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Environmental impact of information and communication technologies on health

Impacto medioambiental de las tecnologías de la información y las comunicaciones para la salud

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Abstract
The Information and Communication Technologies from its evolution, creates new technological means on a daily basis that are introduced into the daily processes that people carry out. The exponential technological increase and its evolution generate technological obsolescence. However, since the disuse of technology, many media have substances that affect the environment and human health if they are not given the appropriate treatment. This research carries out a study of the environmental impact of obsolete technology and its effect on human health.
Keywords: Technologies, environment, human health, electronic waste.

Resumen
Las Tecnologías de la Información y las Comunicaciones (TICs) a partir de su evolución, crea nuevos medios tecnológicos a diario que son introducidos en los procesos cotidianos que realizan las personas. El incremento exponencial tecnológico y su evolución generan obsolescencia tecnológica. Sin embargo, a partir de la caída en desuso de la tecnología muchos medios poseen sustancias que afectan el medio ambiente y la salud humana si no se les da el tratamiento adecuado. El presente trabajo realiza una investigación cualitativa, exploratoria, se realiza un estudio del impacto medioambiental de la tecnología obsolescente y su efecto para la salud humana.
Palabras clave: Tecnologías, medio ambiente, salud humana, basura electrónica.

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1. Introduction

The evolution of Information and Communication Technologies (ICTs) represents a growing phenomenon today. There have been several applications in all areas of knowledge. In the private, industrial and educational sectors, to cite only a few examples, many of their processes and activities are based on the use of technology.

These days, there is no concept of a process involving people who are not present in ICTs (Mar et al., 2017). Authors such as Morozov (2015) have called the phenomenon as the madness of technological solutions. However, technological growth itself sometimes generates the fall into disuse of numerous media that are still functional, representing obsolete technology.

Obsolescence is the fall into disuse of machines, equipment and technologies, not because of their malfunctioning, but because of insufficient performance of their functions in comparison with current demands (Hidalgo, 2010; Morozov, 2015). Obsolescence determines that a group of equipment has a relatively short useful life and is part of ICTs waste known as residues from electrical and electronic equipment (*EEE)* generating technological waste or *e-waste* (Jurado and Jose, 2018).

From the situation outlined above, the question arises: What happens to the technological waste derived from Information and Communication Technologies? The present research carries out an analysis of the environmental impact of technological waste and its implication on human health.

2. Methodology

For the development of the present work, an exploratory research is carried out using as paradigm the qualitative one where, based on a problem statement, the scientific literature is studied to substantiate the incidence of the study phenomenon using the bases proposed by Sampieri (Hernández Sampieri et al., 2010).

The object of study is represented by the waste derived from ICTs; the research is delimited from the impact that technological garbage has on human health. The scientific literature on the object of study was used as a source of information, and the research used as a method the documentary analysis on which the development of the proposal is based.

Technological residues and its impact on health

A report by the United Nations Environment Programme notify that currently between 40 and 50 million tons of electronic waste are generated each year, and it is estimated that the volume of electronic scrap is growing between 16% and 28% every five years (UNESCO, 2010; Alarcón et al., 2019).

The main source of waste generation has a composition of several materials that are found as part of these. Table 1 presents a composition of the waste.

Within the different materials that make up electronic scrap are substances that can affect human health. Their impact is due to the degree of exposure and their route of transfer, which is nothing more than the interaction of the person with the material.

Table 1, referred to the main materials that make up electronic scrap where the hazardous material fraction is mentioned. It is possible to find as part of the hazardous materials, heavy metals such as Lead, Cadmium, Selenium and Mercury. Although the figure representing the composition of these materials is not significant 0.8%, it is important to pay vital attention to the impact on human health.

Table 1
Composition of technological waste
Basic materials

Material	%
1. Ferrous metals	39,1
2. Non-ferrous metals (Al, Cu, Au, Ag.)	21,0
3. Plastics	14,2
4. Monitor glass/TV	13,4
5. Mixed materials with plastics	5,8
6. Cables	2,2
7. Printed circuit boards	1,9
8. Others	1,6
9. Hazardous materials fraction	0,8

Source: (Mar, Puig, and Bron, 2017)

Based on studies carried out, a characterization of different materials and their adverse health effects is presented:

Older devices such as televisions and computer monitors have technology based on cathode ray tubes (CRT). Currently this has become obsolete, but the number of this technology is significant worldwide. The composition of the CRT devices has in its design lead oxide.

After inhalation or ingestion of lead oxide, it passes into the bloodstream, is transported by the red blood cells attached to the proteins in the plasma by 95 %, then distributed through the blood to the bones and soft tissues (liver, kidney, bone marrow and central nervous system); the half-life of the metal in blood is 35 days, in soft tissues 40 days and in bones 27 years, which is why it is present in higher percentages in bones. This route of distribution of lead appears to be similar in children and adults; although in adults the greatest storage is in the bones (Rodríguez Rey et al., 2017).

Lead in the environment becomes dangerous when it suffers its aqueous solution in presence of air. This contaminant can reach people not only through water but also through the ingestion of vegetables and fruits that have absorbed lead from the soil (López, 2008). Lead absorption is a serious public health risk; it provokes mental and intellectual developmental delays in children, it causes hypertension and cardiovascular disease in adults (Londoño-Franco et al., 2016).

Mercury is used in the manufacture of electrical current switches, old equipment, electromechanical relays and other temperature measuring devices. Mercury is a heavy metal that is liquid at temperature.

Acute or chronic exposure can cause adverse effects during any period of development. The effects are most lethal to the child's developing systems, especially the central nervous system. There is no known level of exposure that is safe. Moreover, it is known that humans should not have mercury in their bodies since they have no proven physiological functions. When intoxication is severe or due to prolonged exposure it becomes chronic, damage to brain functions, negative effects on reproduction, and even damage to DNA are observed (Gonzalez Jaimes, 2016).

Devices such as laptops use in their design batteries that have Cadmium in their composition which is also used as a thermal stabilizer in PVC plastics; Cadmium Sulfide is used in solar cells and portable photography, among other uses (Sanchez, 2017). Cadmium has no biological function, but one of its main characteristics is that it can bioaccumulate in different ecosystems, both aquatic and terrestrial, and through these it can enter the food chain and reach living beings, where it has harmful effects on the organs where it accumulates, such as the kidney and liver of vertebrate organisms, and also in invertebrates, it can accumulate in a wide variety of plants and algae.

For the design of metal parts of different equipment, materials such as Chrome, Cobalt and Manganese are used; these metals are components of steel. Chromium is a heavy metal and could possibly accumulate and cause problems if consumed in excess. It can enter the body through the respiratory tract, be ingested by eating or drinking contaminated food, or by direct skin contact. Trivalent chromium found in food and supplements has very little toxicity and in the case of high intake the severity is minimal as absorption is very low.

Hexavalent chromium has very high levels of toxicity, is derived from many industrial products, pigments and stainless-steel manufacturing that cause local irritation (dermatitis) and increase the incidence of cancer, mainly lung cancer and cause stomach discomfort and generate ulcers. It has been observed in different studies, as people who have consumed values higher than the normal dose have presented hepatic, renal and bone marrow damage (Muñoz et al., 2016).

3. Results

Recycling strategy for technological waste

The waste generated by man represents a focus of attention in the preservation of the environment. The Council of the Southern Common Market (MERCOSUR for its Spanish initials) proposed the Treaty of Asunción, the original source of regional community law, which establishes that the States parties share values that find expression in their democratic, pluralistic societies, defenders of fundamental freedoms, human rights and environmental protection (Guinand and Cánepa, 2011). Within the agreements presented for the protection of the environment is the MERCOSUR Policy on Environmental Management of Special Waste of Universal Generation and Post-Consumer Responsibility, which represented the way to consolidate environmental policy (Piera, 2010).

Various initiatives have been implemented such as the guide to legal content for the management of electronic waste (Moraga and Durán, 2010). Currently, compliance with these measures represents a challenge of the knowledge society before the growing generation of technological waste (Cyranek and Silva, 2010).

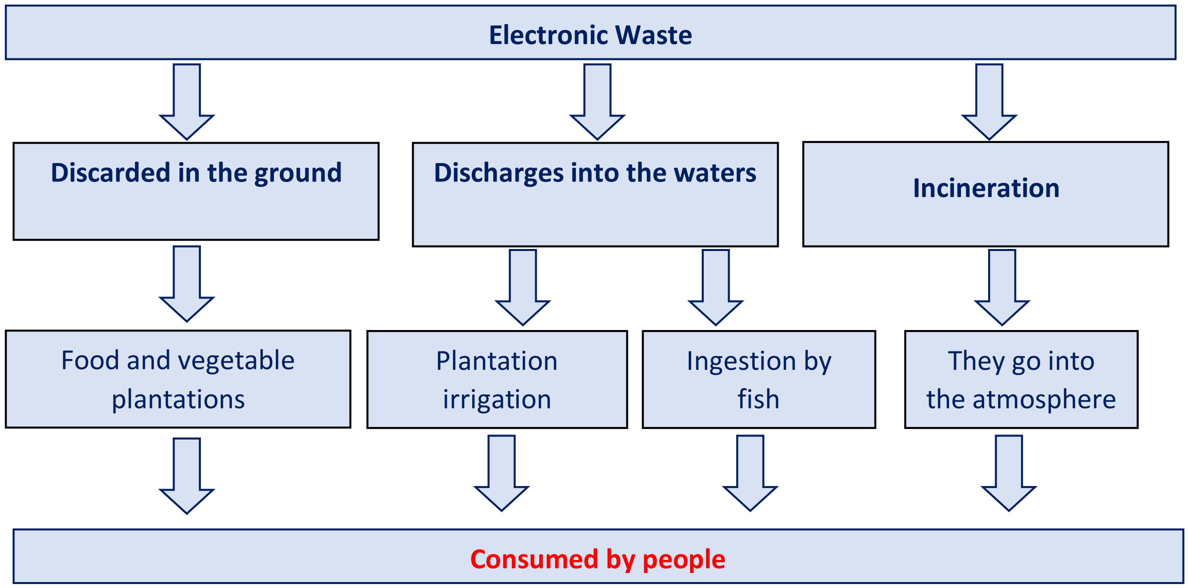
The progress and challenges of regional environmental policies in South America (Guinand and Cánepa, 2011), promotes initiatives from different perspectives, making exports an attractive area for their implementation. The export of electronic waste contributes to Ecuador's foreign trade from an economic perspective, representing a viable alternative for its implementation (Alarcón, 2019).

Create a recycling education in each company by encouraging personnel, with the objective of generating new income for the country, thus achieving exports as environmental alternatives for the treatment of technological waste to reduce environmental impact (Martillo et al., 2018).

Technological waste and its impact on the environment

A person may be unconsciously exposed or consuming substances harmful to health. Spread can be through inhalation of contaminated air, ingestion of contaminated products or physical interaction with a contaminating source (Piedra and Wensley, 2009). Figure 1 shows a pattern of spread of substances that escaped recycling.

Figure 1
Life cycle of technological waste that escaped recycling



Source: own elaboration

Based on a scenario in which it is possible that technological waste escapes recycling as expressed by Piedra (2009) in his work Análisis situacional de la gestión de residuos sólidos urbano (Piedra and Wensley, 2009). A person may be coexisting with the following scenarios:

- Materials that escaped recycling and were buried in the soil, the land is planted with viands and vegetables that were later consumed by man.
- Materials that escaped recycling and were dumped into rivers, these waters are then used to irrigate crops that are consumed by humans.
- Materials that escaped recycling and ended up in the sea, the weights can feed on the waste and later be consumed by man.

4. Conclusions

In today's knowledge society, the exponential growth of technology generates a fall in the disuse of technological resources, which leads to the generation of a large amount of technological waste derived from Information and Communication Technologies. The waste generated has substances that affect human health, becoming a social problem of global magnitude.

The management of technological waste represents a complex phenomenon to solve product to its implication for the environment. Environmental education and the creation of awareness about the need to recycle and export technological waste today represent a working scenario to ensure the survival of human beings on the planet.

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