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EFFICIENT USE OF ELECTRONIC WASTE IN THE UNIVERSITIES OF THE MUNICIPALITY OF TEPIC

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Abstract: This research aims to understand the treatment of electronic and electrical waste generated in higher education institutions, for this the Autonomous University of Nayarit (UAN), Tepic Technological Institute (IT) and the Tepic Technological University (UT) were considered. In order to propose strategies that promote their adequate processing. The mixed method was used, and convenience sampling was determined for 14 people involved. The instrument applied was a questionnaire made up of 29 online questions. According to the results obtained, the control of WEEE must aim at a more efficient use of resources, promoting the recovery of reusable materials to reintegrate them into the production chain, through projects generated in Higher Education Institutions (IES), with the support of government programs, this in order to reduce the environmental impact, and generate actions for social and economic benefit.
Keywords: Environmental care, Electronic waste, Electrical waste, Recycling, Sustainability

INTRODUCTION

Electrical devices are those that are made up of a power source that provides them with energy, cables and other elements such as light bulbs, switches, coils, magnets, motors, etc. They work by transforming, expanding, reducing or interrupting the electrical current supplied by the power source. For example, an incandescent lamp that transforms electricity into light.

On the other hand, electronic devices are those that, made up of multiple circuits, use electrical currents to carry out more complicated operations. In addition, they can be used as batteries to operate for a certain time without being connected to the mains. An example of these could be a laptop or a tablet. (Electronics, 2020).

The solid waste management system of most municipalities in the state of Nayarit is made up of manual sweeping, collection and final disposal subsystems. Nayarit has 22 final disposal sites, of which, only three comply with the Official Standard of the Ministry of the Environment and Natural Resources (NOM-083-SEMARNAT-2003), this standard contains the draft modification in which They specify the environmental protection standards for site selection, design, construction, operation, monitoring, closure and complementary works of a final disposal site for urban solid waste and special management. Regarding location, construction and operational restrictions.

These sites are located in the municipalities of Bahía de Banderas, Compostela and Jala, the latter corresponding to a regional landfill made up of the municipalities of Ahuacatlán, Ixtlán del Río and Jala. The classification of the final disposal site in the municipality of Tepic is an open-air dump (Hernández *et al*., 2013).

Currently, in the city of Tepic, there are more than 50 higher-level educational institutions, which consider electronic and electrical devices, mainly computer equipment (Gobierno del Estado de Nayarit, 2011). Like all products, these devices have a useful lifespan, the result of this is the accumulation of all electronic and electrical waste. For this reason, it is important to determine what the Higher Educational Institutions (HEIs) do with all that decomposed or obsolete waste, its magnitude and its final destination, therefore, part of the project is to investigate whether the already mentioned HEIs have with a regulated program for its treatment, otherwise, have the option open to create a sustainable strategy to avoid the misuse of said waste.

The object of this research is the waste electrical and electronic equipment (WEEE) generated in public educational institutions taking into account the following:

(Autonomous University of Nayarit, Tepic Technological Institute and the Technological University of Nayarit) of the city of Tepic municipality of the state of Nayarit, with the purpose of detecting the magnitude of the waste generated and possible actions for the implementation of reuse or separation of harmful or potentially useful components for sale, as in other regions of the world (Europe, South America) implement it (Caribe,2014). This problem can be analyzed from various perspectives, for example, as public policies studying the impact that waste generation can have on the environment, as well as the economic repercussions.

OBJECTIVES

GENERAL

Know the use and management of electronic and electrical waste generated by the Autonomous University of Nayarit, the Technological University of Nayarit and the Tepic Technological Institute, which allows proposing a sustainable recycling strategy.

SPECIFIC

- Identify the magnitude of electronic and electrical waste in these institutions.
- Determine what the IES (UAN, UT, ITT) do with electronic and electrical waste.
- Propose a sustainable recycling strategy with respect to electronic and electrical waste.

METHOD

It is a research with a mixed approach, exploratory, descriptive, explanatory and transversal. It was considered an exploratory type of research because it is a research topic that is little addressed, since there is research carried out in general on solid waste, mostly, and on electronic waste, but only in certain geographical areas, there are limited research related to waste. electrical and electronic applied to educational institutions (Ramírez et al., 2012). The search for bibliographic sources related to the research topic helped to gain knowledge of issues that have already been asked and to have an idea of the current situation regarding electronic and electrical waste.

It is descriptive since it sought to know the actions that are carried out with electrical and electronic waste, and to establish them as part of a process, for this, it was required to carry out preparation, which included the initial reflection, the definition of the problematic area and the initial design of the study, which may be modified later (Macías *et al.,* 2011).

After that, it involved the explanatory aspect as it was aimed at answering in greater depth the research questions posed to achieve the objectives. It is transversal, since it was done in a specific period of time to know the current situation of the problem (Sampieri, 2014).

The research was limited to those public educational institutions in the city of Tepic, Nayarit; such as the Autonomous University of Nayarit (UAN), Technological University of Nayarit (UT) and the Tepic Technological Institute (ITT), who constantly renew their electrical and electronic devices, mainly computer equipment, discarding obsolete equipment and keeping them in spaces that They are occupied for many years. These institutions were chosen for having large enrollment, adequate infrastructure for the use of electrical and electronic devices, and for being one of the main higher level institutions in the state.

An interview was developed which was designed by its own source, with the integration of questions that generated information that would allow providing a response to the stated objectives. For the

implementation of the interview, the Google Forms tool was used. 14 interviews were carried out with people in charge of processing the administration of electronic and electrical waste in the institutions considered in this research. At the Autonomous University of Nayarit, the interview was applied to those in charge of these departments integrated into the Academic Units that make up the UAN, as well as the person in charge of the Central Department of Material Resources. At the Technological University of Nayarit and the Tepic Technological Institute, they only have one person for waste management.

The interview was made up of questions that covered aspects such as:

- Destination of electronic and electrical waste, mainly computer equipment
- Renewal time for computer equipment
- Types of both electronic and electrical devices.
- Find out if they have records of team casualties.
- Benefits and consequences of waste
- Aspects that make it difficult to carry out actions in favor of the proper use of waste
- Know if there is any program or there has been any campaign related to the proper processing of electrical waste and electronics.

RESULTS

The information collected in the different educational institutions was focused on obtaining data from the people in charge of each institution, this with the purpose of having current data on the processes carried out in each of the universities, knowing the processing of waste, identifying the knowledge that institutions have about the alternatives for the adequate processing of electrical and electronic waste.

The circular economy is an important part of the strategy, since both electronic and electrical devices have components that are not biodegradable, so they are reused. This type of waste enters an economic process in which it favors the development of new products, or even the repair of others, minimizing the production, consumption and disposal of more devices by companies and consumers.

Educational institutions are the main source of knowledge for society, and that is why environmental education applied in society by schools is of great importance, both as a source of information and as a generator of culture in the daily life of people. people.

The sustainable recycling strategy consists of a specialized program that involves the Autonomous University of Nayarit, Mexico (potentially applicable in other institutions) and its academic units/areas, in which a current perspective of high production of electronic and electrical devices in the country, main components of said devices, as well as identifying which ones are harmful to the environment and health and which are potentially marketable, as well as guiding people that some components can be reusable for the creation or restoration of devices that can be used for various social purposes, covering sustainability, economic and social aspects.

According to the results obtained, Fig. 1 shows the total percentage of participation by institution in regards to the response of the instrument that was applied in institutions such as the Autonomous University of Nayarit, the Technological University of Nayarit and the Tepic Technological Institute. It is worth mentioning that the Autonomous University has a higher percentage of people interviewed because most of the Academic Units have people designated for the activities of removing and adding inventories of disused goods, together with the area assigned to the

Directorate of Material Resources, while at the Technological University of Nayarit and the Tepic Technological Institute, they only have one person designated for this type of activities. Figure 1 shows the percentage of participants from each institution surveyed.

The results of the interview applied to the Academic Units of the Autonomous University of Nayarit, show that there is no special department that is in charge of keeping control over the use and destination given to the electronic and electrical devices that are stored., since according to the results of the information collected, those responsible may be teachers who in turn have been assigned as responsible for those areas, the administrative subdirectorate, those in charge of the computer laboratories, the Coordinators, the Directorate of the Academic Unit or administrative.

In the same sense, the Technological University of Nayarit and the Tepic Technological Institute do not have a special department for the control of disused devices and the people designated for these actions are assigned by the Human Resources Directorate. The results obtained showed that 42.9% of the people have worked between 8-11 years, 42.9% of the people interviewed have worked more than 12 years in the institution, 7.1% 4-7 years and likewise 7.1% % of the people interviewed have worked for 1-3 years. In conclusion, it can be deduced that people have a long time knowing the processes that they must carry out according to their position, that is, due to the time that these people have worked in that position, it is considered that they know issues of requisition time and waste disposal.

Based on the results obtained, the main areas by academic unit that have electrical and electronic devices within the UAN are the areas of management, sub-management, coordination, computer rooms, among other more specific areas of the faculties, such as laboratories. specific to the areas of dentistry, medicine, QFB, food technology, engineering, etc.

The average period of updating or renewal of their devices according to the results of the interview of the personnel belonging to the Academic Units of the Autonomous University of Nayarit, they mention that in a period of one to three years it takes to update the electronic or electrical devices that are They use it on a daily basis, 8% update it in a period of 4 to 6 years and 25% take more than 6 years to update it. On the other hand, at the Technological University of Nayarit they are updated every six years onwards, the Technological Institute does so in a period of three years.

Something that they argue at the Technological University is that updating is not carried out more continuously because it is a relatively new institution.

According to the results of the interview, the main devices that are discarded by the different areas of the Institutions are computer equipment.

Figure 2 shows that the majority of obsolete or broken equipment ends up being stored by the different 56 areas interviewed, in the "other" section, in this case it is mentioned by the academic units of the Autonomous University of Nayarit that All electronic and electrical devices are removed from the inventory, stored and later sent to the central department of material resources. In some other cases, it is mentioned that they are thrown away or donated, and removed from the inventory.

Regarding the registry of disused equipment, the people interviewed mention that they do have records of disused equipment, while 21.4% do not have records of disused equipment, they mention that all those records are managed through inventory databases that the institution has created.

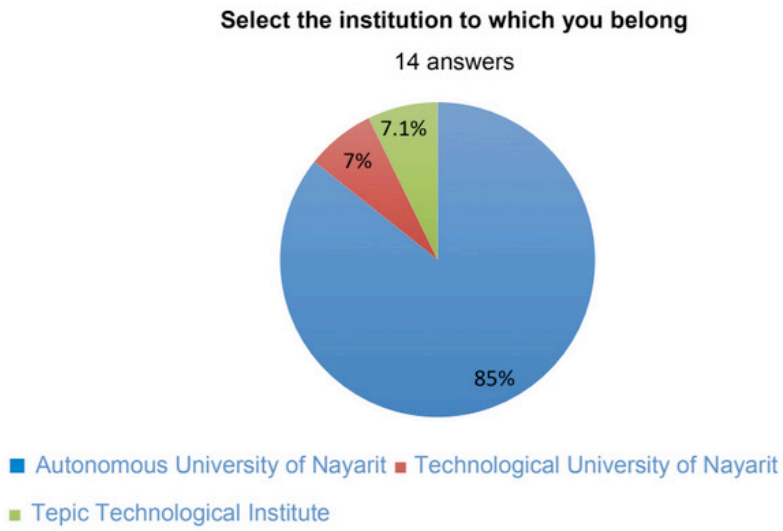

Figure 1. Participating institutions

Source: Own elaboration with data obtained in the applied interview

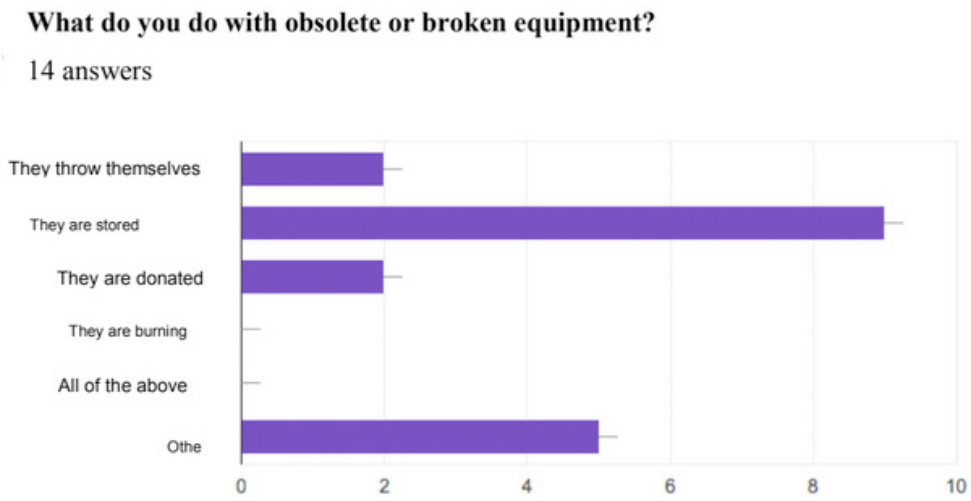

Figure 2. End of disused equipment in the academic units of the Autonomous University of Nayarit

Source: Own elaboration with data obtained in the applied interview.

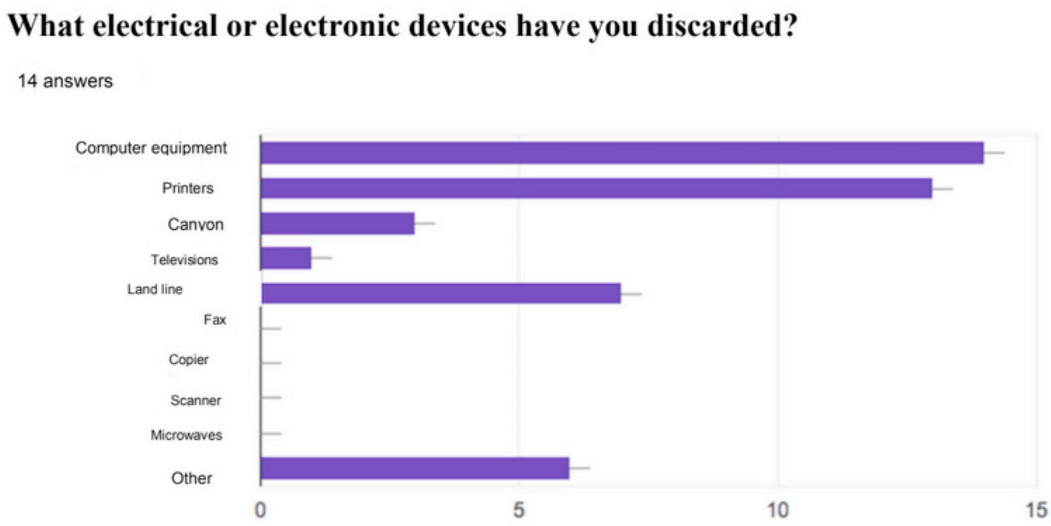

Figure 3 Electrical or electronic devices that are discarded in the different areas of the Academic Units of the Autonomous University of Nayarit.

Source: Own elaboration with data obtained in the applied interview.

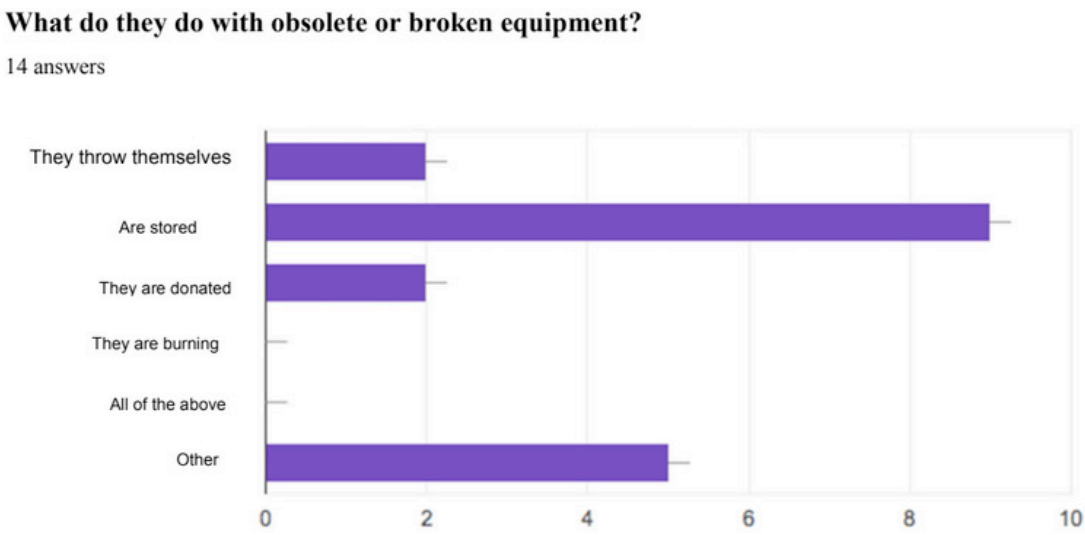

Figure 4: Actions carried out with the devices that are discarded by the different areas and academic units of the Autonomous University of Nayarit.

Source: Own elaboration with data obtained in the applied interview.

The results of the interview show that 75% of the Academic Units of the Autonomous University of Nayarit keep track of the electrical or electronic devices that are stored, among them are the Faculty of Economics, Dentistry, Law, Nursing, Tourism, Food Technology, UACyA, Social and the central department of material resources, while 25% of the academic units of the Autonomous University of Nayarit do not have records of disused devices.

According to the information obtained from Figure 3, the HEIs discard devices such as computer equipment, printers, cannons, televisions, landlines, among other types of devices more specific to the area such as dental equipment, equipment for food analysis., etc.

According to the results of Figure 4, it was concluded that the majority of obsolete or broken equipment ends up being stored by the different areas interviewed, in the "other" section in this case it is mentioned by the faculties. of the Autonomous University of Nayarit that all electronic and electrical devices are removed from the inventory, stored and later sent to the central department of material resources. In some other cases, it is mentioned that they are thrown away or donated.

Regarding the registration of disused equipment, 75% of the Academic Units of the Autonomous University of Nayarit keep track of the electrical or electronic devices that are stored, among them are the Faculty of Economics, Dentistry, Law, Nursing, Tourism, Food Technology, UACyA, Social and the central department of material resources, while 25% of the academic units of the Autonomous University of Nayarit do not have records of disused devices.

The Technological Institute of Tepic and the Technological University of Nayarit do have a record of the artifacts that are left in disuse, but they do not have a recycling and reuse process for these artifacts.

A total of 64.3% of the people interviewed in this research mention that they do not have knowledge of any institution that is dedicated to the treatment of electronic and electrical waste, reaching the conclusion that information is an important factor in the lack of proper use of waste. electronic and electrical, finally, 35.7% of the people interviewed mentioned knowing an institution dedicated to this type of actions in favor of the good use of waste.

DISCUSSION

In Mexico there are some institutions dedicated to the recycling of electronic waste such as ecorecicla.com, which is dedicated to the collection of solid waste for reuse and/or recycling so that it can be converted into raw material. The company offers a safe and sustainable solution to all the electrical material that you no longer want, knowing that they will be reintegrated into a production process after correct disassembly. The company collects computers, LCD and LED monitors, printers, keyboards, electronic cards, mice, cables, regulators, hard drives, shelves, cell phones, servers, power supplies and racks. Collection is at home and accepts up to 500 kilos, in addition to paying for those artifacts that are still in usable condition. Unfortunately these companies do not exist in all states of the Mexican Republic.

In the State of Nayarit, there is a permanent RECYCLING program in the SDS (Secretary of Development and Sustainability), whose objective is to protect the environment, where waste electronic devices are received throughout the year for recycling. But, although this organization exists, there is no program to disseminate the actions it carries out or to link educational institutions.

Currently, the educational institutions investigated lack a fixed program that obligatorily involves them in carrying out

actions that favor the recycling of electronic and electrical waste, this type of waste being very harmful to the environment and the health of the user. living being, likewise, due to its components, they are potentially marketable and some even reusable.

That is why the sustainable recycling strategy for electronic and electrical waste involves aspects such as:

- The Circular Economy.
- Economic Perspectives based on the components of the devices.
- Restoration of potentially reusable devices.
- Commitment on the part of educational institutions in favor of better environmental education, social well-being and sustainable actions that generate economic development.

The circular economy is an important part of the strategy, since both electronic and electrical devices have components that are not biodegradable, so they are reused. This type of waste enters an economic process in which it favors the development of new products, or even the repair of others, minimizing the production, consumption and disposal of more devices by companies and consumers.

CONCLUSION

Educational institutions are the main source of knowledge for society, and that is why environmental education applied in society by schools is of great importance, both as a source of information and as a generator of culture in the daily life of people. people.

The sustainable recycling strategy consists of a specialized program that involves the Autonomous University of Nayarit (potentially applicable in other institutions) and its academic units/areas, in which a current perspective of the high production of electronic and electrical devices in the country, main components of said devices, as well as identifying which ones are harmful to the environment and health and which are potentially marketable, guiding those involved on reuse for the creation or restoration of devices that can be used for various social purposes, covering sustainability, economic and social aspects.

FUTURE LINES OF RESEARCH

It is necessary to implement sustainable projects that involve students through their academic processes as a social service in the case of academic programs focused on the area of technology, generating proposals for recycling and reusing computer equipment for their respective donation. Through projects generated by academic bodies that allow the reuse and good use of electronic waste.

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