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Electronic Waste (E-Waste) Management Awareness and Practices Among Public and Private Higher Education Institutions

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ABSTRACT

The main objective of the study was to determine the level of e-waste awareness and management practices encountered by higher educational institutions in Zamboanga Peninsula. The study employed a descriptive quantitative method research design involving 312 respondents in select Higher Education Institution in Zamboanga Peninsula. The findings revealed that, the level of e-waste awareness of the teaching and non-teaching personnel in Public and Private HEIs across domains was moderately high and the e-waste management practices were less practiced. Disposal and Storage resulted a significant difference, however, there was no significant difference in terms of collection, monitoring and recycling on the level of awareness on e-waste management among HEIs. For e-waste management practices, there was a significant difference in terms of Disposal but no significant difference on collection, monitoring, storage and recycling among HEIs. The study concluded that the teaching and non-teaching personnel have to enhance and maintain the level of relationship between e-waste management awareness and practices in terms of collection, monitoring, disposal, storage, and recycling. HEIs have to exert efforts to increase the level of awareness and practices on e-waste management of their personnel in terms of disposal and storages. The study recommends that, HEIs may hold seminars on e-waste management among their teaching and non-teaching personnel to increase their level of awareness and enhance their practices on e-waste management.

Keywords: Electronics Waste, Electronic Waste Management, E-waste Awareness, E-waste Practices

INTRODUCTION

Waste Electrical and Electronic Equipment (WEEE), also referred to as e-waste, is a global environmental concern since it poses a hazard to both human health and the ecosystem as a whole. Measures must be taken to lessen the negative consequences of e-waste, which has increased dramatically due to new technologies and affordable electrical and electronic devices (Periathamby & Victor, 2013).

Despite growing awareness of the environmental and health hazards associated with e-waste, many higher education institutions struggle to implement effective e-waste management practices. Factors such as limited resources, inadequate infrastructure, and a lack of awareness among stakeholders often hinder efforts to address this pressing issue. Additionally, the rapid turnover of electronic devices due to technological advancements exacerbates the e-waste problem in higher education settings.

Baoas et al. (2016) state that, it is imperative to dispose of e-waste responsibly at all costs. A significant degree of appropriate waste disposal practices that adhere to national laws and current policies and are safe for both people and the environment have resulted from the accurate identification and characterization of electronic trash.

In the context of Higher Educational Institutions (HEIs) in Zamboanga Peninsula undoubtedly generate e-waste and therefore, they have adopted mechanisms, systematically or unsystematically, in monitoring, collecting, and

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disposing of e-waste; and other higher educational institutions bank on city ordinances for disposal orders. Hence, e-waste management in HEIs continues to be improbable. Given the gaps, this study aimed to assess how Higher Education Institutions implement e-waste management awareness and practices for sustainable solutions.

OBJECTIVES OF THE STUDY

The study aimed to determine the level of awareness and investigate the existing e-waste management practices. Specifically, it aimed to: 1) Identify the ICT, Telecommunications Equipment and Office Electronics generated within Higher Education Institutions; 2) Determine the level of awareness on e-waste management in terms of Collection, Monitoring, Disposal, Storage and Recycling; 3) Determine the level of e-waste management practices in terms of Collection, Monitoring, Disposal, Storage and Recycling; 4) Assess the significant difference on the level of awareness in the e-waste management when data are grouped according to Public and Private HEIs; and 5) Assess the significant difference on the level of practices in the e-waste management when data are grouped according to Public and Private HEIs.

METHODOLOGY

The study employed a descriptive quantitative method since it is intended to identify the ICT, Telecommunications Equipment and Office Electronics generated within Higher Education Institutions and determine the level of awareness and practices in e-waste management and also evaluates the differences of both the level of awareness and e-waste management practices among public and private HEIs. The data collected served as the basis for the development of a program for a sustainable solution in e-waste management practices among HEIs. The target population of the study were the teaching and non-teaching personnel of the select Public and Private HEI's in Zamboanga Peninsula. The total sample size of 312 generated using the Slovin's formula.

Table 1
Population and Respondents Distribution by HEIs

Institution Code	No. of Personnel (Teaching & Non-Teaching)	No. of n Respondents
HEI-B1	200	44
HEI-B2	150	33
HEI-B3	153	34
HEI-B4	120	26
HEI-A1	201	44
HEI-A2	212	47
HEI-A3	199	44
HEI-A4	180	40
Total	**1, 415**	**312**

Table 1 shows the total sample size of 312 generated using the Slovin's formula. The study was conducted in four private higher educational institutions and four State Universities and Colleges (SUCs) in Zamboanga Peninsula.

HEI-B1 is a private university in Western Mindanao. This HEI initially catered to primary and secondary education for boys. It became a college in 1952, and elevated into a university in August 2001. This HEI offers 25 baccalaureate programs and 14 graduate programs. Many of its programs are accredited by the Philippine Accrediting Association of Colleges, Schools, and Universities, such as Accountancy, Teacher Education, Business and Arts and Sciences, this is the only higher educational institution in Zamboanga Peninsula that is granted an Autonomous Higher Education status by the Commission on Higher Education.

HEI-B2 is a private Catholic basic and higher education institution owned and administered by the Religious of the Virgin Mary (RVM) in Zamboanga City. The college provides Catholic education to the children and the youth of Zamboanga City and of the southwestern part of Mindanao. It offers nursery, kindergarten, elementary, junior and senior high schools and eight academic programs in the tertiary level.

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HEI-B3 is a private non-sectarian college founded on December 8, 1946. The institution is presently managed by a president. It presently has three Campuses, namely the Central Campus, the West Campus and the East Campus, all located in Zamboanga City. This HEI provides junior, and senior high schools. In addition, HEI – A3 offers six academic programs.

HEI-B4 is a private, Catholic, coeducational basic and higher education institution run by the Roman Catholic Diocese of Pagadian in Pagadian City, Zamboanga del Sur, Philippines. This HEI is considered as the largest among the Diocesan Schools of Pagadian. It offers primary, secondary and tertiary education. The Accountancy and Information Technology programs are distinguished as a Center for Excellence and Center for Excellence and Development, respectively.

HEI-A1 is a state university in Zamboanga City. It was established in July 1905. With a strong commitment to higher education, it has 15 colleges, one institute and two autonomous campuses offering undergraduate and post graduate programs. This HEI is the center of development in College of Education, College of Architecture, and College of Social Work and Community Development was awarded the best school for social work in the Philippines.

HEI-A2 is a state college in Zamboanga City, Philippines. It is located at the heart of Zamboanga City and offers 12 academic programs in the tertiary level and eight graduate programs. This HEI has been chosen by the Department of Agriculture-Bureau of Agricultural Research as a lead agency for the National Research and Development Network for Capture Fisheries. It has also served as Zonal center for fisheries and marine biodiversity of the Mindanao Advanced Education project of the Commission on Higher Education.

HEI-A3 is a non-profit public higher education institution located in Zamboanga City. This university provides engineering, physical, technical education, and senior high school program. The University is also a CHED and MARINA Accredited Maritime Schools by 2023-2024. In addition, it offers two master's programs and two doctorate programs. Other baccalaureate degree programs are also opened, like the Civil Engineering Program, Basic Education and Technology Program, Hotel and Restaurant Management Program, BS ComTech, BS DevCom, BS Infotech and the Professional Education Certificate. Many of its programs are accredited by the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP), such as Engineering and Technology, Teacher Education, Arts, Humanities and Social Science, Information Technology, and Graduate Programs of the University.

HEI-A4 is a public higher education institution in the island province of Basilan, Philippines. Its main campus is located in Isabela City with satellite campuses in Lamitan, Maluso and Tipo-Tipo and an agricultural campus in Santa Clara, Lamitan. The institution offers programs in Education, Political Science, English Language Studies, Islamic Studies, Public Administration, Social Work, Computer Science, Criminology, Nursing, Nutrition and Dietetics and also Agricultural Technology. Moreover, it is also Accredited in some of its programs in the Bachelor of Science in Criminology, Bachelor of Science in Nutrition and Dietetics, and Graduate Programs.

Parallel with this, the study employed the simple random sampling technique to select respondents from the teaching personnel of the Public and Private Higher Education Institutions (HEIs). This means that, the names of the teaching personnel were randomly selected based on their availability to respond to the survey questionnaire. This procedure was carried out in all participating HEIs.

The research instrument of this study was a researcher-made questionnaire checklist. It consisted of two (2) parts. Part I was intended to gather data about the types of HEI's. Part II was to identify the ICT, Telecommunications Equipment and Office Electronics generated within Higher Education Institutions and evaluates the level of awareness and e-waste management practices of the select HEIs. This comprised of five scopes with indicators per scope such as collection, monitoring, disposal, storage, and recycling.

Table 2
Scale Used in Determining the Level of Awareness and Management Practices in Higher Education Institutions

Scale	**Verbal Description**	**Interpretations**	
		Level of Awareness	**Level of Management Practices**
1	Strongly Disagree	Not aware	Not Extensive
2	Disagree	Somewhat aware	Moderate extensive
3	Agree	Aware	Extensive
4	Strongly Agree	Highly aware	Very Extensive

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The table 2 shows the scale used in determining the level of awareness and management practices in higher education institutions. A 4-Point Likert Scale type of questionnaire was employed with its numerical ratings with the corresponding verbal description and interpretation of the study.

For the validity and reliability of instrument, a questionnaire checklist was developed based on the specific problems of the study. After which, this was referred to the adviser for comments and suggestions. Then the same questionnaire-checklist was submitted to a panel of experts who evaluated in terms of relevance, suitability, and appropriateness of the items. For the reliability of the questionnaire checklist, 30 copies were printed and administered to non-respondents for pilot testing. The data taken from them were computed using Cronbach's Alpha and the reliability estimates were as follows:

On the level of awareness of e-waste management in terms of collection (.764), monitoring (.873), disposal (.882), storage (.903) and recycling (.841) which were all considered highly reliable. Moreover, on e-waste management practices in terms of collection (.920), monitoring (.919), disposal (.916), storage (.934) and recycling (.887) which were all described highly reliable. Since both validity and reliability tests affirmed its satisfiable remarks along with its critique evaluation and statistical analysis, it was further justifiable that the instrument was recommendable to be employed for actual data gathering.

To be able to gather the data needed, the researcher was first and foremost sought the permission from the Presidents of State Universities and Colleges (SUCs) and President/Director of Private Colleges and Universities to conduct the gathering of data from their personnel. Upon approval, the letter was presented to the coordinating office like the Office of Research, Supply Office and College Head or Dean of the participating schools with attachments of instrument and informed consent form. The researcher communicated with the college secretary and supply office personnel with matters relative to the data gathering such as distribution and retrieval schedules. All information was dealt with great confidentiality. Neither demographic profile nor background information was solicited from the respondents. A coding system was utilized simply for filling out the questionnaires. The research was conducted in accordance with the ethical guidelines. This includes obtaining a certificate of exemption as an ethics clearance from the office of Research Ethics Oversight Committee

To facilitate the analysis of data, Frequency Count and Rank was used to count the frequency of responses particularly in identifying the types of e-waste generated within Higher Education Institutions. Weighted Mean was used to determine the level of awareness and e-waste management practices in select higher education institutions. While, Mann Whitney U Test was used to determine the significant difference in the e-waste management awareness and practices of the respondents when data are grouped according to types of HEIs and in terms of its variables.

RESULTS AND DISCUSSION

This section presents, analyzes and interprets the data obtained from the respondents using the survey questionnaire. The discussions of the results were carried out according to the research problems.

1. ICT, Telecommunications Equipment and Office Electronics generated within Higher Education Institutions

Table 3
ICT and Telecommunications Equipment Waste

ICT and Telecommunications Equipment Waste	F	%	Rank
1.Laptop	93	30	10
2.Computer system unit	146	47	3
3.LCD projector	110	35	8
4.Computer mouse	133	43	4
5.Networking equipment (wifi router, switch, cables)	105	34	9
6.Printers	155	50	2
7.Computer keyboard	120	38	5
8.UPS	112	36	7
9.Audio Amplifier	71	23	11
10.Video cameras	56	18	12

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11.Computer monitor	114	37	6
12.CDs/DVDs	164	53	1
13.Others	1	0.3	13

Table 3 reveals that the number one (1) ICT and Telecommunications Equipment waste in higher education institutions is CDs/DVDs (164 or 53%), followed by printers (155 or 50%) and computer system unit (146 or 47%) while the least contributor to electronic waste were the PCB Projects (1 or 0.3%) followed by video cameras (56 or 18%).

Other ICT and Telecommunications Equipment e-waste materials in HEIS include computer mouse (133 or 43%), computer keyboard (120 or 38%), UPS (112 or 36%), computer monitor (114 or 37%) and LCD projector (110 or 35%).

CDs/DVDs, Printers and Computer system were the top most ICT and Telecommunications Equipment e-waste in HEIs due to the fact that HEIs used CDs/DVDs, Printers, and computer units in all their offices for easier and efficient delivery of services. The bulk of CDs/DVDs, Printers, and computer units can contribute to an e-waste after they are used for short period of years. The emergence of new models makes other computer units and printers outdated that they are discarded and replaced. Other e-waste materials are also attached with computer units which suggests that these are also replaced when new models are adopted. In the cross-sectional study of Nuwermantsiko, et al. (2021) on knowledge, perceptions, and practices of e-waste management among consumers in Kampala City, Uganda., indicated that computer units along with television were the most disposed e-waste materials.

Table 4
Office Electronic Waste

Office Electronic Waste	f	%	Rank
1.Mobile phone	50	16	9
2.Electric fan	160	51	1
3.Television	93	30	5
4.Water dispenser	89	29	6
5.Air conditioner	131	42	2
6.Calculator	74	24	7
7.Led wall	47	15	10
8.Telephone	72	23	8
9.Photocopier	113	36	3
10.Fax machines	110	35	4
11.Others	15	5	11

Table 4 reveals that the type of electronic waste that contributes the most is electric fan (160 or 51%), followed by air conditioner (131 or 42%) and photocopier and fax machines with 113 or 36% and 110 or 35%, respectively. On the other hand, the least type of e-waste is others or the wall clock and voice recorder (15 or 5%) and led wall with 47 or 15%.

Meanwhile, other office electronic wastes include television (93 or 30%), water dispenser (89 or 29%), calculator (74 or 24%) and telephone (72 or 23%).

Analysis suggests that electric fans were identified as the type of office electronic waste that mostly contributed to e-waste materials. This is so since electric fans are commonly used in offices and classrooms of the HEIs. In the same manner, air conditioner is accounted as the second type of office electronic waste since a good number of this kind is used in the different offices of HEIs. The study of Moi and Sonia (2015) on e-waste awareness and challenges revealed that the leading types of e-waste materials were plastics, classical e-waste (e.g. CRTs, refrigerators, circuit boards, wire cables), and recent e-waste (e.g. LCDs, solar panels).

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2. The level of awareness on e-waste management in terms of collection, monitoring, disposal, storage, and recycling.

Table 5
Level of Awareness on E-Waste Management in terms of Collection

Statements	Weighted Mean	Description
1. I know the designated e-waste collection centers in the institution.	2.69	Moderately high
2. I have participated in an e-waste collection program of the institution.	2.39	Moderately low
3. I am aware that certain retailers or manufacturers offer e-waste collection services.	2.56	Moderately high
4. I understand the harmful effects of improper e-waste disposal on the environment.	3.24	Moderately high
5. I feel confident in my knowledge of how to dispose of my electronic waste properly.	2.83	Moderately high
Average Weighted Mean	**2.74**	**Moderately high**

Legend:

3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

Table 5 shows that statement "I understand the harmful effects of improper e-waste disposal on the environment" obtained a highest mean of 3.24 described moderately high. This suggests that, the respondents possessed an average knowledge about the ill effects of e-waste on the environment when these are not properly handled. This finding support the study of Annamalai (2015) that mentioned about the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, which was established in 1992 to lessen the importation of hazardous waste.

However, the respondents obtained the lowest weighted mean of 2.39 described moderately low on the statement "I have participated in an e-waste collection program of the institution". In other words, these respondents seldom participated in institutional program that deals with e-waste collection. This can be inferred that, these group of respondents were not fully aware of such e-waste program sponsored or initiated by their respective institutions.

Generally, the respondents' responses on the awareness on e-waste management in terms of collection is 2.74 described moderately high. This indicated that, they had moderate level of awareness on how to manage e-waste in terms of collection. In other words, they still lacked the knowledge on how to collect the e-waste materials in their respective campuses. The HEIs have to take the initiative of holding seminars or forums that will heighten their level of awareness on how to deal with e-waste materials especially on the collection process. The collection of e-waste is a huge problem as there is no any systematic approach adopted and developed by the various governments in the country. According, this is the area that has received very little attention (Forti, Baldé, Kuehr, & Bel, 2020).

Table 6
Level of Awareness on E-Waste Management in Terms of Monitoring

Statements	Weighted Mean	Description
1. I know that there are authorities responsible for monitoring e-waste management practices.	2.86	Moderately high
2. I understand how e-waste monitoring helps in reducing environmental pollution.	3.09	Moderately high
3. I am informed about the methods used to track and monitor e-waste from collection to disposal.	2.53	Moderately high

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4. I am aware of any penalties or fines for improper e-waste disposal.	2.54	Moderately high
5. I have received information on how e-waste is monitored after collection.	2.42	Moderately low
Average Weighted Mean	**2.69**	**Moderately high**

Legend:
3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

It can be viewed from table 6 that respondents gave the highest rating of 3.09 described moderately high in "I understand how e-waste monitoring helps in reducing environmental pollution." This shows that the respondents had moderately high level of understanding that monitoring e-waste can help lessen environmental pollution. In other words, monitoring is a good strategy in minimizing environmental degradation. This finding strongly suggest by Bagwan (2024) on Proper E-waste management and monitoring are essential for achieving maximum resource utilization and reducing the adverse impacts of E-waste.

On the other hand, the respondents described moderately low (2.42) in receiving information on how e-waste is monitored after collection. This can be surmised that the respondents had little knowledge about information on how monitoring of e-waste was carried out after collection. The concerned office has disseminated official communication to the different offices on the monitoring of e-waste in their respective institutions.

In general, the respondents generated an average weighted mean of 2.69 described moderately high on the level of awareness of e-waste management in terms of monitoring. In other words, the respondents need more information on e-waste management in terms of monitoring in their respective institutions. It can be inferred that monitoring of e-waste materials is not an established system in HEIs that, they cannot consistently carry out these practices. Strengthening advocacies and information drive are seriously considered to achieve higher level of awareness in terms of monitoring among respondents of the concerned institutions. Chibunna et al. (2021) in his case study on the challenges of E-waste Management among Institutions by employing interviews and surveys as the instruments in Malaysia, the study reported that the lack of awareness among students on monitoring is attributed to inefficient data management, and lack of specific regulations and policies on end-of-life electrical and electronics equipment (e-waste) management, and malpractices within the university.

Table 7
Level of Awareness on E-Waste Management in Terms of Disposal

Statements	**Weighted Mean**	**Description**
1. I know where to take my e-waste for safe disposal.	2.71	Moderately high
2. I am familiar with the environmental risks associated with improper e-waste disposal.	2.94	Moderately high
3. I am aware of local regulations regarding the disposal of electronic waste.	2.54	Moderately high
4. I know which items are classified as e-waste and require special disposal methods.	2.69	Moderately high
5. I am informed about the harmful substances in e-waste that necessitate proper disposal.	2.83	Moderately high
Average Weighted Mean	**2.74**	**Moderately high**

Legend:
3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

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It can be viewed from Table 7 that respondents gave the highest rating of 2.94 described moderately high in "I am familiar with the environmental risks associated with improper e-waste disposal." This means that the respondents were moderately aware that improper disposal of e-waste can lead to environmental degradation. This can be deduced that the respondents as much as possible were careful in disposing their e-waste.

Furthermore, the respondents claim that they have moderately high level (2.54) of awareness on local regulations regarding the disposal of electronic waste. This indicates that the respondents had an average knowledge about city ordinances on the processes of dealing with e-wastes disposal. This can be deduced that more seminars and information are conducted which result to moderate level of awareness about this issue. This finding support the idea of Mor et al. (2021), about few people are aware of e-waste management, despite the relevant authorities doing commendable actions. The respondents are aware of the risks associated with e-waste and its increasing use.

Generally, the respondents claimed that they had moderately high (2.74) level of awareness on e-waste management in terms of disposal. In other words, the respondents were not much informed on how to dispose e-waste. The respondents still need to enrich their knowledge on how to manage e-waste specifically in disposing it. Seminars on e-waste management has to be made available for them to increase their level of awareness on disposal process. There have been policies, legal provisions and advocacy undertakings educating and introducing ways to management and properly dispose of e-waste yet there is no clear understanding of these practices particularly in higher education institutions (Dayaday & Galleto, 2022).

Table 8
Level of Awareness on E-Waste Management in Terms of Storage

Statements	Weighted Mean	Description
1. I am aware of the importance of safely storing e-waste before disposal.	2.96	Moderately high
2. I understand the risks associated with improper storage of electronic waste.	2.99	Moderately high
3. I am informed about how to securely store e-waste to avoid contamination.	2.66	Moderately high
4. I am aware of temporary storage facilities available for e-waste before disposal.	2.59	Moderately high
5. I understand the potential hazards to health and safety of e-waste is stored improperly.	2.99	Moderately high
Average Weighted Mean	**2.84**	**Moderately high**

Legend:
3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

Table 8 reveals that, respondents claimed that they have moderately (2.99) high level of understanding on the risks associated with improper storage of electronic waste and the potential hazards to health and safety of e-waste was stored improperly. This implies that respondents had adequate knowledge on the danger that e-waste generated if not properly stored. This can be deduced that the respondents consistently observed the proper way of storing e-waste. In the same manner, they had enough knowledge that improper storage of e-waste can pose danger to health. This can be interpreted that, the respondents need to enhance their knowledge on e-waste storage so that it can raise their level of awareness about the danger of e-waste if not properly stored. Awareness is an environmental campaign that seeks to not only inform people about the negative effects of producing and handling waste, but also to in still in them the proper mindset that will encourage them to follow desirable waste disposal practices at home, at school, and in other locations (Liou, 1992).

Moreover, the respondents manifested moderately high (2.59) level of awareness on the temporary storage facilities available for e-waste before disposal in their institutions. This means that, the institutions had temporary storage area where e-waste can be stored before disposing them. However, not every respondent was aware of the

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existing storage provided by the school. This suggests that concerned office in HEIs has to widely disseminate information about the existing storage of e-waste to take rid of improper way of managing e-waste in the campus. The finding supported the idea of Andeobu et al. (2021) on a Systematic Review of E-Waste Generation and Environmental Management of Asia Pacific Countries noted that failure to adopt appropriate recycling practices for e-waste may cause environmental disasters and health concerns to humans.

Generally, the respondents rated themselves 2.84 described moderately high in e-waste management in terms of storage. This means that, the respondents were not aware of the e-waste storage in their respective institutions. This can be interpreted that improper e-waste management is being practiced by some respondents because of lack of knowledge about the existing storage facility for e-waste materials or other HEIs have limited storage area where to accommodate e-waste materials. This finding affirms to the study conducted by Paghasian (2017) about the problem in e-waste management emerged from inadequate facilities and waste containers for e-waste materials. HEIs may put to their priority program on the creation of storage facility for e-waste materials to be store safely and to be dispose properly so as not to cause harm to the surrounding environment of the institution.

Table 9
Level of Awareness on E-Waste Management in Terms of Recycling

Statements	Weighted Mean	Description
1. I am aware that electronic waste can be recycled.	3.03	Moderately high
2. I understand the environmental benefits of recycling e-waste.	3.05	Moderately high
3. I am informed about the process of recycling electronic waste.	2.55	Moderately high
4. I am aware of local recycling programs for e-waste.	2.44	Moderately low
5. I know which electronic items are accepted for recycling.	2.53	Moderately high
Average Weighted Mean	**2.72**	**Moderately high**

Legend:
3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

As shown in Table 9, the level of awareness of the respondents on the environmental benefits of recycling e-waste is 3.05 described moderately high. This shows that, the respondents were aware but still need to increase their level of awareness of the ecological benefits that can be derived from recycling e-waste materials. This can be interpreted that respondents possessed little knowledge on how to recycle e-waste materials since they lack the expertise in dealing with technology. Andeobu et al. (2021) emphasized the importance to adopt appropriate recycling practices for e-waste on the study about Systematic Review of E-Waste Generation and Environmental Management of Asia Pacific Countries that failure to adopt appropriate recycling practices for e-waste may cause environmental disasters and health concerns to humans.

On the other hand, the respondents had moderately low (2.44) level of awareness on local recycling program for e-waste which suggests that, they had not attended any local recycling program on e-waste recycling. The HEIs have to hold a seminar on recycling e-waste materials so that the respondents can enhance their level of awareness. According to Villanueva (2013), one of the four essential elements of a successful e-waste management program is education. Poor e-waste management information dissemination tactics will reduce public awareness and program participation.

Generally, the respondents rated themselves 2.72 described moderately high on the level of awareness on e-waste management in terms of recycling. This indicates that the respondents possessed an average knowledge in recycling e-waste materials. They knew a little about handling, classifying and transforming e-waste materials into useful products. However, HEIs have to increase the level of awareness of their personnel with regard to recycling of e-waste materials. HEIs can hold seminars on e-waste management to enable their personnel to deal with them. Recycling is the safest method among the different e-waste management practices where implementing proper rules to make as mandatory are wearing protective masks and gloves and safety glass when dismantling and avoiding easy methods of

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extraction such as incineration which results harmful fumes and avoiding dumping and avoiding using acid baths (NRDC, 2021).

Similarly, Dayaday & Galleto (2022) recommended the formulation of policy and putting up of recycling facilities in coordination to HEIs to promote recycling of e-waste materials and technical support and capacity-building programs to the recyclers.

Table 10
Summary of the Results on the Level of Awareness on E-Waste Management

Awareness on e-Waste Management	Weighted Mean	Description
Collection	2.74	Moderately high
Monitoring	2.69	Moderately high
Disposal	2.74	Moderately high
Storage	2.84	Moderately high
Recycling	2.72	Moderately high

Legend:
3.26 – 4.00 = strongly agree = high
2.51 – 3.25 = agree = moderately high
1.76 – 2.50 = strongly disagree = moderately low
1.00 – 1.75 = low

Table 10 shows that, the respondents had described moderately high in the level of awareness in e-waste management. The highest level of awareness on e-waste management is in storage (2.84), followed by collection and disposal with 2.74 each, recycling with 2.72 and the lowest level of awareness among respondents was in monitoring. This means that the respondents have no knowledge about the monitoring of e-waste in their respective institution. These finding can be supported on the study by Bagwan (2024), that highlights the Electronic waste (E-waste) generation and management scenario of India, and ARIMA forecasting of E-waste processing capacity of Maharashtra state till 2030 that proper E-waste management and monitoring are essential for achieving maximum resource utilization and reducing the adverse impacts of E-waste, in line with the Sustainable Development Goals.

Analysis suggests that, the respondents need to enhance their level of awareness in areas of e-waste management. The HEIs can only attain effectiveness in dealing with e-waste materials in areas of collection, monitoring, disposal, storage and recycling when the respondents are fully aware on what to do with e-waste materials. In other words, the respondents should know the policies and regulations on e-waste management issued by the concerned agency.

This supports the idea of Dela Cruz (2020) that an e-waste management program is implemented moderately. Hence, R.A. section 55. No. 9003 required the Commission on Higher Education (CHED), the Department of Education (DepEd), and other national organizations to implement an e-waste management information and continuing education program. The main goals of education and information sharing should be to: a. raise public awareness of the negative effects of e-waste and community-based solutions to the problem; b. offer workable solutions that will have the biggest impact on the issue; and c. persuade people to buy eco-friendly products. Additionally, R.A. No. 9512, also known as the Environmental Awareness and Education Act of 2008, mandates that the aforementioned organizations incorporate environmental education into the curricula of all educational institutions, public and private.

3. The level of e-waste management practices in terms of collection, monitoring, disposal, storage, and recycling.

Table 11
Level of E-Waste Management Practices in Terms of Collection

Statements	Weighted Mean	Description
1. Designated e-waste collection points are strategically located across campus.	2.44	Less practiced
2. Specialized containers or bins are used to segregate different types of electronic waste.	2.41	Less practiced

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3. Clear signage and instructions are provided at e-waste collection points.	2.39	Less practiced
4. Regular maintenance and servicing of e-waste collection bins or containers are conducted.	2.46	Less practiced
5. Feedback mechanisms are established to gather input from users on the accessibility, convenience, and effectiveness of e-waste collection facilities and services.	2.42	Less practiced
Average Weighted Mean	**2.43**	**Less practiced**

Legend:

3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

Table 11 shows that the respondents had the highest rating of 2.46 described less practiced in "Regular maintenance and servicing of e-waste collection bins or containers are conducted." This indicates that the HEIs were not consistent in providing maintenance and services of e-waste collection bin or container. This can be interpreted that HEIs do not regularly conduct maintenance of their e-waste bins or containers.

However, according to the study on collection conducted by Baxter et al. (2016) that High-quality materials and energy are effectively recovered from Waste Electrical and Electronic Equipment (WEEE) show net environmental advantages from appropriate waste handling in terms of global warming potential (GWP). The net benefit of recovering energy and materials is greater than the drawbacks of careless disposal. This suggest that, the institutions practice ways on how to collect e-waste by providing and assigning personnel to collect and regular check of e-waste in a designated collection area of the institution.

Furthermore, "clear signage and instructions are provided at e-waste collection points" is rated at 2.39 described less practiced. This means that most of the HEIs did not have signage and instructions where to place their e-waste materials. This can be interpreted that e-waste in these institutions are not seriously considered for proper collection. In other words, HEIs have to take seriously the provision of signage and instructions where e-waste can be placed and collected within the campus. This finding also supported the idea by Gaur et al. (2023) on raising awareness also contributed to the sustainability of e-waste management programs or practices in Universities with regards to collection, monitoring, and disposal.

Overall, the average weighted mean of 2.43 described less practiced on the e-waste management practices in terms of collection. This signifies that, the respondents had not formed a ways of managing e-waste materials in terms of collection. Collection has been an issue to them, since, they did not apply or carry out this practices. This suggests that respondents have to attend seminars and other forms of e-waste management assembly to enhance their e-waste collection management. The study on waste management practices in Lyceum of the Philippines University (LPU) had a contrasting result in which the researcher reported that there was an effective waste management program in terms of collection (Punongbayan et al, 2014).

Table 12
Level of E-Waste Management Practices in Terms of Monitoring

Statements	**Weighted Mean**	**Description**
1. There are clear guidelines or protocols in place for documenting and tracking e-waste disposal activities.	2.48	Less practiced
2. Electronic waste disposal records are maintained to track the quantity and types of e-waste generated and disposed.	2.46	Less practiced
3. There is an up-to-date e-waste material identification and management plan.	2.38	Less practiced
4. Regular inspections are conducted to check the condition and integrity of e-waste storage and facilities.	2.43	Less practiced

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5. Monitoring mechanisms are in place to ensure compliance with local and national regulations governing e-waste management.	2.43	Less practiced
Average Weighted Mean	**2.44**	**Less practiced**

Legend:
3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

It can be gleaned in Table 12 that respondents less practiced (2.48) on the guidelines or protocols in place for documenting and tracking e-waste disposal activities. This indicates that, the respondents were inconsistent in carrying out the guidelines and protocols in documenting and tracking disposal activities. This can be interpreted that, they have not internalized the guidelines and protocols on disposal activities in their respective HEIs. Dayaday & Galleto (2022) suggested that the HEI should give utmost priority to e-waste disposal practices.

Similarly, the respondents claimed that, they have less practiced (2.38) the up-to-date e-waste material identification and management plan. This implies that respondents were not fully aware of the existence of e-waste material identification and management plan they seldom implement it. The HEIs management needs to disseminate the information, if there is any, about latest waste material identification and management plan to its personnel so that this can be regularly practiced. This finding supported the study by Bagwan (2024) that proper E-waste management and monitoring are essential for achieving maximum resource utilization and reducing the adverse impacts of E-waste, in line with the Sustainable Development Goals.

In general, the respondents had generated an average weighted mean of 2.44 described less practiced on e-waste management in terms of monitoring. This implies that e-waste monitoring in the HEIs was not well practiced. This suggests that HEIs have not established an effective monitoring system on e-waste management. They still need to plan for a systematic process on how to monitor e-waste materials in their respective campuses. HEIs have to subscribe to local government for a proper and systematic procedures on how to monitor e-waste materials. Dayaday and Galleto (2022) in their evaluation of the e-waste management implementation of HEIs in South Central Mindanao, using survey questionnaires and in-depth interviews with 13 HEI representatives revealed that it difficult to conduct monitoring of e-waste materials due to lacked off audit resolution and procedure, and no definite legislation or laws among HEIs.

Table 13
Level of E-Waste Management Practices in Terms of Disposal

Statements	Weighted Mean	Description
1. E-waste is disposed of in compliance with local, national, and international regulations and standards.	2.60	Moderately practiced
2. Disposal facilities are equipped with technologies and processes to ensure the safe handling, treatment, and disposal of electronic waste.	2.47	Less practiced
3. Hazardous components and materials contained in electronic waste are properly segregated and managed to prevent environmental contamination and health risks.	2.53	Moderately practiced
4. Public awareness campaigns and educational initiatives are implemented to promote responsible e-waste disposal.	2.41	Less practiced
5. There is a continuous evaluation and updating of disposal practices in response to emerging technologies, regulatory changes, and best practices in e-waste management.	2.41	Less practiced
Average Weighted Mean	**2.48**	**Less practiced**

Legend:
3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

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As shown in Table 13, the respondents achieved the highest weighted mean (2.60) described moderately practiced in disposing e-waste materials in compliance with local, national and international regulations and standards. This means that respondents moderately followed disposed e-waste materials consistent to local, national and international regulations and standards. They cannot carry out it all the time, since, they lacked the resources to fully implement the standard procedures in disposing e-waste materials and also there is limited number of certified vendors offering its services to dispose e-waste of the different institution. This was mentioned by Adeel et al. (2023) about factors such as hindering e-waste disposal were lower monetary benefits for disposal, breach of sensitive information, nostalgic association with devices, and non-availability of disposal facilities.

Although, public awareness campaigns and educational initiatives are implemented to promote responsible e-waste disposal and continuous evaluation and updating of disposal practices in response to emerging technologies, regulatory changes, and best practices in e-waste management were less practiced (2.41) by the respondents. This indicates that HEIs did not seriously consider public awareness campaigns and educational initiatives to promote responsible e-waste disposal. This can be attributed to lacked of disposal facilities and storage, despite the awareness that, they possessed with regard to proper procedures of disposing e-waste materials. They also claimed that they did not continuously evaluate and update their disposal practices in response to emerging technologies and regulatory changes. HEIs have priorities other than the management of e-waste in terms of disposing e-waste materials.

Similar findings supported the study by Dayaday and Galleto (2022) about the lack of clarity regarding these practices especially in Higher Education Institutions (HEIs) on the policies, laws, and advocacy initiatives that teach and introduce correct e-waste management and disposal methods.

Overall, the average weighted mean of 2.48 described less practiced in e-waste management in terms of disposal. This shows that respondents did not regularly practice e-waste disposal in their respective HEIs. Hence, HEIs do not remind their personnel regularly on how to dispose e-waste materials or the HEIs still lacked the management system on how to dispose their e-waste materials. In contrast to the study conducted by Punongbayan (2014) in Lyceum of the Philippines University Batangas (LPU-B) on solid waste management program where he disclosed that collection of waste was effective. Similarly, Molina and Catan (2021) in their study on e-waste management awareness and practices among Grade 12 students disclosed that there was a good e-waste management practices in terms of disposal.

Table 14
Level of E-Waste Management Practices in Terms of Storage

Statements	Weighted Mean	Description
1. The institution has designated secure areas for the temporary storage of e-waste before disposal.	2.51	Moderately practiced
2. There are specialized containers for storing different types of e-waste to prevent environmental contamination.	2.40	Less practiced
3. An inventory management system to track the quantity and types of e-waste stored on-site is available.	2.42	Less practiced
4. There are measures in place to prevent unauthorized access to e-waste storage areas	2.39	Less practiced
5. The institution established protocols for the safe handling and storage of e-waste containing sensitive data to ensure data security.	2.42	Less practiced
Average Weighted Mean	**2.43**	**Less practiced**

Legend:

3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

Table 14 shows that the respondents claimed that the institutions had moderately practiced (2.51) securing designated areas for the temporary storage of e-waste before disposal. In other words, HEIs took the efforts of providing storage where e-waste materials were temporarily stored. The HEIs management knew the risk and danger of e-waste components to the environment and health of the people.

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Similarly, the respondents disclosed that measures in place to prevent unauthorized access to e-waste storage areas are less practiced (2.39). This implies that HEIs seldom considered measures to prevent unauthorized access to e-waste storage areas. In other words, they had less restrictions made to any personnel who intend to go to e-waste storage area.

Generally, the respondents disclosed that, they less practiced e-waste management in terms of storage with an average weighted mean of (2.43). This implies that the respondents did not consider seriously storing e-waste materials in storage areas. Since some HEIs have no storage areas for e-waste which lead the respondents to store their e-wastes not necessarily in storage areas. Storage of e-waste materials was less practiced because of the problems of waste management is due to insufficient funding, inadequate facilities and waste containers (Paghasian, 2017).

However, a study conducted in Pakistan concluded that the creation of an inventory is essential for emerging nations since e-waste generation is fluctuating and growing significantly in these regions. Additionally, they displayed the present growth in e-waste creation, which obviously necessitates appropriate processing and disposal of e-waste (Sajid et al., 2019). Hence, HEIs may include in their sustainability environment plan the creation of storage facilities for safe storing of e-waste before disposal.

Table 15
Level of E-Waste Management Practices in Terms of Recycling

Statements	Weighted Mean	Description
1. Recycling methods that recover valuable materials from e-waste is prioritized.	2.49	Less practiced
2. The institution provides easy access to e-waste recycling bins or collection points for employees.	2.36	Less practiced
3. The institution ensures that e-waste is processed in a manner that minimizes harm to the environment.	2.41	Less practiced
4.The promotion of e-waste recycling initiatives and programs to employees and stakeholders is well-established.	2.36	Less practiced
5.E-waste recycling practices are integrated into the overall sustainability strategy of the institution.	2.42	Less practiced
Average Weighted Mean	**2.41**	**Less practiced**

Legend:
3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

Table 15 reveals that, “recycling methods that recover valuable materials from e-waste is prioritized” got the highest mean of 2.49 described less practiced. This means that, the respondents did not give priority to using recycling methods that recovered valuable materials from e-waste. This can be inferred that, the respondents seldom recycle e-waste materials because they lacked the knowhow or the expertise and the time to carry out this practice.

In the same manner, the institution provides easy access to e-waste recycling bins or collection points for employees and the promotion of e-waste recycling initiatives and programs to employees and stakeholders was well-established with a mean of 2.36 described less practiced. This suggests that e-waste recycling bins or collection points were not evident in the campus. This could be interpreted that the HEIs did not provide any recycling bin for e-waste materials in the strategic areas of the campus. In the same manner, the respondents claimed that less priority was given to the promotion of e-waste recycling initiatives and programs to employees and stakeholders. This can be deduced that the HEIs did not have any program or initiative that promotes recycling as a method of handling e-waste materials.

In contrast, the study of Peralta & Fontanos (2006) argue that the recycling market should be strengthened in order to divert e-waste from landfills, extending their lifespan while also offering a new source of materials recovery as the amount of e-waste in the Philippines continues to increase, baseline information for planning and creating the buy-back programs and recycling facilities that are required to address this e-waste.

Overall, the average weighted mean of 2.41 described less practiced in e-waste management practices in terms of recycling. This indicates that recycling of e-waste materials in HEIs was not well established. The HEIs may not have

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given priority to recycling of e-waste materials as part of their agenda. This could be attributed to lacked of knowledge on how to recycle e-waste materials and lack of resources to carry out the recycling of the same. However, Mayers et al. (2008) on Extended Producer Responsibility for Waste Electronics reported that policy makers implemented a directive that will make producers responsible for waste electrical and electronic equipment at end-of-life known as the "WEEE" Directive. Under this new legislation, producers are required to organize and finance the take-back, treatment, and recycling of WEEE and achieve mass-based recycling and recovery targets. This legislation is part of a growing trend of extended producer responsibility for waste, which has the potential to shift the world's economies toward more circular patterns of resource use and recycling. Because of this study, HEIs may collaborate to producers or other stakeholders in terms of recycling to install recycling facilities in HEIs to promote the recycling process and train assign personnel of HEIs in handling e-waste.

Table 16
Summary of the Results on the Level of E-Waste Management Practices

E-Waste Management Practices	Weighted Mean	Description
Collection	2.43	Less practiced
Monitoring	2.44	Less practiced
Disposal	2.48	Less practiced
Storage	2.43	Less practiced
Recycling	2.41	Less practiced

Legend:

3.26 – 4.00 = highly practiced
2.51 – 3.25 = moderately practiced
1.76 – 2.50 = less practiced
1.00 – 1.75 = not practiced

As shown in Table 16, the various components of e-waste management practices were described less practiced. Among the five e-waste management practices, disposal was rated the highest (2.48), followed by monitoring (2.44), collection and storage with 2.43 each and the lowest rating (2.41) was recycling.

Analysis suggests that, these five e-waste management practices were not seriously carried out by the respondents specially on the recycling. This could be attributed to their lack of knowledge on e-waste management particularly in recycling or the HEIs did not strictly implement the e-waste management system practices for lack of resources.

The result of this finding as supported by the study of Peralta & Fontanos (2006) that the recycling market should be strengthened in order to divert e-waste from landfills, extending their lifespan while also offering a new source of materials recovery as the amount of e-waste in the Philippines continues to increase. Baseline information for planning and creating the buy-back programs and recycling facilities that are required to address this e-waste.

4. Significant difference on the level of awareness in the e-waste management when data are grouped according to Public and Private HEIs.

Collection

The data on e-waste awareness in terms of collection was subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing the data. The result shows that, there was a violation of the assumption of normality which implies that a non-parametric test was suitable in analyzing the data (W = 0.969, p-Value = 0.001).

Table 17
Level of Awareness in the E-Waste Management in Terms of Collection by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.71	2.80	0.708	0.443	0.0394	Accepted	Not significant
Private	2.77	2.80	0.734				

*Significant at @=0.05

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Table 17 shows that private HEI (2.77) has higher mean than the public HEI (2.71) which means that, the former have higher level of awareness on e-waste management practices in terms of collection than the latter though they have these same median (2.80). However, public HEIs have less variability in their level of awareness in terms of collection as shown in the standard deviation value. In other words, respondents in public HEIs manifested a more similar level of awareness on the collection practices of e-wastes. On the other hand, private HEIs had quite spread in their level of awareness in terms of collection. This means that respondents in private HEIs had variation in their collection practices of e-waste.

Furthermore, the p-Value of Mann-Whitney U (p-Value>.05) suggests that public HEIs and private HEIs personnel did not differ significantly in their level of awareness on e-waste management in terms of collection. In other words, the respondents in both types of HEIs have similar level of awareness on collection of e-waste, that is, moderately high. This level of awareness needs enhancement to make the respondents conscious about e-waste collection which could help their respective institutions implement the laws and ordinances governing e-waste management. The institutions have to conduct programs/projects/activities to make every personnel in the institution aware of the risks that e-waste can bring to the health and environment as a whole.

Furthermore, the effect size of 0.0394 indicated that types of HEIs has negligible effect on the level of awareness of the teaching and non-teaching personnel in e-waste management awareness in terms of collection. In other words, both types of HEIs have similar efforts in implementing Republic Act No. 9003 which consequently make their level of awareness on collection of e-waste moderately high. Both types of HEIs should take extra efforts to implement e-waste management in terms of collection by requiring every personnel to be conscious of the danger of e-waste if left unattended. In a study of Mor et al. (2021) the respondents did not differ significantly in their level of awareness of e-waste when categorized according to types of school. Therefore, the hypothesis which states that there is no significant difference on the level of awareness in the e-waste management in terms of collection was accepted.

Monitoring

The data on monitoring that measures the level of awareness of the respondents were subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing data. The result suggests that there was a violation to the assumption of normality which indicates that a non-parametric test was needed to analyze the data (w = 0.978, p-Value = 0.001).

Table 18
Level of Awareness in the E-Waste Management in Terms of Monitoring by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.64	2.60	0.787	0.174	0.0894	Accepted	Not significant
Private	2.76	2.80	0.701				

*Significant at @=0.05

Table 18 shows that private HEIs have higher mean than public HEIs which means that, the teaching and non-teaching personnel in private HEIs possessed a higher level of awareness than those in public HEIS on e-waste management in terms of monitoring and this is further validated in the median where private HEIs manifested a higher level of awareness than the public HEIs.

The standard deviation value (0.701) indicated that, the respondents in the private HEIs possessed similar level of awareness on monitoring of e-waste; whereas, the respondents in the public HEIs slightly differ than their counterpart as shown in the standard deviation value (0.787). Furthermore, the p-Value (p-Value >0.05) suggests that, the personnel of private HEIs and public HEIs displayed similar level of awareness on e-waste management in terms of monitoring, that is moderately high. The implication of this result is that HEIs cannot be a partner of the government in implementing e-waste management unless the former will take the initiative of creating an office in their respective institutions. This can be deduced that personnel in both types of HEIs need to intensify their level of awareness on monitoring of e-waste. This can be realized by attending seminars, symposia and other forms of e-waste conferences.

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On the part of the institutions, they should invite resource personnel from the local government unit to orient their personnel on e-waste management in terms of monitoring.

The effect size of types of HEIs to the level of awareness on e-waste management in terms of monitoring was negligible (.0894). This shows that the institutions have little impact on the level of awareness of the personnel on e-waste management in terms of monitoring. Analysis suggests that types of HEIs did not affect the level of awareness on e-waste management on monitoring among respondents. In other words, HEIs have similar efforts of introducing e–waste management program in terms of monitoring. In this study, moderate efforts were established that more sweats are needed to increase the level of awareness on e-waste management among personnel of HEIs. In a study of Mor et al. (2021) it was found out that types of school did not affect the level of awareness on e-waste management. Moreover, their study on E-Waste Awareness among Higher Secondary Students, no significant difference existed on the level of awareness when data are categorized to types of school.

The hypothesis which states that there is no significant difference on the level of awareness in the e-waste management in terms of monitoring was accepted.

Disposal

The data used for analysis was subjected to Shapiro Wilk test to establish the appropriate statistic to use in finding significant difference on the level of awareness on e-waste management in terms of disposal. The result shows that the assumption to the normality was violated as shown in the p-Value (w = 0.970, p-Value 0.001) which less than the alpha level of .05 indicating that a non-parametric test will be employed to analyze the data.

Table 19
Level of Awareness in the E-Waste Management in Terms of Disposal by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.66	2.80	0.800	0.026	0.146	Rejected	Significant
Private	2.84	3.00	0.671				

*Significant at @=0.05

As shown in Table 19, the private HEIs manifested a higher level of awareness than public HEIs on e-waste management in terms of disposal as shown in their respective means. This indicates that, the former possessed higher level of awareness than the latter on e-waste management in terms of disposal. The standard deviation values dictate that private HEIs have quite similar responses on their level of awareness on e-waste management in terms of disposal compared to pubic HEIs. In the same manner, the median of private HEIs are higher than that of the public HEIs which indicated that respondents in the former possessed higher level of awareness than the respondents in the latter.

Furthermore, the p-Value is less than the alpha level (p-Value<0.05) which indicated that there was significant difference on the level of awareness on e-waste management in terms disposal when data were grouped according to types of HEIs. In other words, private HEIs personnel were more aware on e-waste management in terms of disposal than the personnel of public HEIs. This means that private HEIs personnel were more aware on how to dispose their e-waste that the public HEIs personnel. This implies that private HEIs have taken steps in reminding their personnel on how to dispose e-waste or they have briefed their personnel the consequence of improper disposal of e-waste on their health and the environment. This can be further deduced that private HEIs were provided with information on how to dispose e-waste in their institutions.

The effect size is minimal which implies that types of HEIs slightly affected their level of awareness on e-waste management in terms of disposal. In other words, the institutions have not made notable contributions to increase the level of awareness on e-waste management in terms of disposal. The institutions have to seriously consider the implementation of Republic Act on e-waste management by coordinating with the appropriate government agency for its implementation. This finding is in contrast to the previous study which indicted that no significant difference existed on the level of awareness when data are categorized to types of school (Mor et al., 2021).

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The hypothesis which states that there is no significant difference on the level of awareness in the e-waste management in terms of disposal was rejected.

Storage

The data on e-waste awareness in terms of storage were subjected to Shapiro Wilk test to determine the appropriate statistic to use in the analysis of data. The result clearly reveals that there was a violation to the assumption of normality which suggests that a non-parametric test has to be used to analyze the data (W = 0.967, p-Value = 0.001).

Table 20
Level of Awareness in the E-Waste Management in Terms of Storage by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.75	2.80	0.817	0.035	0.139	Rejected	Significant
Private	2.96	3.00	0.612				

*Significant at @=0.05

Table 20 discloses that private HEIs recoded a higher mean than the public HEIs which indicated that, the former had demonstrated higher level of awareness on e-waste management in terms of storage than the HEIs A. The standard deviation value reveals that private HEIs manifested more similarities on the responses than the public HEIs with regard to awareness on the e-waste management in terms of storage. The is validated in the median where private HEIs had higher median than the public HEIs which signified that respondents in the former had higher level of awareness than the latter in terms of storage.

Furthermore, the p-Value (p-Value<0.05) indicates that there was a significant difference on the level of awareness on e-waste management in terms of storage when data are grouped according to types of HEIs. Private HEIs personnel were more aware than their counterpart on how e-waste are stored. The private HEIs were provided with information and instruction on how storage of e-waste can be undertaken. In other words, private HEIs had made more efforts of informing their personnel on how to store their e-waste than their counterparts in the public. Advocacies were made by private HEIs to make their personnel knowledgeable on how to store their e-waste in the campus.

However, the effect size (0.139) also suggests that types of HEIs had small effect in the level of awareness of e-waste management in terms of storage between private HEIs and public HEIs. Analysis of the results suggest that, types of institution is a variable that affected the level of e-waste management practices. This can be interpreted that HEIs displayed variability in the level of awareness on e-waste management in terms of storage. This is in contrast with the study of Mor et al. (2021) on E-Waste Awareness among Higher Secondary Students, no significant difference existed on the level of awareness when data were categorized to types of school. Therefore, the hypothesis which states that there is no significant difference on the level of awareness in the e-waste management in terms of storage was rejected.

Recycling

The data on e-waste awareness in terms of recycling was subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing the data. The result shows that there was a violation of the assumption of normality which implies that a non-parametric test was suitable in analyzing the data (W = 0.969, p-Value = 0.001).

Table 21
Level of Awareness in the E-Waste Management in Terms of Recycling by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.63	2.60	0.883	0.063	0.122	Accepted	Not Significant
Private	2.84	2.80	0.666				

*Significant at @=0.05

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Table 21 reveals that private HEIs registered a higher mean than the public HEIs which indicated that, the former had higher level of awareness than the latter on e-waste management in terms of recycling. However, private HEIs showed more similarities in their responses than the private HEIs with regard to the level of awareness on e-waste management in terms of recycling as indicated in their respective standard deviation values. Moreover, the median indicated that respondents of private HEIs have higher responses than public HEIs which means that, the former have higher level of awareness on recycling than the latter.

However, the p-Value (p-Value>0.05) indicates that, the two groups of respondents showed no significant difference in their level of awareness on e-waste management in terms of recycling. In the context of this study, both groups showed a moderate level of awareness on e-waste management in terms of recycling. This extent of awareness on recycling of both groups suggests that HEIs have to take the initiative to introduce programs/activities that will enhance respondents' level of awareness on e-waste management in terms of recycling.

Moreover, the effect size of .122 indicates that types of institutions have negligible effect on the level of awareness of the respondents with regard to e-waste management in terms of recycling. In other words, the institutions made little contribution on their personnel's' level of e-waste awareness in terms recycling. This can be inferred that little efforts were made by the institutions to introduce e-waste management on how to recycle them. In this case, a need for a strong advocacies have to be made within the institution to increase the level of awareness among their personnel in regard to recycling of e-waste materials. According to Mor et al. (2021) in their study on E-Waste Awareness among Higher Secondary Students, no significant difference existed on the level of awareness when data are categorized to types of school. The hypothesis which states that there is no significant difference on the level of awareness in the e-waste management in terms of recycling was accepted.

5. Significant difference on the level of practices in the e-waste management when data are grouped according to Public and Private HEIs.

Collection

The data on e-waste practices in terms of collection was subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing the data. The result shows that there was a violation of the assumption of normality which implies that a non-parametric test was suitable in analyzing the data (W = 0.954, p-Value = 0.001).

Table 22
Level of E-Waste Management Practices in Terms of
Collection by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.39	2.20	0.881	0.376	0.0581	Accepted	Not Significant
Private	2.47	2.60	0.883				

*Significant at @=0.05

It can be seen in Table 22 that private HEIs have a higher mean than the public HEIs which means that, the former manifested a better e-waste management practices in terms of collection than the latter. The standard deviation values suggest that both types of institution show variability in their responses on e-waste management practices in terms of collection. In other words, the respondents have mixed responses; some rated their practices in terms of collection high and others low; however, most of them had moderate practiced of e-waste collection. However, the median shows that the respondents of private HEIs possessed better practiced than the public HEIs in terms of collection of e-waste materials.

Furthermore, the p-Value (0.376) is greater than the assumed alpha (p-Value>0.05) implies that, there was no significant difference on the e-waste management practices in terms of collection when data was grouped according to types of institutions. In other words, HEIs regardless of type, demonstrated similar e-waste management practices in terms of collection. This can be deduced that private and public HEIs have made similar efforts of encouraging their personnel to observe collection practices of e-waste materials. In other words, both have moderately practiced in their collection of e-waste materials. Both types of institutions have to exert efforts of introducing measures on how to improve their e-waste practices in regards to collection.

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Moreover, the effect size of types of HEIs on the e-waste management practices in terms of collection is negligible which connotes that the institutions have not taken bold steps on the e-waste collection practices. A need for the HEIs to seriously consider the implementation of e-waste management by coordinating with the local government units to intensify the collection practices. Therefore, the
hypothesis which states that there is no significant difference on the level of practices in the e-waste management in terms of collection was accepted.

Analysis shows that, the variable, types of HEIs, was not a significant factor that affected the level of e-waste management practices in terms of collection. In other words, types of HEIs did not contribute heavily to the e-waste management practices in terms of collection. Regardless of types of HEIs, the respondents similarly demonstrated e-waste management practices in terms of collection. Both types of HEIs carried out similar level of collection practices of e-waste described less practiced. In other words, collection of e-waste as part of the management practices was not seriously pursued by HEIs. This result is consistent with the previous study which indicated that private and public schools have similar level of e-waste management practices (Bautista, 2019).

Monitoring

The data on e-waste management practices in terms of monitoring was subjected to a Saphiro Wilk Test to ascertain the appropriate statistic to use in analyzing the data. Shapiro Wilk test (W = 0.951, p-Value = 0.001) discloses that there was a violation of the assumption of normality which suggests that a non-parametric test was to be used.

Table 23
Level of E-Waste Management Practices in Terms of
Monitoring by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.42	2.40	0.861	0.769	0.025	Accepted	Not Significant
Private	2.45	2.60	0.853				

*Significant at @=0.05

As shown in Table 23, the private HEIs generated a slightly higher mean than the public HEIs which means that, the former had better e-waste management practices in terms of monitoring than the latter when data were grouped according to types of HEIs. Furthermore, private HEIs manifested more similar responses than the public HEIs on e-waste management practices in terms of monitoring as shown in their respective standard deviation values.

Furthermore, the p-Value (0.769) is greater than the assumed alpha (p-Value>0.05) which indicates that there was no significant difference on the e-waste management practices in terms of monitoring when data are grouped according to types of HEIs. This further means that both types of institutions have similar monitoring practices of e-waste materials that is less practiced. Both types of HEIs have to intensify their monitoring of e-waste materials in order to improve their practices by inviting resource persons from local government units to conduct seminar on monitoring of e-waste materials. The implication of this result can contribute to environmental hazard which can also affect the health of the students as well of their personnel.

The effect size suggests the types of HEIs have a negligible effect on the e-waste management practices in terms of monitoring. Analysis suggests that the type of HEIs was a variable that did not affect the assessment of the respondents on the e-waste management practices in terms of monitoring. In the context of this study, monitoring as a management practice on e-waste was less practiced regardless of the types of educational institution. This can be interpreted that HEIs regardless of type exerted similar efforts in monitoring e-waste materials. The level of e-waste management practices in terms of monitoring has to be taken seriously to enhance the level of e-waste management practices in terms of monitoring among HEIs. Bautista (2019) showed that, there was no significant difference on e-waste management practices between public and private schools. Therefore, the hypothesis which states that there is no significant difference on the level of practices in the e-waste management in terms of monitoring was accepted.

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Disposal

The data on e-waste practices in terms of disposal was subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing the data. The result shows that there was a violation of the assumption of normality which implies that a non-parametric test was suitable in analyzing the data (W = 0.969, p-Value = 0.001).

Table 24
Level of E-Waste Management Practices in Terms of Disposal by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.39	2.20	0.850	0.024	0.148	Rejected	Significant
Private	2.60	2.60	0.828				

*Significant at @=0.05

Table 24 shows that private HEIs registered a higher mean than the public HEIs which indicates that the former manifested better e-waste management practices in terms of disposal than the latter The standard deviation indicates that private HEIs respondents were more homogenous than the public HEIs respondents in regard to their e-waste management practices in terms of disposal. In other words, responses from private HEIs were more similar than the public HEIs on disposal practices. Moreover, the median shows that private HEIs had higher level of responses than public HEIs on e-waste management practices in terms of disposal. In other words, as a group private HEIs had higher group responses than the public HEIs on disposal practices.

Furthermore, the p-Value (0.024) which is less than the alpha level (p-Value<0.05) which indicates that there was a significant difference on the e-waste management practices in terms of disposal among respondents when grouped according to types of HEIs. The data further dictated that types of HEIs had a negligible effect on the responses of the respondents on e-waste management practices in terms of disposal. The hypothesis which states that there is no significant difference on the level of practices in the e-waste management in terms of disposal when data are grouped according to types of HEIs was rejected.

Analysis shows that the variable, types of HEIs, affected the e-waste management practices in terms of disposal. In other words, private HEIs were more serious than public HEIs in implementing e-waste management in terms of disposal. This implies that personnel in private HEIs were religiously practicing proper e-waste disposal perhaps because the HEI management has been pushing for its implementation. The result supported previous study which indicated that private school had better e-waste management practices than the public schools (Bautista, 2019).

Storage

The data on e-waste practices in terms of disposal was subjected to Shapiro Wilk test to ascertain the appropriate statistic to use in analyzing the data. The result shows that there was a violation of the assumption of normality which implies that a non-parametric test was suitable in analyzing the data (W = 0.964, p-Value = 0.001).

Table 25
Level of E-Waste Management Practices in Terms of Storage by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.35	2.20	0.880	0.085	0.113	Accepted	Not Significant
Private	2.53	2.60	0.802				

*Significant at @=0.05

It can be gleaned from Table 25 that private HEIs registered a higher mean than the public HEIs which means that the former have better e-waste management practices in terms of storage than the latter. The same table revealed

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that private HEIs demonstrated more similar responses than the public HEIs which can described the former were more homogenous as a group than the latter. In addition, the respondents in private HEIs have higher responses than the respondents in public HEIs as evidenced in the median values.

The p-Value= 0.085 (p-Value>.05) suggests that there is no significant difference on the e-waste management practices in terms of storage when data were grouped according to types of HEIs. In other words, the respondents, regardless of types of HEIs, did not significantly differ in their e-waste management practices in terms of storage. Therefore, types of HEIs does not affect the e-waste management practices in terms of storage. They manifested similar level of e-waste management practices in terms of storage which is described less practiced. This can be surmised that the HEIs as a whole did not seriously consider the implementation of storage for their e-wastes because they did not have a set of policies and guidelines on how e-waste can be handled. Bautista (2019) in his study on the "Level of awareness and practices on e-waste management among college students" revealed that public and private schools did not differ in the e-waste management practices.

The effect size of .113 revealed that types of institutions had negligible effect in the variation of the respondents' responses on storage practices. This can be deduced that, the institutions have not greatly made efforts to improve storage practices on e-waste materials as evidenced in their collective practices of less practiced. Therefore, the hypothesis, which states that there is no significant difference on the level of e-waste management practices in terms of storage when data are grouped according to types of HEIs, is accepted.

Recycling

The data on e-waste management practices in terms of recycling was subjected to Shapiro Wilk which discloses that the p-Value (W = .963, p-Value = .001) is less than the alpha level indicating that a violation of the assumption of normality was violated. This means that a non-parametric test specifically the Mann-Whitney U test will be used.

Table 26
Level of E-Waste Management Practices in Terms of Recycling by types of HEIs

Types of Institution	Mean	Median	Sd	p-Value	Effect size	Decision	Interpretation
Public	2.34	2.20	0.885	0.140	0.0968	Accepted	Not Significant
Private	2.49	2.60	0.858				

*Significant at @=0.05

As shown in Table 26, private HEIs obtained a higher mean than the public HEIs which means that, the latter had better e-waste management practices in terms of recycling than the former. However, the public HEIs had lower standard deviation than the private HEIs which means that, the former had similar responses than the latter.

Furthermore, the p-Value= 0.140 (p-Value>.05) suggests that there is no significant difference on the level of e-waste management practices in terms of recycling when data are grouped according to types of HEIs. In other words, HEIs, regardless of types, manifested similar recycling e-waste management practices which are described less practiced. This result suggests that HEIs have to make a huge effort to improve their recycling practices.

The data also show that, the effect size of types of HEIs on the e-waste management practices in terms of recycling is negligible. Analysis suggests that the variable, types of HEIs, did not greatly affect the e-waste management practices in terms of recycling. Both types of HEIs showed similar level of e-waste management practices in terms of recycling, that is less practiced. In other words, the respondents experienced similar e-waste management practices in recycling in their respective HEIs. Both types of HEIs did not take extra efforts to implement recycling of e-waste because of the absence of guidelines and policies. This result confirms previous study which indicated that there was no significant difference on the on e-waste management practices between public and private schools (Bautista, 2019). Therefore, the hypothesis, states that there is no significant difference on the e-waste management practices in terms of recycling was accepted since the p-Value is beyond the threshold of alpha 0.05.

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CONCLUSION:

Based on the findings, the following conclusions were drawn:

1. There is a need to minimize the ICT, Telecommunications Equipment and Office Electronics waste by improving the proper handling and maintenance of electronic materials.
2. There is a need for the teaching and non-teaching personnel of the HEIs to strengthen their level of awareness on e-waste management in terms of collection, monitoring, disposal, storage, and recycling.
3. The teaching and non-teaching personnel have to enhance their e-waste management practices in terms of collection, monitoring, disposal, storage, and recycling.
4. HEIs A have to exert efforts to increase the level of awareness on e-waste management of their personnel in terms of disposal and storage.
5. HEIs A have to enhance their e-waste management practices in terms of disposal.

RECOMMENDATIONS:

Based on the findings the following recommendations were made:

1. HEIs may provide e-waste management seminars to their teaching and non-teaching staff in order to raise awareness and improve existing procedures. Bringing in experts from local or national government organizations and other interested parties who can help ensure the seminars go smoothly.
2. The local government units may take the initiative to conduct an orientation designed to strengthen e-waste management program of the HEIs. The local government can orient personnel of the HEIs on policies and regulations governing e-waste management for effective implementation.
3. HEIs may develop regulations and policies for managing e-waste because Electronic and ICT equipment were used extensively by most HEIs.
4. HEIs may promote advocacy campaign activities regarding E-waste management practices and awareness.
5. A similar study may be conducted by other researchers in the other Region to include more HEIs to confirm the findings of this study.

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