes treatment facilities nearby 3. Lack of knowledge about recycling of e-wastes 4. Lack of knowledge about toxic substances present in e-wastes 5. Lack of intensive training in the management of e-waste 6. Lack of knowledge and skills in handling toxic substances	Develop and implement a comprehensive garbage and e-waste management policy to integrate e-waste management into the curriculum and instruction. Educate students on suitable e-waste handling practices to help them learn how to handle hazardous materials in e-waste.	College heads, Department Chairpersons, College Instructors, Students, and College staff
Most higher education institutions are heavily dependent on ICT equipment and electronic devices; hence these institutions should	There is no existing waste and e-waste management policy in the institution and the department	1. Develop and implement a comprehensive waste policy on the management of e-waste in the institution and the department	Solid Waste Management Committee, College heads, Department Chairperson,

Recommendations	Reason	Strategy	Person Involved
develop policies and guidelines on the management of e-waste. In addition, the proper disposal of electronic trash should be a top responsibility at every HEI.		2. There has to be a reorganization of all electronic waste products into more appropriate categories, such as those that are outmodeled, broken, or beyond repair.	College Instructors,
The local government doesn't have any ordinance about e-wastes management	E-waste management is not included in the solid waste management policy of the institution	Self-disciplinary actions must strengthen	College heads, Department Chairpersons, College Instructors, Students, and College staff
Dissemination and information are required since HEIs have a limited understanding of e-waste and the harm it causes to people and the environment.	There is no support from the school and the department that will advertise or promote e-wastes management in the institution.	The education campaign must include information about TSD facilities that are accredited to handle electronic trash. The PR campaign includes recycling-focused events and drives to collect electronic waste. HEIs should provide repair services to reclaim damaged electronic devices to reduce the stockpile of e-waste, ensure the supplier's after-sale support, and advocate for extended producer responsibility (EPR). After the product's lifespan has expired and it is no longer functional, the supplier is responsible for collecting and disposing of it.	College heads, Department Chairpersons, College Instructors, Students, and College staff
To appropriately store unwanted electronic equipment, adequate storage with sufficient containers and	The institution currently lacks a proper location for the collection and disposal of electronic trash.	The yearly inventory of supplied equipment among teachers and staff should be a part of the e-waste management strategy.	College heads, Department Chairpersons, College Instructors, Students,

Recommendations	Reason	Strategy	Person Involved
racks should be constructed.			and College staff
Lack of concerns about solid waste management and treatment of e-wastes	Students are not exposed to handling e-waste and show no care about their disposal of e-waste	Expose the students to handling e-waste and toxic substances present in e-waste and guide the students in proper recycling and disposal of e-waste	College heads, Department Chairpersons, College Instructors, Students, and College staff
The amount of electronic trash produced at educational institutions requires dedicated staff members and the formation of a committee with the mandate to track and account for all such items.	There is currently no staff member designated to take inventory and process e-waste.	1. Hire a competent person that will manage the recycling and disposal of e-waste. 2. To better safeguard the environment and recycle garbage, educational institutions should cooperate with government and non-government groups.	College heads, Department Chairpersons, College Instructors, Students, and College staff

Conclusion

Based on the findings, most of the respondents are male and belonged to the age bracket ranging from 21-25 and are First Year students. Most of the VALPOLY EST students chose "Electronic Components" with a total of 42 or 22.34% as the most common e-waste they generate and 62 or 32.98% of the total number of EST student respondents mostly chose the method "Resell to junkshops as scraps "as a method of disposal of their e-waste. The assessment of the EST students on the level of their awareness in managing e-wastes attained a grand mean of 2.61 which indicates that the EST students are "Aware" in managing their e-wastes. There is no significant difference in the level of awareness of the VALPOLY EST students on e-waste management in terms of Age and Gender while there is a significant difference in the level of awareness of the VALPOLY EST students on e-waste management in terms of Year Level. The assessment of the challenges encountered by the VALPOLY EST students in managing their e-waste obtained a grand mean of 3.42 that indicates that the VALPOLY EST students "Strongly Agree" that there are challenges encountered by the VALPOLY EST students in managing their e-waste.

Recommendation

From the findings and conclusions generated in this study, the researcher humbly recommends the following:

1. The VALPOLY EST department needs to support measures to educate students about the dangers of e-waste and improve waste management. Jager (2015) advises enhancing the curriculum as a means to foster true environmental concern and e-waste awareness. It is the responsibility of the Department of Environment and Natural Resources, the Department of Education, and the Commission on Higher Education to include solid waste management in the educational system in the Philippines, as stated in Agenda 21 for Sustainable Development.

2. VALPOLY EST department should implement a policy-level intervention to decrease the production of e-waste. It must encourage cooperation between stakeholders, environmental groups, government, and NGOs to recycle electronic waste; conduct a policy review of solid waste management; incentivize the utilization of environmentally friendly products within the college's departments; and spread the word of the looming crisis.
3. The institution should guarantee stronger implementation and enforcement of existing policies regarding e-waste, such as the Basel Convention, RA 6969 and 9003, and DAO 2013-22. Proposed measures, such as drafting guidelines on the ESM of WEEE and waste disposal guides, must be reviewed and implemented without delay.
4. VALPOLY has to form a committee to keep track of and tally all of the electronic trash produced. To this end, it is important to categorize all e-waste objects as either repairable, usable, or outdated.
5. VALPOLY should appropriately store the discarded e-wastes, enough containers should be provided, and shelves should be set up with proper labels.
6. The VALPOLY EST department should collaborate with government and non-government agencies already working to save the environment and recycle used materials. Institutional strategies, norms, and laws that address the special difficulties of institutional settings in the disposal of electronic waste will further improve the current situation.

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