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Professional paper

THE LEVEL OF AWARENESS AND RECYCLING HABITS OF UT-COMPUTER SCIENCES STUDENTS ON E-WASTE MANAGEMENT

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Abstract

Anything with electricity or electronic components is considered electronic waste, often known as Waste from Electrical and Electronic Equipment (WEEE). The rapid demand for technology has led to the continuous production of new electronic devices. According to statistics, e-waste production reached a record 62 million tones (Mt) in 2022, up 82% from 2010. This paper aims to investigate the knowledge of first-cycle Computer Science students at the University of Tetova regarding electronic waste, recycling, and the environmental harm that these devices can cause. Our findings are critical in helping IT businesses and legislators implement financial incentives, secure disposal facilities, and corrective measures to raise the amount of e-waste disposed of. The study's conclusions demonstrate that most Computer Sciences students had a marked increase in awareness and knowledge of the issue. Furthermore, it was noted that there was a considerable direct impact of the educational intervention on the student's intention to recycle e-waste. Anyway, females seem to be more interested in e-waste and have more experience related to the topic compared to male students.

Keywords: E-waste, WEEE, computer sciences students, recycling.

1. Introduction

Numerous electronic devices have been invented as a result of rapid economic development, urbanization, and technological innovation, significantly improving our quality of life. Today's world's obsession with electrical and electronic devices and the desire to own the latest gadgets have led to the creation of modern electronics with shorter lifespans and other issues related to the complexity of their design.

Electrical and Electronic Equipment (EEE) includes a wide range of products, including nearly all household or business items with circuitry or electrical components that have a power or battery supply for performing their functions.

EEE becomes e-waste once it has been discarded by its owner as waste without the intent of reuse. E-waste includes a broad term for electronic and electrical equipment that is unwanted, obsolete, non-functioning, or has reached the end of its useful life. E-waste currently constitutes the fastest-growing waste stream globally.

E-waste encompasses a wide variety of discarded products and is classified into six main categories. Each category of e-waste has different functions and materials used, which can have different effects on the environment and human health if they are not carefully managed and treated. Its improper disposal is life-threatening because it includes hundreds of different substances, many of which are toxic and polluting elements that can flow into the soil, surface, and underground water or be emitted into the air. Hazardous components, valuable materials, and specific sizes of each type of e-waste all influence how it must be collected, treated, recycled, or disposed of in an environmentally sound manner (ESM). Numerous valuable materials, including gold, silver, copper, plastic, and palladium, can be recovered from e-waste, and used as possible new raw materials.

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Recycling involves the collection, dismantling and processing of old electronic equipment to recover valuable materials. These materials can then be reused in the production of new products, reducing the need to extract raw materials from the earth.

2. Literature Review

According to the study conducted by United Nations University, it is estimated that 177 thousand tons of WEEE will be generated in the Western Balkan region by 2030, compared to the predicted 142 thousand tons in 2018 [1]. On the other hand, of 195 countries in the world, only 41 quantify their e-waste generation and regulate and monitor recycling streams officially [2].
In 2019, the world generated a striking 53.6 Mt of e-waste, the formal documented collection and recycling was 9.3 Mt, thus 17.4% compared to e-waste generated [3]. It's worth mentioning that more than 320 tons of gold and more than 7,500 tons of silver are utilized every year to make computers, mobile phones, tablets, and other appliances around the world [4].
E-waste generation worldwide has nearly doubled since 2010, from 33.8 million metric tons to roughly 62 million tons in 2022. Electronic waste is one of the fastest-growing waste streams, with global e-waste generation projected to reach 82 million metric tons by 2030. Less than one quarter (22.3%) of the year's e-waste mass was documented as having been properly collected and recycled in 2022, leaving US $62 billion worth of recoverable natural resources unaccounted for and increasing pollution risks to communities worldwide [5].

3. Research Methodology

This study aimed to assess the knowledge, awareness, and practice of e-waste management of Computer Science students, the study was conducted at the University of Tetova.
The research methodology employed in this study utilizes a survey method via an electronic questionnaire as the primary tool for data collection. The questionnaire was meticulously crafted to address the research objectives effectively. Each question was designed to elicit specific information relevant to the study's focus areas.

3.1 Questionnaire design: The questionnaire was distributed through email. The questions included open-ended ones containing long answers by the respondents, as well as closed-ended ones including multiple-choice, Likert scale, and dichotomous questions. It was designed with 18 questions that cover three sections:

- Demographic data
- General information about e-waste.
- Opinion about the e-waste management.

4. Analysis and Results

According to the research conducted on computer science students, in total, we have reached **98 responses.** From the accumulated results, as illustrated in Figure 1, on average, **65%** of the participants in the questionnaire are boys and **35%** are girls. From the graph, we can note that **37%**include students in the first year of studies, **31%** second year, **17%**third year, **and 15%** fourth year.
From the crosstab of the variables **gender** and **year of study** in the figure below, it shows that in the first year of studies, boys had the largest participation in the questionnaire compared to girls, in the second and third years we also have the same results, while in the fourth year, we have greater participation of girls.

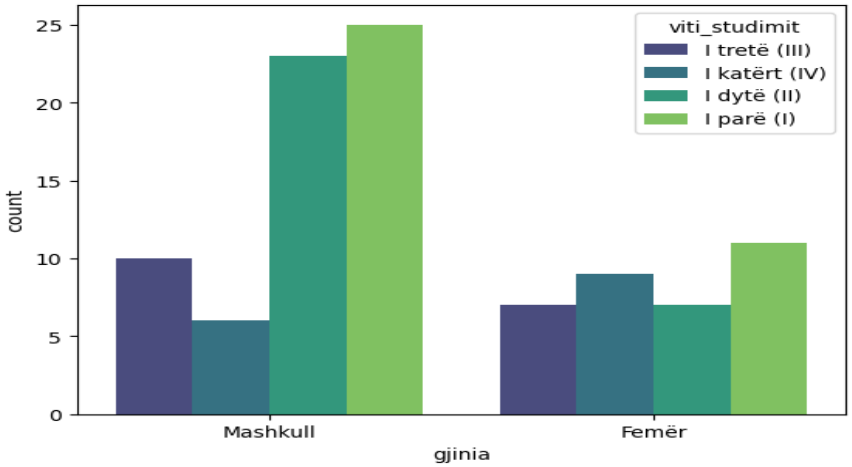

Figure 1. Gender participation by year

The analysis made with students of all years of study and the question of how often they replace their equipment, it is more obvious that among second-year students we have more answers that they replace equipment every 2-3 years, we have students who they replace them every 4-5 years and a small percentage do not replace them until they are functional.
For first-year students, we do not have any answers from students for the option of replacing every year or rarely/never. In the second and third year, it also turns out that students replace the devices more every 2-3 years.

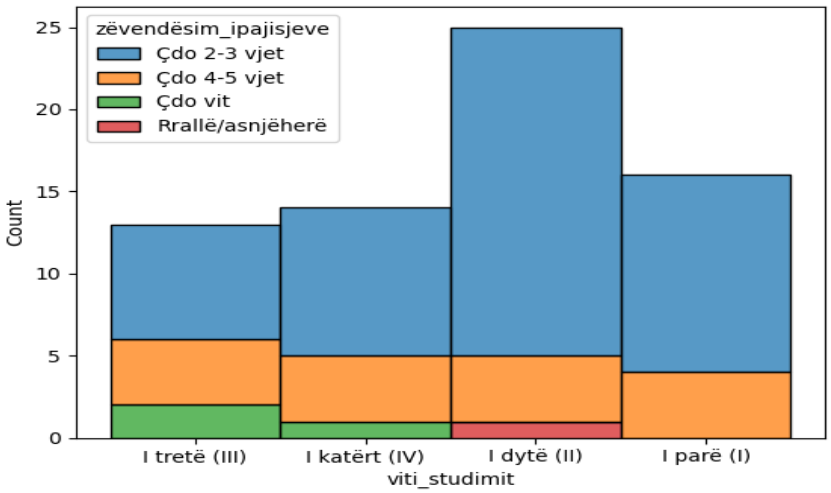

Figure 2. Recycling habits

Figure 3 displays the knowledge of the Computer Sciences students with the term electronic waste (e-waste). It turns out that first-year students have less knowledge in this aspect, while students of other years are more familiar with this issue.

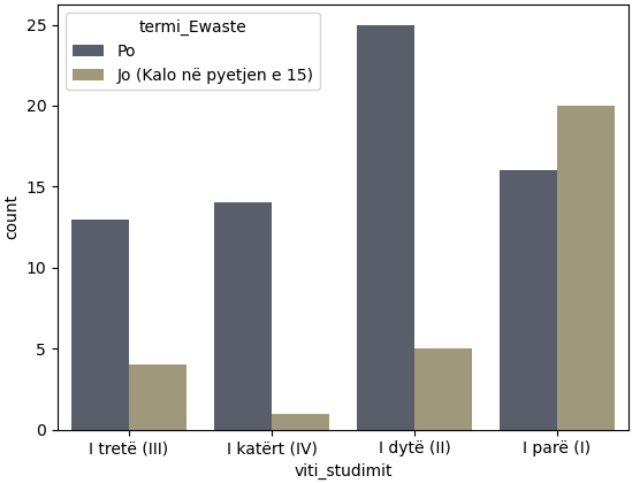

Figure 3. E-waste knowledge

We may infer from the responses gathered that fourth-year students were more involved in recycling electronic waste-related activities than other years students were.

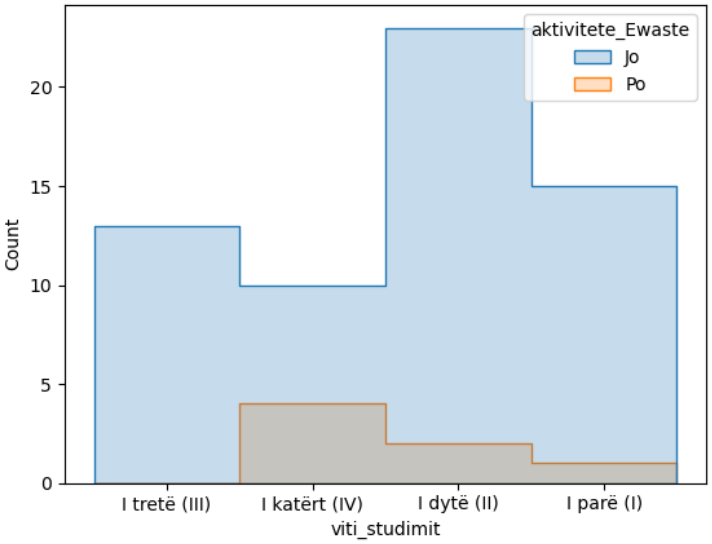

Figure 4. E-waste Activities

About the question of what happens to outdated electronics that students replace with new ones, the graph showing the responses from boys and girls indicates that males and females both keep more items that they give away or remove from usage. We can therefore conclude that neither boys nor girls recycle a lot of technological debris.

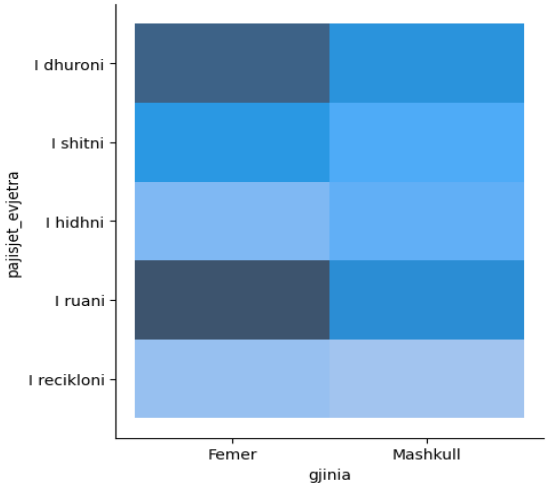

Figure 5. Old electronic habits

Regarding the question, what environmental issues or harm do you believe e-waste causes, based on the responses provided, the students believe that electronic waste poses a greater danger of disease to humans and does more harm to the environment. This schema is represented in Figure 6.

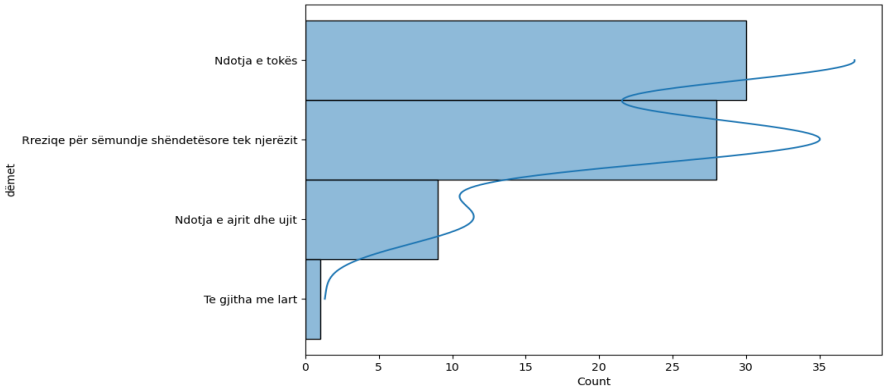

Figure 6. Environmental Harm

The correlation in the heatmap below shows that there is a moderate 51% correlation according to the Pearson coefficient between the places where electronic waste is collected and activities regarding this phenomenon in general. Probably if there are more such places it will encourage students to participate in more e-waste activities.

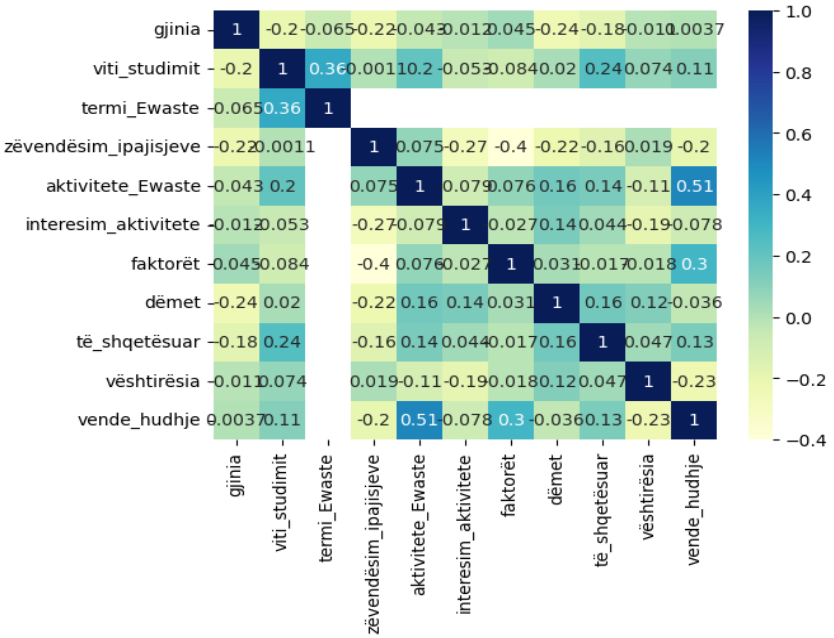

Figure 7. Variables Correlation

In accordance with the topic, an electronic guitar has been built measuring 46.5 cm long and 16.5 cm wide. The reusable elements include the motherboard, transistors, led diodes, CD's, and IDE cable, as illustrated in Figure 8 below.

Figure 8. E-waste Guitar

4. Conclusions

Increased awareness about e-waste is imperative for both individuals and society as a whole. From reducing environmental impact to promoting responsible consumption and disposal habits, educating people about the hazards and consequences of improper e-waste management can lead to tangible positive outcomes.
From the accumulated results it can be concluded that:

- From a total of 98 answers analyzed, it results that 20% of students have no knowledge at all about e-waste in general.
- From a more detailed analysis of the students who expressed that they have knowledge about e-waste, we concluded that female students have more knowledge about e-waste compared to males, also they are more interested in participating in activities related to e- waste.
- From all the students of different years of study, very few have emphasized that they have carried out activities related to the recycling of this waste.
- The biggest damage that comes to us from electronic waste is soil pollution.

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