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The Effect of an Electronic Waste Management Training Program on Work Environment

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Abstract

Background: Electrical and Electronic Equipment has become necessary and reinforces living principles, but often holds poisonous chemical compounds that negatively impact human well-being and the surroundings and fuel the climate confrontation. Electrical waste is a crucial, urgent challenges of throughout this period that should be avoided. **Aim:** This study aimed to explore the effect of electronic waste management training program on work environment. **Design:** Quasi experimental research design was utilized. **Setting:** the current study was conducted at Badr University Hospital, which is affiliated to Helwan University. **Subjects:** A Convenience sample of (n =82 nurses) was used. **Tools of data collection:** Data were collected using two tools; (I) Electronic waste questionnaire and (II) Work environment scale. **Results:** The result illustrates that (97.6%) of the studied nursing personnel gained a satisfactory level of knowledge regarding electronic waste management during the post-test phase, and (95.1%) at follow-up test as compared with the phase of the pre-test (36.6%). As well, (95.1%) of the studied nursing personnel gained a positive work environment during the post-test phase, shadowed by follow-up test (89%) as paralleled with the pre-test (40.2%). **Conclusion:** This study concluded that electronic waste management training program had positive large effect size on nursing personnel's work environment during pre, post and three-months follow-up **Recommendations:** Staff nurses should trained on handling electronic waste to overcome a negative impact on health environment.

Key words: E-Waste Management, Nursing Personnel, Training Program, Work Environment

Introduction

E-waste (EW) is reserved apparently that counters the blending or interaction between contradictory EW and admits a check between capsules to monitor leaks or spills **(IGAD, 2023)**. EW is distinguished as dropped or trashed Electrical and Electronic Equipment (EEE) **(Chaudhary et al., 2023)**. EW production is an entire concern that requires emergency administration. EW surrounds all electronic instruments in the way that televisions, calculators, laptops, container phones, chargers, adaptors, and so on. Prevailing arrangements of e-waste disposal include landfilling, flaming, and burning **(Jaspal et al., 2023)**.

E-waste refers to EEE that have been attained during the whole of its valuable growth, including all parts, subassemblies, and consumables that are few at the time of discarding. The

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price of supplies, to a degree calculating, peripheral supplies, TVs, laptops, printers, and mobile handsets, but more electrical toys, room for cooking food machines, etc., is abandoning as long as other styles having to do with EEE are climbing, such as various scheme properties, the great happiness of, as a rule, non-electrical equipment, development in cloud computing aids and data centres, and briefer and smaller substitute cycles for EEE **(Baldé, 2024)**.

Electronic waste situation and conclusion conveniences concede possibility pose a risk of fire and discharge on account of the appearance of incendiary fabrics and chemical compounds. These hazards can cause harm or even afterlife to employees and the nearby public. Immoral management and conclusion practices, to a degree excited or disposal of e-waste in landfills, can heighten the strength, security, and material impacts of EW situations. Correct administration practices, in the way that reusing and dependable disposition, are owned by minimise these impacts **(Nandan et al., 2023)**.

Pertaining to work security and referring to practices or policies that do not negatively affect the environment hazards on account of EW pertaining to work security and incidental hazards on account of EW have arose as important concerns in the current age. Peasants operating in the management, disassembling, and reusing of e-waste face differing pertaining to work risks, generally stopping from uncovering hazardous chemical compounds **(Nandan et al., 2023).** Institution surroundings refer to the aspects like psychosocial, physical surroundings, surroundings procedures, atmosphere, and work existence balance that are in the institution scene **(Lucy & Wanyoike, 2022)**.

The working environment means processes, orders, structures, forms, or environments in the institution that influence favourably or negatively nurses acting. The active surroundings can further be visualized as a condition place things be able the tasks in an ideal, secure, healthful, and easy habit. It can likewise be delineated as the strength to share information during the whole of arranging contingent upon by what method whole surroundings is planned to authorize arrangements to apply whole surroundings as if it were an advantage **(*Emmanuel*, 2021)**.

Inaccurate administration of EW warns our environment. Traditional procedures to tackle EW, namely, landfilling and burning, pose a harsh epidemic toward the atmosphere. Though our dump is earlier full of different complete wastes, EW leachates that accomplish many poisonous aspects and combinations can advance underground water and pollute it. Blazing or burning of EW releases malignant vapour that holds free radicals, namely, furans, dioxides, fluorocarbons, etc., into the air **(Debbarma et al., 2023)**. Healthy work environments are categorized as; (a) a high level of trust among management and employees, (b) a culture that supports communication and collaboration, and (c) a climate where employees' feel physical and emotional safety and well- being **(*Kol et al., 2017*).**

An attractive and reassuring working environment supports circumstances that allow operators to act efficiently, making best use of the information, abilities, and capabilities and the accessible funds in consideration of supply excellent of arrangement help **(Alkaabi et al., 2022)**. Associations in the current ending encounter various troubles on account of the flexible environments of the business environment. Individuals of a party's many struggles search out discharge allure troop to suit to an active surroundings, realise and aim. The gathering come across the needs of the stick by giving helpful active surroundings to increase output, efficiency, effectiveness, and work engagement **(Ovais et al., 2022)**.

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Significance of the study

The Global e-waste Monitor 2020 reckoned that the global documentation and recycling of e-waste are minimal (14.66%); the highest is 42.5% in Europe, followed by 11.7% in Asia, 9.4% in the Americas, 8.8% in Oceania, and only 0.9% in Africa. Today, 71% of the population has incorporated policies on e-waste, different from region to region; the remaining 29% are yet to bind themselves with a legal framework to ensure legal practices for a sustainable e-waste management. The problem of e-waste has become an immediate and long term concern as its unregulated and improper accumulation and recycling can lead to major environmental problems endangering not only human and animal health but also environment health due to toxic and other dangerous materials available **(Forti et al., 2020).**

In fact, Egypt has no serious national programs and regulations to handle e waste properly, and e-waste activities are dominated and controlled by garbage traders and waste collectors. Egypt is the highest e-waste generation country in Africa, generating more than 20% of e-waste generated in African countries. Egypt has no proper infrastructure for e-waste management. Improper handling of e-waste materials will cause serious impacts on health and environment. Meanwhile, Egyptians are not aware of the environmental protection, and the discarded electronic products may find their way as second-hand use and finally scraped. Thus, proper handling of e-waste is essential in Egypt, and recycling activities is an economically promising industry **(Hesham et al., 2021)**

Aim of the study

This study aimed to explore the effect of electronic waste management training program on work environment.

Research hypothesis: -

After developing and implementing of electronic waste management training program there will be a positive effect on work environment among nursing personals and enhance of nurses' awareness about electronic waste management and work environment at pre, post, and follow-up.

Subject and methods

Research design: Quasi experimental research design was utilized to conduct this study.

Setting: The study was conducted at Badr University Hospital affiliated with Helwan University and localized the region of Badr City, Cairo, Egypt.

Sampling: A convenience sample of all available nurses (82 nurses) from both sex working in the critical care unit, emergency room, and inpatient department accepted to participate in this study, available at the time of the study were included in sample.

Tools for data collection:

Tool (I): Self-administrative electronic waste questionnaire: This tool assessed the awareness of the nursing personnel about the electronic waste. It entailed of two parts:

- **Part (I): Personal characteristics sheet;** collect data related to personnel characteristics data of the study subjects such as: (Age, gender, material status, nursing education, job title, years of experience, department, work shift, place of birth and residence).
- **Part (II): A structured self-administrative questionnaire;** constructed and adapt by the researcher based on ***Sultan, (2022)*** & ***Okoye, A. and Odoh, C. (2014)*** and revised by 5 experts, and pilot tested. The scale consists of 38 items that contain 4 dimensions; (1) the level of knowledge towards importance of e-waste (8 items); (2) the level of

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awareness towards importance of e-waste (12 items); (3) the involvement in electrical/electronic waste generation (8 items); and (4) the impact on the environment (10 items)

The scoring system:-

The questionnaire consisted of 4 dimensions (38 items) with a total score of (76). Two grades were given for correct answer and one grade given for incorrect answer. The total grades of items summed up, converted into a percentage score, and classified in to three levels as the following:-

- The satisfactory level, is equal or more than 60 % (46-76 score).
- The unsatisfactory level, is less than 60% (38-45 score).

Tool (II): Work environment scale; constructed and adapted by the researcher based on as **Moos, (2008),** revised by 5 experts, and pilot tested. The scale consists of 10 dimension that contain (90 items) as the following; (1) involvement (9 items); (2) co-worker – cohesion (9 items); (3) supervisor support (9 items); (4) autonomy (9 items); (5) task orientation (9 items); work pressure (9 items); clarity (9 items); managerial control (9 items); innovation (9 items); and physical comfort (9 items).

The scoring system:-

The scale consisted of 10 dimension and (90 items) with a total score of (180). Two grades were given for yes response and one grade given for response of no). The total grades of items summed up, converted into a percentage score **(Mahgoub et al., 2019)**, and classified in to three levels as the following

- The positive level, is equal or more than 60 % (108-180 score).
- The negative level, is less than 60% (90-107 score).

Validity and reliability:

Validity:

Validity of the tools was approved (face and content). The forms were interpreted into numbers and tested by a group of five experts specific to nursing administration from various three Universities, that is to say; three professors from Ain sham University; Damanhour University (one professor); Cairo university (one professor), and Cairo University (one professor)

Reliability:

Cronbach's Alpha was used to determine the internal reliability of the tool. Reliability of the tools was test to determine the extent to which the questionnaire items are related to each other and the result was (0.**926** & 0.**994**) for electronic waste questionnaire and work environment scale.

Ethical and legal consideration:

The research authorization got from the Faculty of Nursing ethical committee of Helwan University before offset the training, an authorization got from the Manager of Badr Hospital connected with the University. Informed consent was given to each sharing subject superior to information accumulation; participant informed about the determination and wonted consequences of the study, and confident about harmless presence, participant's partnership was willing, and nurses had the right to be removed from the study at whatever time outside some reason. Participants still were confident that anonymity and confidentiality remained

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approved, as were the assembled information second-hand for the study purpose. Ethics, principles, civilization and trust were esteemed.

Pilot study

The pilot study was completed activity on (10%) of the total sample content (8 nurses) to test relevance and clearness of forms and occasion wanted to complete it. No adjustments existed finished so participant in the pilot study remained contained in the study sample.

Field work:

First Phase: Assessment:

The researcher changed the tools for data accumulation, join the Director of Badr Hospital connected with university to clarify the purpose and course of the study, together all essential knowledge about nurses (numbers, qualifications, areas, gender, age and years of experience occupied in the hospital). Attended the pilot study on 10% of the total nursing staff (8), furthermore the researcher start to accumulate at beginning of August 2023 completed at beginning of September 2023 (one months), by utilizing the same tools.

Furthermore the researcher start to accumulate data from beginning of September 2023 completed at beginning of November 2023 (3 months), by utilizing the same tools at day-to-day work and subsequently disclosing the study ruling class. The researcher scheduled the visits to the ward as following; the researcher visited the hospital 3 visits per week; each visit was categorized from 4-5 hours (from 9am to 2pm).

Firstly, the researcher started the knowledge about electronic waste questionnaire (pre-test) to determine the information of nursing personnel before achieving educational program. The time wanted to end this tool categorized between (10-15) minutes. **Secondly** the researcher used the self- administrative questionnaire (pre-test) to determine the information about work environment of nursing personnel before implementing educational program. The time wanted to complete this form categorized between (15-25) minutes. Total period wanted to complete two together forms was categorized middle from two points (25-40) record.

Second Phase: Designing

The researcher planned a training session and established an information assessment questionnaire concerning electronic waste and work environment for nursing personnel. Established the pre-test results, the approximate aims of the knowledge assessment concerning electronic waste training program was to enhance nursing personnel knowledge about electronic waste and work environment. Knowledge estimate questionnaire concerning electronic waste that training program was created expected constant with the nursing work force needs. This phase, begun initially in December 2023 completely ended in January 2024 (two months).

Nursing electronic waste training program was transported by the researcher, who divided nursing personnel into (8) groups; each group contained (10) acting as a nurse under the instruction and support of Badr University Hospital Nursing Manager considering the routine assigned work.

Third Phase: Implementation

Implementation of training program concerning nursing electronic waste took 8 weeks as subsequent (Nursing electronic waste training program was taken 6 sessions / week (two months) as following: each group from the eight groups of nursing personnel took (3 visits/week) to conduct the program content, two visits of them included (2 sessions), which,

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took (6 hours) with 15 minutes for break time). Different teaching methods were used in conducting the training program as (Lectures, group discussion and brain storming). Also media used as (Power point, data show, white board and program booklet) that was prepared by the researcher for nursing personnel which helped them to revise and refresh program content taken during sessions. At the end of each session nursing personnel informed about the next session time.

Electronic waste training program for nursing personnel was held in the education room of Badr university Hospital during the day shift in coordination with nursing director and according to the daily work schedule.

Fourth Phase: Evaluation

The purpose concerning this phase was to enhance of electronic waste knowledge for participants through a training session afterwards, administering a training session by utilizing questionnaires that were determined to participants promptly subsequently finishing the program.

Pre-test evaluation: before starting the training session, appraisal questionnaire was given (pre-test) to participants to determine nurses' knowledge about nursing electronic waste and work environment scale.

Immediate evaluation: after the accomplishment of the training session, an information appraisal questionnaire was given (post-test) to participants to determine nurses' knowledge about nursing electronic waste and work environment scale.

Follow-up post-program: reassessment was finished afterwards, three months post-attending the training session. The same tools were used in Follow-up evaluation was begun in April 2024 and ended in May 2024 (two months).

Administrative design

Authorization to complete activity this study was acquired from the Dean of the Faculty of Nursing, Helwan University, and the Manager of Badr Hospital connected with the University to conduct the study. Individual spoken consent was still acquired by each fostering work force to participate in the study.

Statistical design

Data admission and exploration were completed using SPSS statistical package version 26. Categorical variables were articulated as number and percentage while incessant variables were conveyed as (mean ±SD). Chi-Square (x2) tested the association between row and column variable of qualitative data. ANOVA test associate the mean of typically disseminated quantitative variables. While T independent test associate the mean of typically disseminated quantitative variables in two groups. As well, Pearson correlation measured correlation between quantitative variables.

For all tests, a two-tailed p-value ≤ 0.05 was considered statistically significant, P-value ≤ 0.01 was considered highly statistically significant, while, p-value> 0.05 was considered not significant. Eta square (**η2)** measured the effect size (The referential framework for identifying the effect size for ANOVA-test value) **(Cognitive and Brain Science Unit, 2021*).***

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Table (1): Frequency distribution of personal characteristics among the studied nursing personnel (n=82)

Personal characteristics		No	%
Age (in years)	< 20	10	12.2
	20- < 30	64	**78.0**
	30- < 40	7	8.5
	40- < 50	1	1.2
	$\bar{x}$ ± SD	**25.68 ± 4.86**	
Gender	Male	45	**54.9**
	Female	37	45.1
Place of birth	Rural	56	**68.3**
	Urban	26	31.7
Place of residence	Rural	52	**63.4**
	Urban	30	36.6
Marital status	Single	56	**68.3**
	Married	25	30.5
	Divorced	1	1.2
Education	Technical institute	68	**82.9**
	Bachelor's degree	14	17.1
Job title	Staff nurse	66	**80.5**
	Head nurse	13	15.9
	Supervisor	3	3.6
Year of experience	1 < 5 years	25	30.5
	5 years < 10 years	45	**54.9**
	≥ 10 years	12	14.6
	$\bar{x}$ ± SD	**7.36 ± 4.52**	
Department	Critical Care Unit.	27	32.9
	Emergency room.	13	15.9
	Inpatient Department	42	**51.2**
Work shift	Full time	75	**91.5**
	Part time	7	8.5

Table (1) shows that (78%) of the age of the studied nursing personnel are ranged from 20- < 30 years old, with a mean age of 25.68 ± 4.86. About gender, (54.9%) of the studied nursing personnel are male, and (45.1%) are a female. As well, (68.3% & 63.4 %) of the studied nursing personnel are from rural area at place of birth and place of residence, respectively. Considering marital status, (68.3%) are single. Additionally, (82.9% & 80.5%) of nurses holding a technical certificate and being staff nurse, respectively. Moreover, (54.9%) of nurses had experience lasting from 5 years < 10 years with a total age of 7.36 ± 4.52. Finally, (51.2%) and (91.5%) of nurses working at in-patient department and are working full time respectively.

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Table (2): Comparison between mean score of knowledge regarding electronic waste management during pre, post & three months follow-up among the studied nursing personnel (n=82)

Items		Pre	Post	3 months follow-up	F Test	P- Value
		$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD		
Importance of E-Waste	Un-Satisfactory	8.08±0.27	8.0±0.0	8.0±0.0	122	0.000 ***
	Satisfactory	13.88±2.26	15.67±0.85	15.51±1.12		
	Total	**10.41±3.20**	**15.49±1.45**	**15.15±1.95**		
Importance of E-Waste management	Un-Satisfactory	12.35±0.55	12.50±0.70	12.75±0.95	176	0.000 ***
	Satisfactory	19.80±2.8	23.25±1.49	23.18±1.31		
	Total	**15.07±4.03**	**22.99±2.23**	**22.67±2.60**		
Involvement in Electrical/ Electronic Waste Generation	Un-Satisfactory	8.02±0.123	9.0±0.00	8.25±0.50	314	0.000 ***
	Satisfactory	13.00±2.33	15.48±1.14	15.40±1.01		
	Total	**8.99±2.23**	**15.40±1.34**	**15.05±1.83**		
Impact on the environment	Un-Satisfactory	10.42±0.50	11.0±0.0	10.00±0.00	138	0.000 ***
	Satisfactory	15.41±3.29	19.26±1.33	19.35±1.55		
	Total	**13.22±3.51**	**19.16±1.60**	**19.01±2.33**		
Total	Un-Satisfactory	39.44±1.70	43.0±2.82	39.75±2.87	**201**	**0.000*** **
	Satisfactory	62.0±10.13	73.79±2.24	73.53±3.20		
	Total	**47.70±12.5**	**73.04±5.27**	**71.88±7.97**		

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 F: ANOVA Test

Table (2) denotes that the studied nursing personnel perceived higher mean score (**73.04±5.27**) at the post-test phase of knowledge regarding e-waste management, shadowed by follow-up test (71.88±7.97) as contrasted with the pre-test (47.70±12.5) (Total score=76).

Table (3): Comparison between mean score of work environment during pre, post & three months follow-up among the studied nursing personnel (n=82)

Items		Pre	Post	3 months follow-up	F Test	P-Value
		$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD		
Involvement	Negative	9.06±0.24	9.0±0.0	9.33±0.51	68.8	0.000 ***
	Positive	17.50±1.2	17.63±1.3	17.53±1.3		
	Total	**12.35±4.2**	**17.41±1.9**	**16.93±2.5**		
Co-worker Cohesion	Negative	9.02±0.14	9.50±0.70	9.17±0.40	77.9	0.000 ***
	Positive	17.39±1.4	17.75±1.1	17.50±1.4		
	Total	**12.18±4.1**	**17.55±1.6**	**16.89±2.6**		
Supervisor Support	Negative	9.02±0.14	9.50±0.57	9.25±0.46	67.2	0.000 ***
	Positive	17.25±1.6	17.77±1.04	17.65±1.1		
	Total	**12.23±4.1**	**17.37±2.1**	**16.83±2.7**		
Autonomy	Negative	9.02±0.14	9.0±0.0	9.13±0.35	65.3	0.000 ***
	Positive	17.18±1.9	17.71±1.2	17.65±0.95		
	Total	**12.30±4.2**	**17.39±2.0**	**16.82±2.7**		
Task Orientation	Negative	9.00±0.0	9.25±0.50	9.22±0.44	65.7	0.000 ***
	Positive	17.0±2.0	17.77±0.50	17.67±0.88		

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	Total	**12.22±4.1**	**17.35±2.09**	**16.74±0.27**		
Work Pressure	Negative	9.02±0.14	9.33±0.57	9.13±0.35	63.2	0.000***
	Positive	17.12±1.9	17.71±1.2	17.62±1.16		
	Total	**12.38±4.2**	**17.40±1.97**	**16.79±2.7**		
Clarity	Negative	9.08±0.26	9.20±0.44	9.0±0.0	59.9	0.000***
	Positive	17.63±1.1	17.79±0.99	17.63±1.18		
	Total	**12.21±4.20**	**17.27±2.28**	**16.68±2.93**		
Managerial Control	Negative	9.02±0.14	9.0±.0	9.0±0.0	53.8	0.000***
	Positive	17.09±1.7	17.69±1.3	17.62±1.13		
	Total	**12.37±4.4**	**17.16±2.4**	**16.67±2.91**		
Innovation	Negative	9.02±0.14	9.25±0.5	9.11±0.33	57.2	0.000***
	Positive	17.09±1.9	17.65±1.28	17.63±1.1		
	Total	**12.37±4.1**	**17.24±2.21**	**16.70±2.87**		
Physical Comfort	Negative	9.0±0.0	9.0±0.00	9.10±0.00	0.160	0.852
	Positive	16.09±2.18	16.17±2.15	16.19±2.14		
	Total	**14.88±3.33**	**15.12±3.23**	**15.13±3.23**		
Total	Negative	٩٤,١٨±3.61	95.0±5.94	93.89±5.44	**56.3**	**0.000*** **
	Positive	172.03±17.39	175.18±11.34	175.10±8.53		
	Total	**125.51±40.0**	**171.27±20.62**	**166.18±26.8**		

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 F: ANOVA Test

Table (3) clarifies that, the studied nursing personnel perceived higher mean score (171.27±20.62) of work environment at post-test, then the phase of follow-up test (166.18±26.8) as matched with the pre-test (125.51±40.0) (Total score=180).

Table (4): Correlational matrix between knowledge regarding importance of electronic waste management and work environment during pre, post & and three-month follow-up among the studied nursing personnel (n=82)

Work environment	**Knowledge regarding importance of e-waste management**					
	Pre-test		Post-Test		Follow-up	
	R	P	R	P	R	P
Pre-test	0.900	0.000**				
Post-Test			0.682	0.000**		
Follow-up					0.803	0.000**

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 F: ANOVA Test

Table (4) explains that, there was a statistically significant positive correlation (Ranged from moderate to high correlation) between knowledge regarding electronic waste management and work environment throughout the program among the studied nursing personnel at r= ranged from 0.682 to 0.900 & P= 0.000

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Table (5): Effect size and η2 of electronic waste management training program on level of knowledge regarding electronic waste management during pre, post & three months follow-up among the studied nursing personnel (n=82)

Interval	Mean	SD	F Test	P value	H	η2	Effect size
Pre-test	47.70	12.57	201	0.000***	0.790	0.6.24 ***	Large effect
Post-test	73.4	5.72					
Follow-up	71.88	7.97					
Total	64.20	14.81					

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 F: ANOVA Test

* Small effect size = 0.01 to < 0.06 **Medium effect size =0.06 to < 0.14 ***Large effect size ≥ 0.14

Table (5) supports the research hypothesis and clarifies that enhancing awareness about electronic waste management training program had positive large effect size on nursing personnel**'s** level of knowledge regarding e-waste management during pre, post and three-months follow-up at η2= 0. 624.

Table (6): Effect size and η2 of electronic waste management training program on work environment during pre, post & three months follow-up among the studied nursing personnel (n=82)

Interval	Mean	SD	F Test	P value	H	η2	Effect size
Pre-test	125.51	40.0	56.3	0.000***	0.563	0.317 ***	Large effect
Post-test	171.27	20.62					
Follow-up	166.18	26.83					
Total	154.32	36.46					

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 F: ANOVA Test * Small effect size = 0.01 to < 0.06

**Medium effect size =0.06 to < 0.14 ***Large effect size ≥ 0.14

Table (6) supports the research hypothesis and clarifies that enhancing awareness about electronic waste management training program had positive large effect size on nursing personnel**'s** work environment throughout the program.

Discussion

The result of electronic waste has reached startling levels everywhere, pretending significant environmental, commercial, and well-being risks. Comprehensively resolves the challenges, impacts, and potential answers linked to electronic waste administration in expanding countries with its own government. Researcher focal points the immediate need for decent regulations, nursing growth, and knowledge to discourse the growing question of electronic waste administration **(Khanal et al., 2024)**.

The aim of this study was conducted to explore the effect of electronic waste management training program on work environment among nursing personals. Concerning the personal characteristics of the studied nurses, as regard the age and gender; the study results show that more than three-quarters of the nurses' age were ranged from twentieth to less than thirteen years old, with a mean age of 25.68 ±4.86. As well, more than half of them were male. From researcher point of view, most of male had a good direction toward nursing profession.

This result was in consistant with ***Thirunavukkarasu et al. (2022)*** study entitled "Knowledge, attitude and practice towards bio-medical waste management among healthcare workers: a northern Saudi study" who described that more than three-quarters of the nurses'

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age were than thirteen to thirteen nine years old, with a mean age of 34.35 ±9.5. Also, more than half of them were male.

Oppositely, ***Mahmoud et al (2022)*** study entitled "Effect of an educational program for nurses working in maternal and child health care centers about health care waste management", and found that about twentieth of nurses' age were ranged from twentieth to thirteen and from thirteen one to fourteen years old, with a mean age of 42.2 ±9.9. Moreover, the majority of nurses were female.

With regard to the studied nurses' marital status and residence; more than three-fifths of nurses were single from rural area at place of birth and place of residence. This result supported by ***Thirunavukkarasu et al. (2022)*** who illustrated that more than half of the participated nurses were single live away from urban areas. On contrast to ***Mahmoud et al (2022)*** study who bring into being that the majority of the studied sample were married and also more than half of nurses born and live in rural area.

Concerning the studied nurses' Education, job title, and year of experience; the results demonstrated that the majority of nurses were technical institute and only seventeen of them were bachelors; working as staff nurses with more than half of them had less than tenth years of experience. From researcher point of view most of nurses with bachelor's degree or get enough experience prefer to work in privet hospital or travel for financial causes hospital need only limited number of nurses had high job titles due to limited positions.

In the same line ***Mahmoud et al (2022)*** study showed that the majority of the studied nurses were diploma and institute nursing; working as staff nurses with more than half of nurses had tenth years of experience. On the other hand **Saleh et al. (2023)** study entitled "Effect of green management training program on nursing managers' perception of occupational safety and green management practices" who found that more than three-quarters were staff nurses had bachelor degree with a half of them had more than tenth years.

Regarding the studied nurses' working department and work shift time; the result of the study demonstrated that the most of nurses had full time working in inpatient department. From researcher point of view most of hospital need only limited number of nurses to work in critical and emergency units and the rest of nurses were distributed in other hospital inpatient departments.

In the same line ***Nuwematsiko et al. (2021)*** study entitled "Knowledge, perceptions, and practices of electronic waste management among consumers" who found the most of nurses had full time working in different inpatient department with more than a half of them were informal employment.

The result of the study statical comparison between mean score of knowledge regarding importance of e-waste and e-waste management, involvement in e-waste generation, and its impact on the environment clarifies that nurses had perceived higher mean score of knowledge at post-program implementation (During post & three months follow-up) compared to pre-program implementation among the studied nursing personnel with a highly statistically significant difference between total mean score of knowledge regarding e-waste management. From the researcher point of view e-waste management not only cause serious threats to the environment but also induce a significant waste of valuable materials so all organization should act on the sustainability of e-waste management education for all of the staff personal.

This result supported by the study done by ***Nguyen et al. (2024)*** entitled "Determinants of residents' e-waste recycling behavioral intention" and stated that there obvious improvement of the studied sample main score of understanding of e-waste management intention,

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electrical/electronic waste generation and recycling activities, and its potential environmental effect with a highly statistically significant difference between total mean score of knowledge at post-program implementation likened to pre-program implementation.

In the same line the study results done by ***Kshtriya*** *and* ***Anchala (2023)*** entitled "Knowledge, attitude, practice, and generation of electronic waste (e-waste) among students of health sciences in a private college in Pune" and found that the majority of the studied nursing students participated in the study had higher score of knowledge about the E–wastes management, environmental hazards and aware of any substantial health risk/ occupational hazard related with e-waste at post study interrelated to pre-training implementation .

In relation to the level and mean score of work environment; the result of the study denoted that the most of the studied nurses perceived a higher mean score with positive response to the work environment, during the post-test which decline to majority of nurses at follow-up phase post-program implementation matched with the phase of pre-test with a highly statistically significant differences between total mean score of work environment during program phases.

From researcher point of view, nurses were realized that there great relation between workplace environment and employees' performance. Nurses reported that factors, such as level of physical comfort (availability of resources, proper furniture, and lighting), channels of mmanagerial communication, work interaction and involvement, supervisory support and balanced workload, privacy are considered important factors in nurses' innovation and productivity.

This result supported with by the study done by ***Shaikh (2023)***, entitled "Relationship between employees' performance and workplace environment" and found throughout the phases of in-service intervention program training that the work environment (Job satisfaction, supervisor support, innovation and creativity, organizational managerial skills, workplace environment incentives, furniture, lighting, and ventilation) had a high positive effect on the healthcare staff performance and competency level with a highly statically differences between phases of implementation.

Likewise, the result the study completed by ***Herawati et al. (2023)***, entitled "The effect of workload and supervisor support and coworker support on job satisfaction and job performance" and found that throughout the study implementation most of the participants reported a higher level of positive satisfaction regarding variable workload, supervisor support throughout managerial control, co-worker support, and job tasks clarity, awareness and orientation and on Job performance satisfaction.

Also, ***Al Sabei et al. (2020)*** in study titled "Nursing work environment, turnover intention, job burnout, and quality of care: the moderating role of job satisfaction" labeled factors that influence the certain environment, that may humiliate change intention, and increase work date with nurses. These factors involve autonomy, preservation of natural resources, the connection between doctors and nurses, and administrative support.

In relation to correlation between knowledge regarding e-waste management and work environment; It clarifies that, there was a statistically significant positive correlation (Ranged from moderate to high correlation) between knowledge regarding e-waste management and work environment as well on the and scatter dot correlation statistics regarding cumulative score through-out the program implementation.

This result constant with ***Madkhali et al., (2023)*** study entitled "Comprehensive review on e-waste management strategies and prediction methods" found a statistically significant

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positive correlation between knowledge and awareness regarding e-waste management and work environment sustainability. Similarly, the result of the study done by ***Jahan*** and ***Mim (2023)*** entitled "Evaluating the level of knowledge and awareness regarding EW among university students in Bangladesh) and found a statistically significant positive correlation between knowledge regarding e-waste management process and health work environment.

In the same in the result of the study done by ***Shinde (2020)*** entitled "Nursing students knowledge, attitude, and practice towards e–waste management", who reported a statistically significant positive correlation between studied nurses' knowledge practice and attitude and e-waste management process and work environment.

According to the research hypothesis the results clarifies that enhancing nurses' awareness about electronic waste management training program had positive large effect size on nursing personnel**'s** level of knowledge regarding e-waste management and work environment during pre, post and three-months follow-up at $\eta 2 = 0.624$.

This result in agreement with ***Madkhali et al., (2023)*** study who found positive large effect size on nurses' knowledge and awareness regarding e-waste management and work environment maintenance. Similarly, the result of the study done by ***Jahan*** and ***Mim (2023)***, who found a positive large effect size on nurses' knowledge regarding e-waste management process and health work environment.

Conclusion

Based on the study result most of the studied nursing personnel gained a satisfactory level of knowledge regarding e-waste management during the post-test and followed phase compared with the phase of the pre-test. In addition most of the studied nursing personnel gained a positive work environment during the post-test phase, decreased to majority of nurses at follow-up test paralleled with about two-fifths at the pre-test. Additionally, the electronic waste management training program had positive large effect size on nursing personnel's work environment during pre, post & three-months follow-up, this findings support the research hypothesis.

Recommendation

Nursing personnel

1. Enhance nursing personnel about e-waste impose that effect on health and environmental hazard.

Organizational Level

1. Aware the health care providers that toxic waste requires distinctive treatment for environmentally disposed.
2. Handling of electronic waste to overcome a negative impact on health environment.

Educational level

1. Conduct educational program among nursing staff personnel's about recycling of e-waste.

Research level

1. Develop the electronic waste strategies and its effect on the health care setting.

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