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Institutional e-waste management: A knowledge, attitude, and perception study among the administrative staff at Mindanao State University, Iligan Institute of Technology, Philippines

Rezanne Mabyl Burlado*, Rodolfo II Romarate, Peter Suson, Wella Tatil

Department of Environmental Science, School of Interdisciplinary Studies, Mindanao State University, Iligan Institute of Technology, Tibanga, Iligan City, Philippines

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ABSTRACT

As institutions continuously rely on electronic devices for their services, the management of electronic waste (e-waste) has become an environmental concern. E-wastes, which comprises electrical and electronic equipment (EEE), is known to be an emerging contaminant and one of the fastest growing waste streams; yet limitedly known. This study investigates the knowledge, attitudes, and perceptions (KAP) of the staff in various administrative offices at Mindanao State University - Iligan Institute of Technology (MSU-IIT) towards institutional e-waste management. Using a descriptive quantitative design, surveys were distributed across university offices to assess the KAP and identify areas for improvement in policy, training, and institutional engagement related to e-waste handling. Results revealed high familiarity with the term "e-waste" (mean = 3.68) and a high awareness of the hazardous substances it contains (mean = 3.82). However, there is limited knowledge about the university's "take-back" policy (mean = 3.05), and 72.50% of the respondents were unaware of the designated disposal facility. Correlation analysis revealed a strong correlation between knowledge and perception (r=0.95), and between knowledge and attitude (r=0.97), implying that those who are informed on e-waste tend to have insights into the risks it poses. Nonetheless, it also indicates that knowledge alone does not ensure responsible practices. The findings highlight the need for a clearer orientation, policy dissemination, and training to strengthen administrative participation in e-waste handling. This study contributes actionable insights for improving MSU-IIT's waste management systems and advancing institutional sustainability.

***Corresponding Author:** Rezanne Mabyl Burlado ✉ rezannemabyl.burlado@g.msuiit.edu.ph
https://orcid.org/0009-0006-5843-2406

Co-authors:
Rodolfo II Romarate: https://orcid.org/0000-0002-8528-0675
Wella Tatil: https://orcid.org/0009-0007-2025-3653

INTRODUCTION

According to the World Health Organization (2024), electronic wastes (e-wastes) are classified as an emerging contaminant and known to be one of the fastest growing solid waste streams in the world. E-waste is all electrical and electronic equipment (EEE) that reached its end-of-life (Pont *et al.*, 2019). These consist of television sets, computers, smartphones, air-conditioning units, or any items that have circuit and electrical components that have power and battery supply (Parajuly *et al.*, 2019). E-waste can be both hazardous and a resource, as it contains valuable elements, such as Gold (Au), Silver (Ag) and Lead (Pb) (Rawat *et al.*, 2019). However, it is also hazardous since it may release toxic substances such as Lead (Pb), Mercury (Hg), and Cadmium (Cd) into the environment, potentially causing contamination that affects human safety and health (Garcia *et al.*, 2024).

Higher Education Institutions (HEI) are a significant contributor of e-waste, primarily due to frequent upgrading of Information Communication and Technology (ICT) equipment. The demand for advanced technological equipment in higher education institutions has increased to support the modernization of learning and the integration of information and communication technologies (ICT) (Dayaday and Galleto, 2022). This often results in the accumulation of large amounts of discarded or obsolete electronics, many of which are either stored for extended periods of time or improperly discarded (Adrias and Dalugdog, 2025; Bravo *et al.,* 2025). All sectors, including individuals and institutions, are known to be a contributor to the growing e-waste stream (Nandan *et al.,* 2023).

Regardless of the growing volume of e-waste in HEIs, only a few studies have been conducted to evaluate the level of awareness among institutional stakeholders. For instance in the Philippines, Adrias and Dalugdog (2025) conducted a study at Laguna State Polytechnic University and found that while the respondents are aware of the potential danger and hazard of obsolete electronic equipment (EEE), this awareness does not translate into action. Similarly, Meneses and Galita (2015) reported that although respondents at Bulacan State University have a higher awareness of e-waste, most of the discarded electronic equipment remained stored in the warehouse which indicates the inefficiency of their disposal practices.

Similar patterns have been observed internationally. In Zimbabwe, Maphosa (2021) assessed the knowledge of students regarding e-waste, where it was found that although they are aware of e-waste and its hazard, there is a lack of awareness on its regulations and collections. In Australia, Islam *et al.* (2020) found that although students demonstrated high awareness, due to limited formal recycling programs their disposal practices remained insufficient.

These findings suggest that awareness alone does not guarantee responsible e-waste practices. As Borawska (2017) emphasizes, while the development of sustainability programs is the responsibility of policymakers, its success is dependent mostly on awareness, opinion and understanding of people they aim to serve. In a study by Awitan and Gervacio (2025), it cited Bhutoo *et al.* (2023), who found that attitudes, perceived behavioral control, and openness to experience significantly shape e-waste recycling intentions. It highlighted the need for interventions that go beyond awareness.

In an institutional setting, understanding how every working individual perceives and responds to issues is essential in designing effective programs. Thus, assessing the knowledge, attitudes and perceptions (KAP) of administrative personnel provides critical insights in developing effective policies and training programs that align with the needs and behavior.

At the Mindanao State University - Iligan Institute of Technology, although the students were aware of e-waste and their potential hazard, practices on formal recycling and adherence to e-waste management are still lacking (Habagat *et al.*, 2024). E-waste continues to pose increasing challenges to environmental and

human health. While existing studies often focus on academic departments and student populations, the role of administrative offices and personnel remains largely overlooked. Administrative units are equipped with various electronic equipment, including computers, scanners and printers among others. However, there is still a gap in understanding how non-teaching units participate, manage, mitigate, or handle the obsolete electronic equipment.

As universities such as MSU-IIT continue to digitize services and upgrade infrastructure, administrative offices likely generate, accumulate and dispose of a large amount of electronic waste, making administrative offices a crucial component of sustainability efforts of the university.

To address this gap, this study seeks to evaluate the knowledge, attitude, and perceptions (KAP) of administrative staff at Mindanao State University - Iligan Institute of Technology (MSU-IIT) towards institutional e-waste management. Specifically, this study aims to assess the KAP of MSU-IIT administrative staff and identify areas for improvement in policy, training, and institutional engagement related to e-waste handling. The findings of this study aim to contribute to the development of a comprehensive and sustainable waste management system of the University.

This research also offers insights for all academic communities worldwide to participate in the“zero waste” approach. When a university adopts sustainable practices, it does not only benefit its own community but extend its influence beyond its boundaries. Through responsible e-waste management on campus, and by embedding its value and lessons into a campus culture, it does not only contribute to their local government but also to global sustainability (Awitan and Gervacio, 2025; Rodríguez-Guerreiro *et al.*, 2024). As Higher Education Institutions strengthen its role in sustainability this study contributes to the United Nations Sustainability Development Goals (SDGs), specifically, SDG 11: Sustainable Cities and Communities, which aims to properly manage e-waste , improve its collections, and recycling rates, and reduce environmental impacts from landfill (Forti *et al.*, 2020); SDG 12: Responsible consumption and production, that targets to reduce waste generation, ensuring sustainable production and consumption patterns (Anuardo *et al.*, 2023; Forti *et al.*, 2020); and SDG 17: Partnership for goals, which encourages the strengthening and creation of partnerships among governments, private sector, and civil society to attain sustainable e-waste management (Anuardo *et al.*, 2023). It act as a role model to promote sustainability and sustainable lifestyle.

MATERIALS AND METHODS

Sampling area

Mindanao State University - Iligan Institute of Technology (MSU-IIT), established in 1968, is recognized for its strong foundation in science and technology, its commitment to rigorous research, and its active involvement with communities (Mindanao State University - Iligan Institute of Technology, n.d.). The university upholds academic excellence and promotes the holistic development of individuals and society (Fig. 1).

This study was conducted within MSU-IIT main campus and examines how the university manages their generated e-waste. It focuses on the knowledge, attitude, perceptions, and practices of administrative staff regarding e-waste, using these insights to understand how environmental practices are carried out in the university.

Research design

This study utilizes a descriptive quantitative design, in which a survey was conducted to determine the knowledge, attitude, and perceptions of administrative staff regarding e-waste.

The study employed a purposive sampling approach, targeting administrative personnel across university offices, with participation based on availability and willingness to respond.

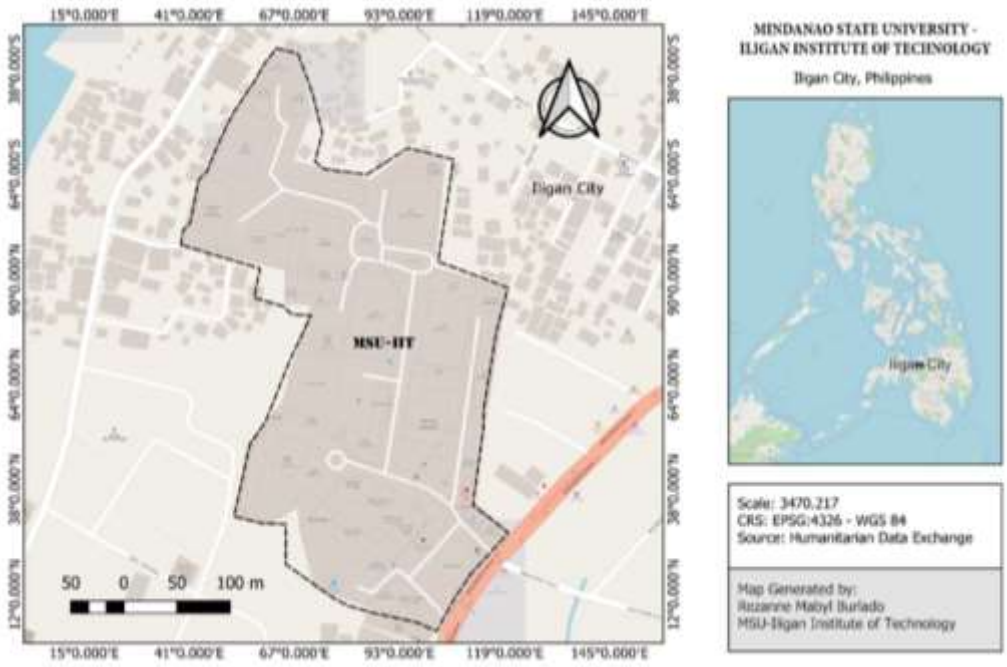

Fig. 1. Study location map

Surveys were distributed in printed form and administered in person, allowing respondents to complete the survey at their convenience. Additionally, informal conversation and field observation were also noted to provide contextual insights into the administrative practices and perceptions. These conversations were not audio-recorded or transcribed, but key points were noted. This approach allowed for spontaneous reflections and candid observations, especially in settings where administrative staff were busy and loaded with work. While these accounts are presented with caution, they offer valuable perspectives that complement the structured survey data and enrich the understanding of e-waste management practices within the university.

Prior to data collection, the study secured an approval from the university's chancellor for the research permit. The ethical clearance with a number of UERB CODE: UERB-2025-00426 was also obtained from the university's Institutional Ethics Review Committee, and informed consent was presented to all participants.

Data collection and analysis

The study distributed the survey based on the university's organizational structure (Table 1), which outlined the administrative offices targeted for the participation. To estimate the total population, a staff count was requested from the Human Resource Management Division.

Table 1. Administrative offices involved in e-waste generation and management at MSU-IIT

Offices	Sub-offices/Department
Office of the Chancellor (OC)	Centralized Secretariat
	Office of Budget Management
	Internal Audit Services Unit
	Office of the Campus Secretary
	Security and Investigation Division
	Office of Legal Services
	Office of Public Information
	Research Integrity and Compliance Office
Vice-Chancellor for Academic Affairs (OVCAA)	Office of the University Registrar
	University Library
	Office of Admissions Scholarships and Grants
	Office of the National Services Training Program

Vice-Chancellor for Administration and Finance (OVCAF)	Accounting Division Cashiering Division Human Resource Management Division Physical Plant Division Supply and Property Management Division Procurement Management Division Office of Business Affairs
Vice-Chancellor for Strategic Initiatives (OVCSI)	Office of Institutional Planning and Development Services Office of Monitoring and Evaluation Office of Quality Assurance and Management Services Mindanao Center for Resiliency
Vice-Chancellor for International Affairs (OVCIA)	WE CARE OFFICE
Vice-Chancellor for Public Affairs (OVCPA)	Alumni and Endowment Fund Center Gender and Development Center Institute for Peace and Development in Mindanao Institute for Policy Innovation and Leadership
Vice-Chancellor for Research and Enterprise (OVCRE)	Research Management Office Research Dissemination Office Knowledge and Technology Transfer Office

HRMD provided a number of permanent staff per office. A total of 225 permanent staff were counted excluding administrative personnel under colleges and Integrated Development School (IDS). Some offices were nested under broader divisions in the HR system, which led to certain units not being reflected in the records.

To calculate the minimum required sample size, Slovin's formula was applied using the 225 population of administrative staff. At a 5% margin of error, an approximately 144 calculated sample size. However, due to time constraints and willingness to participate, only 120 responses were collected. Job classification was not verified, so all responses were analyzed as a single group (Table 2).

Table 2. Distribution of survey responses compared with HR-reported staff in administrative offices

Offices	HR permanent staff count	Actual sample
OC	48	21
OVCAA	33	5
OVCRE	10	4
OVCAF	42	22
OVCSI	10	8
OVCSS	19	10
OVCPA	5	10
OVCIA	-	3
Others*	58	37
Total	225	120

Note: Some job order staff may be included due to the nature of survey distribution, however job classification was not verified. *This includes other offices listed by the HR

The data was collected using a structured survey tool, allowing the administrative staff to respond without disrupting their daily duties. The KAP survey instrument was adapted and modified from Habagat *et al.* (2024), and was divided into four sections: (i) respondents's socio-demographic profile; (ii) knowledge of e-waste management; (iii) attitudes on e-waste management; and (iv) perception of e-waste management.

The survey responses were compiled in google sheets and analyzed to identify patterns in knowledge, attitudes, and perceptions related to e-waste. A 5 point likert scale was also used where "1" represents "Strongly Disagree" to a "5" represents "Strongly Agree", and follow up questions which were answerable by "Yes" or "No", with open-ended questions specifying their answers. Mean and standard deviation were also calculated; mean scores tell us a summary of respondents' general stance or awareness in each domain, while standard deviation indicates the degree of variability in responses, or how spread the answers are. These descriptive statistics provide an interpretation of the overall trends of the respondents' answers. The values were then interpreted as reflected in Table 3.

To examine the relations among Knowledge, Attitude, and Perception, correlation analysis was conducted using Pearson's correlation coefficient (r). This method assesses the strength and direction of linear relationships between continuous variables (Table 4).

Table 3. Assigned values and interpretation ranges for survey responses

Description	Value	Mean score range
Strongly agree	5	4.20-5.00
Agree	4	3.40-4.19
Slightly disagree	3	2.60-3.39
Disagree	2	1.80-2.59
Strongly disagree	1	1.00-1.79

Table 4. Interpretation Guide for Correlation Coefficients adapted from Schober *et al.* (2018)

Correlation coefficient r	Interpretation
0.00 - 0.10	Negligible correlation
0.10 - 0.39	Weak correlation
0.40 - 0.69	Moderate correlation
0.70 - 0.89	Strong correlation

In assessing the perceived hazard level of different electronic equipment, respondents were asked to rank the 5 items from most to least hazardous. Each rank was assigned a corresponding weight rank 1 = 5, rank 2 = 4, rank 3 - 3, rank 4 = 2, and rank 5 = 1. The total weighted scores were then calculated by multiplying the frequency of each rank by its assigned weight. Higher scores indicate greater perceived hazard.

Limitations

While the study employed a purposive sampling approach targeting administrative staff, participation was voluntary and dependent on staff's availability. The survey was distributed by administrative offices, consequently job classification of respondents was not tracked or verified.

Participation was based solely on willingness and availability, so the actual sample was analyzed as a whole. It also includes offices in HR records but not reflected in the university's Gantt Chart, as well as responses from participants who did not specify their department.

This approach was chosen to maximize response rate and reach a broader pool of participants, recognizing that administrative staff are also busy with their own work responsibilities. As a result, the sample may not fully represent the entire administrative population, and findings should be interpreted with this limitation.

Additionally, some insights were gathered through informal conversations rather than structured interviews. These exchanges were not audio-recorded or formally transcribed and were done respecting the limited time of the staff due to work load.

Furthermore, the high correlation observed between knowledge, attitude, and perception may be due to conceptual overlap among knowledge, attitude, and perception, as well as the use of self-report Likert scales that encourage consistent responses among the variables. While these values provide strong support for the KAP framework, they should be interpreted with caution, recognizing that measurement overlap may have contributed to the strength of the coefficients.

RESULTS AND DISCUSSION

Demographic profiles of respondents

Among the 120 respondents, 44.17% identified as female, 31.67% as male, 0.83% as transgender, and 23.33% preferred not to disclose their gender identity. This distribution reflects a diverse and inclusive respondent pool, with a significant portion opted for privacy. The largest age group is 26-30 years old (23.33%), followed by respondents who were over 46 years old (15.83%), then 22-25 years old (13.33%). A notable number (23.33%) also chose not to disclose their age. Respondents varied in length of service, with 25.00% having served the university for more than 10 years. This shows a strong presence of long-term staff. Meanwhile, 23.33% served the university for 1-3 years, and about 8.33% of the participants were newly hired (less than 1 year). Notably, 25.83% of the respondents preferred not to disclose their tenure (Table 5).

Knowledge of e-waste management

To achieve effective e-waste management, stakeholders awareness is a key factor (Islam *et al.*, 2020). Thus, the proper handling of e-waste must be observed. To handle such waste, it is necessary that stakeholders must be knowledgeable about its potential hazard and value. In this study, the majority of respondents strongly agreed (18.30%) and agreed (50.8%) to be familiar with "e-waste" and its definition (Fig. 2); indicating that more

than half of the respondents expressed clear awareness of the term. Simultaneously, 30.8% expressed varying levels of disagreement, suggesting that even though the level of awareness is high, some respondents may benefit from further orientation and seminar on e-waste.

Table 5. Demographic characteristics of the staff who participated in the survey

Demographic variables		Frequency (n=120)	Percentage
Gender	Male	38	31.67
	Female	53	44.17
	Transgender	1	0.83
	Prefer not to say	28	23.33
Age	18-25 years old	16	13.33
	26-30 years old	28	23.33
	31-35 years old	11	9.17
	36-40 years old	12	10.00
	41-45 years old	6	5.00
	> 46 years old	19	15.83
	Prefer not to say	28	23.33
Years in service	< 1 year	10	8.33
	1-3 years	28	23.33
	4-6 years	11	9.17
	7-10 years	10	8.33
	> more than 10 yrs	30	25.00
	Prefer not to say	31	25.83

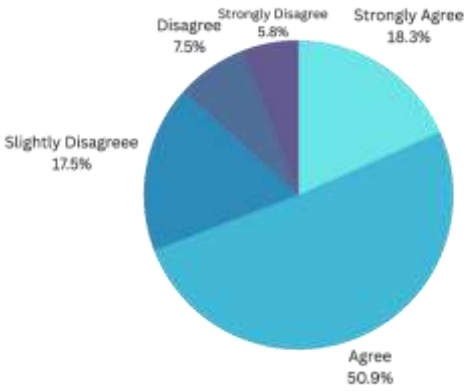

Fig. 2. Respondents' familiarity with the term "electronic waste or e-waste"

Nonetheless, respondents demonstrated a high level of knowledge about e-wastes and its environmental implications (Table 7). Awareness on hazardous substances that an e-waste contains was a bit higher, with a mean of 3.82 (SD=0.98), suggesting that respondents recognize the potential harm that discarded electronics are associated with. Knowledge on the separation of e-waste from general solid waste is also high (mean=4.24;SD=0.75), which indicates that most of the respondents are aware of the importance of the special waste segregation for e-wastes.

Improper disposal of e-waste has been linked to environmental and health problems, including the release of hazardous substances such as mercury, contributing to environmental contamination and health risks on humans (Houessionon *et al.*, 2021; Vaidya *et al.*, 2025).

Environmental knowledge was strongly acknowledged. The statement "I know unmanaged e-waste can cause soil, air, and water contamination, hence, environmental pollution", received a mean score of 4.07 (SD=0.83), while "I know e-waste management is important for environmental protection" received a mean score of 4.27 (SD=0.72). This suggests that respondents are highly aware of the environmental value of proper e-waste handling. These findings align with the study of Habagat *et al.* (2024), which reported similarly high levels of e-waste knowledge among MSU-IIT students, suggesting that both administrative staff and students of the university possess a strong foundational understanding of e-waste and its environmental significance.

However, knowledge on e-waste policies and procedures was more diverse. The statement "I am familiar with how this e-waste is managed and discarded" had a lower mean score of 3.29 (SD=0.99), stipulating that there is uncertainty or limited knowledge about institutional practices.

Nonetheless, respondents agreed for an institutional system for proper e-waste inventory (M= 3.97; SD=0.91) and labeling (M= 3.89, SD= 0.37).

Knowledge on take-back policy (M=3.05, SD=0.98) was relatively low and the respondents expressed support for the implementation of this policy, signifying their recognition of its proper enforcement (M= 3.84, SD= 0.73). The university implements a "take-back" policy through

Memorandum Receipt (MR) system. Employees who are issued electronic devices receive an MR, making them responsible for the equipment until its end-of-life (EoL) or replacement (Habagat *et al.*, 2024). Once the equipment reaches its useful life, it will be then handled and turned over to the supply and procurement management division for its disposal.

In terms of the awareness of institutional e-waste management practices at MSU-IIT. Most (86.67%) of the respondents are not familiar with the e-waste management and of the policies on how to manage obsolete electronic equipment (76.67%) in the university. Similarly, they (72.50%) do not know of any facility within ITT that disposes of e-waste (Table 6).

Table 6. Respondent's awareness on E-waste management practices at MSU-IIT

Question	Yes (n, %)	NO (n,%)	No answer (n,%)
Are you familiar with any e-waste management practices currently implemented at MSU-IIT?	11 (9.17%)	104 (86.67%)	5 (4.17%)
Does your department have policies on how to manage obsolete electronic equipment?	20 (16.67%)	92 (76.67)	8 (6.67%)
Do you know where the e-waste is supposed to be stored or handed over within the department?	39 (32.50%)	74 (61.67%)	7 (5.83%)
Do you know when discarded e-waste should be transferred to the assigned office?	32 (26.67%)	76 (63.33%)	12 (10.00%)
Do you know any facility in MSU-IIT to dispose of E-waste?	23 (19.17%)	87 (72.50%)	10 (8.33%)

Table 7. Respondent's knowledge on e-waste management

Sl	Statement	Mean	Std. Dev.
1	I am familiar with the term "electronic waste or e-waste" and its definition.	3.68	1.05
2	I am aware that these devices can contain hazardous substances.	3.82	0.98
3	I know e-wastes may contain recoverable precious metals like copper, iron, gold, silver, platinum and rare earth elements.	3.87	0.96
4	I know e-waste pollution can affect human health	4.11	0.77
5	I know unmanaged e-waste can cause soil, air, and water contamination, hence, environmental pollution	4.07	0.83
6	I am aware that e-waste must be separated from other waste.	4.24	0.75
7	I know e-waste management is important for environmental protection.	4.27	0.72
8	I am familiar with how this e-waste is managed and discarded.	3.29	0.99
9	I know that improper storage of batteries and mercury-containing bulbs may lead to explosions or chemical exposure.	4.14	0.77
10	Regular maintenance can reduce e-waste	4.11	0.73
11	I know about the take-back policy on e-waste.	3.05	0.98
12	I think a take-back policy would be effective in e-waste management at MSU-IIT.	3.84	0.73
13	I know that damaged electronic equipment (computer, laptops, printers) on campus is being condemned in the Procurement Plan and Development of the MSU-IIT	4.12	0.87
14	I know e-waste must be inventoried	3.97	0.91
15	I know that e-waste must be labeled properly when disposed	3.89	0.37
16	There is a proper storage area in the office for discarded waste products.	3.71	1.11

Habagat *et al.* (2024) noted the unfamiliarity of students about the "take-back" policy, which is also similar to the findings of this study revealing a low knowledge of the policy among the administrative staff. This is notable since administrative staff are the primary recipients of electronic equipment and are expected to participate in the take-back process. This low awareness may be due to the composition of the respondents. While 25% of the respondents had more than 10 years in service, significant portions (23.33%) are only with the university for 1-3 years. This variation suggests that the policy may not be distributed or spread among the staff, particularly to those newer and contractual.

Fig. 3 shows a comparison between two groups of respondents, one with 10 years and above of service, and those with 0-3 years. Both groups showed below 50% of agreement of the take-back policy. This is a bit concerning since it is expected for the first group to have knowledge, and presumed to have received memos or orientation with the turnover of

equipment. It is also important to note that Job Order (JO) or contractual employees are typically not issued electronic equipment which may influence their knowledge about the said policy. This low awareness suggests that the policy, although operational, may not be communicated across the institution, which highlights the need for clearer orientation not only for those who are directly handling the equipment but also for the whole university community.

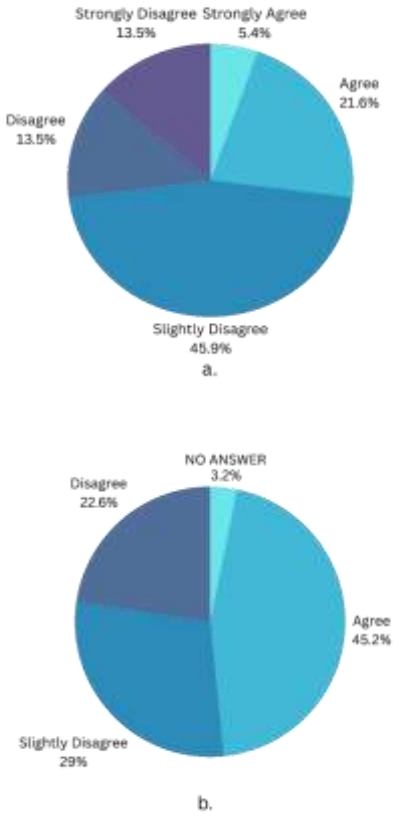

Fig. 3. Comparison of knowledge on take-back policy between newer employees (a. 0-3 years in service) and older employees (b. 10-above years in service)

Understanding which items that the administrative staff perceived, gives an insight into their level of awareness and disposal practices. High perceived knowledge often leads to strong behavioral intentions with regards to responsible waste management (Owojori *et al.*, 2022).

Respondents were asked to identify the common e-waste that they perceived that their department generates. The survey allowed multiple selection with categories: large household and laboratory appliances (LLA), small household and laboratories appliances (SLA), IT and telecommunication equipment (ICT), consumer equipment and photovoltaic panels (CEP), lighting equipment (LE), electrical and electronic tools (EET), toys, leisure, and sport equipment (TLS), medical devices (MD), monitoring and control instruments (MCI) and automatic dispenser (AD). Fig. 4 presents the distribution of e-waste that the respondents think their department generates. IT and telecommunications equipment (ICT) come out as the most identified e-waste (71.67%), followed by lighting equipment (LE) and large household and laboratory appliances, (LLA) with 52.50% and 38.33%, respectively. This was also seen in the study of Meneses and Galita (2015), where the inventoried e-waste found that IT and telecommunications equipment were the dominant category. This pattern reflects the increasing demand for information and communication technologies (ICT) driven by digitalization, and also the reliance on ICT devices in admin and academic settings (Ghulam and Abushammala, 2023).

Fig. 4. Distribution of e-waste categories identified by respondents

Attitude and practices of e-waste management

Overall, the data collected reflects a highly favorable disposition toward responsible e-waste practices (Table 8). The highest mean score recorded was on the importance of e-waste management (M= 4.39, SD= 0.69), indicating a strong agreement among the respondents.

Additionally, respondents also favor learning more about the proper e-waste disposal methods and its implications (M= 4.24; SD= 0.70), suggesting that

they are open to the opportunity to deepen their knowledge and promote responsible e-waste practices.

One informant reveals that after using the electronic equipment, they do not feel responsible for its disposal, stating that it will eventually be condemned by the Supply Office and that its fate does not affect them. Another informant also said that small e-waste such as batteries are sometimes disposed of in trash bins, resulting in their mixture with general waste. This practice highlights the absence of accessible disposal options and the need for clearer guidance on handling minor e-waste. This attitude was similarly observed in the study of Adrias and Dalugdug (2025), where although the respondents demonstrated a high level of awareness of the potential hazard of e-waste, their knowledge did not translate into action.

Table 8. Respondents' attitudes toward e-waste management

Sl	Statement	Mean	Std. Dev.
1	I am aware of the problem with proper e-waste management in the country.	3.67	0.92
2	I am aware of the problem with proper e-waste management at MSU-IIT.	3.54	0.87
3	I believe e-waste management should be a common responsibility of individuals.	4.19	0.74
4	I am aware that separating e-waste from general waste is essential for proper handling and disposal.	4.21	0.77
5	I believe that batteries and mercury-containing bulbs should be stored separately and labeled as hazardous due to their potential to explode or leak harmful substances..	4.33	0.76
6	I feel a personal responsibility to properly dispose of my electronic devices to minimize e-waste.	4.19	0.70
7	I believe departments should have a clearly designated area for storing e-waste.	4.33	0.65
8	I am willing to be involved in setting up a responsible and safe recycling scheme in the institution.	4.03	0.74
9	I am willing to actively participate in e-waste management initiatives provided by the university.	4.13	0.72
10	The environmental impact of electronic waste concerns me, and I believe it is essential to address.	4.18	0.67
11	I believe that raising awareness about the impact of e-waste is crucial for fostering responsible disposal habits.	4.22	0.68
12	I am open to learning more about the proper e-waste disposal methods and its implications.	4.24	0.70
13	I see myself as having a role in contributing to the responsible management of e-waste.	4.09	0.70
14	I will support any university-led initiatives aimed at promoting e-waste recycling and responsible disposal.	4.25	0.66
15	A material recovery facility can lessen the e-waste pollution in the environment at MSU-IIT.	4.20	0.73
16	I believe it is important to extend the lifespan of electronics to reduce e-waste	4.13	0.82
17	Proper e-waste management is important	4.39	0.69
18	I believe maintenance is essential to prolong equipment life	4.27	0.66
19	I believe maintenance is essential to reduce e-waste	4.31	0.65

In terms of lighting equipment, staff reported that when bulbs require replacement, they contact the procurement office. LED lights are typically repaired, while fluorescent bulbs, in which only a few buildings use, are replaced with LED. Field observation, however, revealed that the discarded fluorescent tubes are stockpiled outside the physical plant division, awaiting proper disposal. Notably, these bulbs are stored alongside other materials such as electrical wirings, paint cans, wood, and roofing sheets. According to one informant, waste is also mixed inside the designated storage room, upon checking the storage area/ warehouse discarded electronic products were piled together with other discarded items such as office chairs, cabinets, metal cabinets, and wooden tables among others.

This practice appears to be inconsistent with DAO 2013-22, which mandates proper labeling, storage and segregation of hazardous waste. This highlights the need for clearer guidelines and infrastructure for safe e-waste handling.

Respondents practice varied personal approaches to extend the lifespan of the electronic equipment (Table 9). Among these, regular cleaning and maintenance

emerged as the most common (79.17%), followed by avoiding overcharging of batteries (65.83%), proper handling and storage (65.83%), and updating of software or firmware (55.83%). This practice implies a reduction on the volume of e-waste generated, and delayed its disposal, minimizing premature replacement. When a product has a short lifespan, it needs more replacement which in turn increases manufacturing demand and contributes to more waste. By prolonging its useful life, it does not only reduce e-waste accumulation but also minimizes environmental and institutional pressure associated with its disposal (Alarcon, 2024; Prabhu and Majhi, 2023; Hazelwood and Pecht, 2021). Furthermore, many respondents expressed willingness to participate in responsible disposal practices (89.2%), indicating openness to enhanced waste management systems within the university (Fig. 5).

Table 9. Identified practices to prolong electronic equipment lifespan

Practices	Frequency (n)	Percentage (%)
Regular cleaning and maintenance	95	79.17
Avoiding overcharging batteries	79	65.83
Using voltage regulators or surge protectors	43	35.83
Repairing devices instead of replacing them	58	48.33
Updating software or firmware when available	67	55.83
Proper handling and storage	79	65.83
Sharing or reusing devices within the office	41	34.17
None	2	1.67

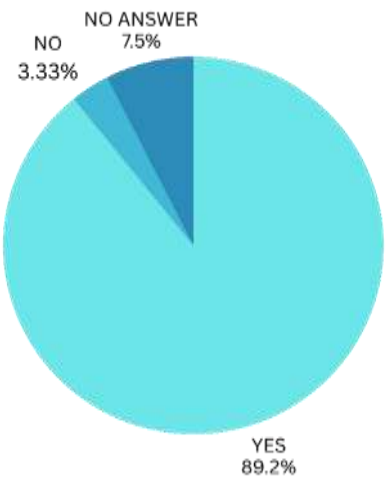

Fig. 5. Willingness to participate in disposal practices

Perception of e-waste management

Respondents perceived that a proper e-waste management should be widely disseminated to the IIT constituents (M= 4.34, SD= 0.77) and that e-waste needs to be managed more effectively to reduce environmental pollution (M= 4.33, SD= 0.77), indicating a strong support for education and improved e-waste system (Table 10). Notably, many respondents disagreed with disposing of e-waste with regular waste, reflecting awareness of its toxic components. E-waste requires special waste management due to its hazardous nature (Akram *et al.*, 2019), emphasizing the need for a dedicated management system within the institution.

Table 11 presents the weighted ranking of electronic equipment based on perceived hazard levels. The computed score indicates that batteries were perceived as the most hazardous item, obtaining the highest total weighted score of 274. This reflects strong awareness of the risks associated with battery disposal.

According to the U.S. Environmental Protection Agency (EPA), batteries contain hazardous substances, such as mercury (Hg) and cadmium (Cd), which when disposed of in trash may result in their accumulation in landfills. Mercury can affect the human brain, central nervous system, kidneys and liver among others. In the environment it could accumulate in marine invertebrates, bio-accumulate in the food chain, and is one of the leading mercury contaminants in fish. Cadmium (Cd), a known carcinogen, may cause lung cancer and kidney stones, in the environment it may also affect the kidneys of animals, it could contaminate the soil, which will be taken up by the plants and accumulate on fruits, vegetables and grass. These are only two among many hazardous substances found in batteries emphasizing the need for specialized disposal protocols and

institutional awareness (Charkiewicz *et al.*, 2023; Davidova *et al.*, 2024; Kumar and Rizvi, 2024).

This risk is not exclusive to batteries but also to other electronic devices, since e-waste is made up of numerous toxic substances, including heavy metals and persistent organic pollutants (POPs). If not managed properly, these materials may contaminate soil, flora, and fauna, and eventually reach humans through environmental exposure and the food chain (Kumar and Rizvi, 2024; Li *et al.*, 2024; Ramesh *et al.*, 2023; Liu *et al.*, 2020).

Table 10. Respondents' perception on e-waste management

Sl	Statement	Mean	Std. Dev.
1	Storing e-waste is harmful.	3.96	0.92
2	E-waste should be disposed of with general waste.	2.77	1.38
3	E-waste can be disposed of through 3R which is "Reduce, Reuse and Recycle".	3.63	1.00
4	E-waste can be recycled.	3.59	1.00
5	E-waste recycling is harmful to the environment.	3.45	0.98
6	E-waste recycling has negative effects on human health.	3.57	0.84
7	There are health effects associated with e-waste.	3.99	0.76
8	The rapid increase in technology and the heavy reliance on electronic gadgets contribute to the increase in e-waste.	4.17	0.81
9	I have personal attachments to electronic equipment even when out of use.	3.37	1.09
10	E-waste needs to be managed more effectively to reduce environmental pollution.	4.23	0.82
11	I believe that MSU-IIT has the responsibility to educate its community about the proper handling of electronic waste.	4.33	0.77
12	Proper e-waste management should be widely disseminated to the IIT constituents.	4.34	0.77
13	I segregate e-waste from other waste	3.97	0.88
14	Electronic maintenance is prioritized in our department.	3.86	0.92

Table 11. Weighted ranking of electronic equipment perceived as hazardous

Equipment/Item	Rank 1 (x5)	Rank 2 (x4)	Rank 3 (x3)	Rank 4(x2)	Rank 5 (x1)	Total score
Telecommunication Devices	5 (25)	9 (36)	15 (45)	11 (22)	12 (12)	140
Monitors/Computer	1 (5)	14 (56)	13 (39)	20 (40)	5 (5)	145
Batteries	47 (235)	6 (24)	4 (12)	1 (2)	1 (1)	274
Fluorescent Lamps	5 (25)	23 (92)	7 (21)	8 (16)	12 (12)	166
Printers	1 (5)	2 (8)	13 (39)	14 (28)	22 (22)	102

Electronic waste, although detrimental when not handled properly, still presents economic opportunities. It holds recyclable materials such as Gold (Au), Silver (Ag), Lead (Pb) and rare earth elements (REE) (Ghulam and Abushammala, 2023; Liu *et al.*, 2023; Rawat *et al.*, 2019).

Approximately 48.7% of the respondents agreed that the institution can benefit from the precious materials found in e-waste (Fig. 6). Respondents suggested several potential applications, such as using recovered components for engineering and science experiments, and supporting research initiatives. Some also noted that several parts could be extracted and reused for academic purposes, while others proposed generating income by selling usable materials to businesses that require them. These responses reflect a practical and resource oriented perspective on e-waste, emphasizing its potential value beyond disposal.

Fig. 6. Donut chart showing responses to the question: "Do you think the institution can benefit from the precious materials found in e-waste?"

Correlational analysis between knowledge, attitude, and perception shows a strong positive relationship (Table 12). The correlation between Knowledge and Attitude shows a strong linear relationship (r= 0.97), similarly, correlation between Knowledge and

Perception (r=0.95) is also high. The strength of these correlations may indicate a degree of measurement overlap or shared response bias.

Table 12. Pearson's correlation between knowledge, attitude, and perception of administrative staff of MSU-IIT

	Knowledge	Attitude	Perception
Knowledge	-	0.97	0.95
Attitude	0.97	-	0.88
Perception	0.95	0.88	-

Despite this consideration, the findings highlight that knowledge serves as a key factor influencing behavioral intentions and attitudes. Attitude, in turn, can be described as a tendency to evaluate and act in a particular way, while perception informs intention, where knowledge translates in appropriate or inappropriate intentions that also leads to appropriate and inappropriate behavior. Additionally, it also indicates abilities to perform a given behavior, with risk perception influencing self-confidence in controlling that behavior. The fundamental principle of KAP surveys is that knowledge shapes attitudes, and both serve as the foundation for practice (Laeequddin *et al.*, 2022; Manalo, 2022; Owojori *et al.*, 2022). Collectively, these findings highlight the interconnectedness of knowledge, attitude, and perception in shaping institutional behavior. Strategies that address information dissemination may be beneficial in improving e-waste management.

CONCLUSION

This study demonstrates that university administrative staff possess a high level of knowledge and a positive attitude toward electronic waste (e-waste) management, along with a willingness to participate in proper disposal practices. However, the absence of clearly defined institutional protocols and designated e-waste disposal areas limits the translation of this awareness into effective action. These findings highlight the importance of strengthening institutional policies and infrastructure to support responsible e-waste management and to fully utilize staff capacity in promoting a sustainable and environmentally accountable campus.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed to strengthen e-waste management within the institution:

1. Institutionalize e-waste education and training: E-waste management should be integrated into staff orientation programs and reinforced through regular training sessions to ensure consistent understanding of proper handling, storage, and disposal practices.
2. Establish clear e-waste management protocols: The university should develop and implement clear, standardized procedures for e-waste segregation, collection, storage, and disposal, in line with national regulations such as DAO 2013-22.
3. Designate and equip e-waste collection areas: Clearly identified and accessible e-waste collection points should be established within the campus to facilitate proper disposal and reduce informal or improper handling.
4. Enhance policy visibility and communication: Information, education, and communication (IEC) materials—such as posters, guidelines, and digital notices—should be widely disseminated to improve awareness of institutional policies and disposal procedures.

Implementing these recommendations can strengthen institutional e-waste management systems, enhance staff participation, and align university practices with environmental regulations, thereby contributing to a more sustainable and accountable campus environment.

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REFERENCES

Adrias JR, **Dalugdog WD**. 2025. Internal stakeholders' awareness, practices, and attitudes towards waste electrical and electronic equipment management at one state university in the Philippines. TWIST **20**(2), 308–315. http://www.twistjournal.net

Alarcon J. 2024. Strategies to extend the lifespan of electronic devices. esmartrecycling.com. https://esmartrecycling.com/blog/strategies-to-extend-the-lifespan-of-electronic-devices

Awitan AS, **Gervacio GC**. 2025. Awareness and practices in e-waste management through environmental education toward a waste reduction plan. Knowledge Commons (Lakehead University). https://doi.org/10.17613/nhbfc-91k75

Borawska A. 2017. The role of public awareness campaigns in sustainable development. Economic and Environmental Studies **17**(44), 865–877. https://doi.org/10.25167/ees.2017.44.14

Bravo ED. 2025. Level of awareness on e-waste hazards and management in a university set-up: basis for policy development. Pakistan Journal of Life and Social Sciences **23**(1). https://doi.org/10.57239/pjlss-2025-23.1.00170

Charkiewicz AE, **Omeljaniuk WJ**, **Nowak K**, **Garley M**, **Nikliński J**. 2023. Cadmium toxicity and health effects—A brief summary. Molecules **28**(18), 6620. https://doi.org/10.3390/molecules28186620

Davidova S, **Milushev V**, **Satchanska G**. 2024. The mechanisms of cadmium toxicity in living organisms. Toxics **12**(12), 875. https://doi.org/10.3390/toxics12120875

Dayaday MG, **Galleto FA Jr**. 2022. Electronic waste (e-waste) management of higher education institutions in south central Mindanao, Philippines. Environment and Natural Resources Journal **20**(5), 1–9. https://doi.org/10.32526/ennrj/20/202200053

Garcia R, **Marcilla A**, **Flores L**, **Lapong E**. 2024. Toward sustainable e-waste management: bridging gaps and insights from General Santos City, Philippines. Journal of Interdisciplinary Perspectives **3**(1). https://doi.org/10.69569/jip.2024.0629

Ghulam ST, **Abushammala H**. 2023. Challenges and opportunities in the management of electronic waste and its impact on human health and environment. Sustainability **15**(3), 1837. https://doi.org/10.3390/su15031837

Habagat J, **Mosqueda A**, **Suson P**, **Tatil W**. 2024. E-waste literacy: the knowledge, attitude, and perception of MSU-IIT students towards e-waste management. Deleted Journal **13**, 21–42. https://doi.org/10.62071/jssh.v13i.656

Hazelwood DA, **Pecht MG**. 2021. Life extension of electronic products: a case study of smartphones. IEEE Access **9**, 144726–144739. https://doi.org/10.1109/access.2021.3121733

Houessionon MGK, **Ouendo ED**, **Bouland C**, **Takyi SA**, **Kedote NM**, **Fayomi B**, **Fobil JN**, **Basu N**. 2021. Environmental heavy metal contamination from electronic waste recycling activities worldwide: a systematic review from 2005 to 2017. International Journal of Environmental Research and Public Health **18**(7), 3517. https://doi.org/10.3390/ijerph18073517

Islam MT, **Dias P**, **Huda N**. 2020. Young consumers' e-waste awareness, consumption, disposal, and recycling behavior: A case study of university students in Sydney, Australia. Journal of Cleaner Production **282**, 124490. https://doi.org/10.1016/j.jclepro.2020.124490

Kumar A, **Rizvi FF**. 2024. Hazardous effects of battery waste and role of the Battery Waste Management Rule 2022 in enhancing energy efficiency. International Journal of Current Science Research and Review **7**(11). https://doi.org/10.47191/ijcsrr/v7-i11-14

Laeequddin M, **Abdul WK**, **Sahay V**, **Tiwari AK**. 2022. Factors that influence the safe disposal behavior of e-waste by electronics consumers. Sustainability **14**(9), 4981. https://doi.org/10.3390/su14094981

Li B, **Liu D**, **Zhang L**, **Wu Y**, **Ding X**, **Zeng X**. 2024. Challenges of e-waste dismantling in China. Toxics **12**(12), 867. https://doi.org/10.3390/toxics12120867

Liu K, **Tan Q**, **Yu J**, **Wang M**. 2023. A global perspective on e-waste recycling. Circular Economy **2**(1), 100028. https://doi.org/10.1016/j.cec.2023.100028

Manalo JA. 2022. Awareness, attitude, and behavior of senior high school students on e-waste recycling. LUKAD **3**(1), 95–110. https://lukad.org/wp-content/uploads/2022/08/95-110-Manalo.pdf

Maphosa V. 2021. Students' awareness and attitudinal dispositions to e-waste management practices at a Zimbabwean university. Journal of Information Policy **11**, 562–581. https://doi.org/10.5325/jinfopoli.11.2021.0562

Meneses GL, **Galita WM**. 2015. Electronic waste (e-waste) management at selected colleges of the Bulacan State University: perspectives for program development. OALib **2**(4), 1–8. https://doi.org/10.4236/oalib.1101428

Mindanao State University – Iligan Institute of Technology. N. D. History. https://msuiit.edu.ph/about/facts/history.php

Nandan A, **Suresh A**, **Saole P**, **Jeevanasai S**, **Chandrasekaran R**, **Meili L**, **Azelee NW**, **Selvasembian R**. 2023. An integrated approach for electronic waste management—overview of sources of generation, toxicological effects, assessment, governance, and mitigation approaches. Sustainability **15**(24), 16946. https://doi.org/10.3390/su152416946

Owojori OM, **Mulaudzi R**, **Edokpayi JN**. 2022. Student's knowledge, attitude, and perception to solid waste management: a survey toward a more circular economy from a rural-based tertiary institution in South Africa. Sustainability **14**(3), 1310. https://doi.org/10.3390/su14031310

Parajuly K, **Kuehr R**, **Awasthi AK**, **Fitzpatrick C**, **Lepawsky J**, **Smith E**, **Widmer R**, **Zeng X**. 2019. Future e-waste scenarios. Figshare. https://researchrepository.ul.ie/articles/report/Future_e-waste_scenarios/19812673

Pont A, **Robles A**, **Gil JA**. 2019. E-waste: everything an ICT scientist and developer should know. IEEE Access **7**, 169614–169635. https://doi.org/10.1109/access.2019.2955008

Prabhu SN, **Majhi R**. 2023. Disposal of obsolete mobile phones: a review on replacement, disposal methods, in-use lifespan, reuse and recycling. Waste Management & Research **41**(1), 18–36. https://doi.org/10.1177/0734242x221105429

Ramesh M, **Paramasivan M**, **Akshay P**, **Jarin T**. 2023. A review on electric and electronic waste material management in the 21st century. Materials Today Proceedings. https://doi.org/10.1016/j.matpr.2023.01.057

Rawat S, **Verma L**, **Singh J**. 2019. Environmental hazards and management of e-waste. In Springer eBooks, pp. 381–398. https://doi.org/10.1007/978-981-13-6358-0_16

Rodríguez-Guerreiro M, **Torrijos V**, **Soto M**. 2024. A review of waste management in higher education institutions: the road to zero waste and sustainability. Environments **11**(12), 293. https://doi.org/10.3390/environments11120293

Schober P, **Boer C**, **Schwarte LA**. 2018. Correlation coefficients: appropriate use and interpretation. Anesthesia & Analgesia **126**(5), 1763–1768. https://doi.org/10.1213/ane.0000000000002864

U. S. Environmental Protection Agency. n.d. Used household batteries. U.S. Environmental Protection Agency. Retrieved December 4, 2025, from https://www.epa.gov/recycle/used-household-batteries

Vaidya RG, **Kundaliya DD**, **Joshi JP**. 2025. From generation to recovery: a systematic review of e-waste management, metal recovery, and circular economy solutions. International Journal of Creative Research Thoughts **13**(2). https://ijcrt.org/papers/IJCRT2502578.pdf

World Health Organization. 2024. Electronic waste (e-waste). https://www.who.int/news-room/fact-sheets/detail/electronic-waste-%28e-waste%29