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Consumption, use and disposal patterns of electric devices among university students in Mar del Plata, Argentina

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Abstract

The production of electronic devices, based on the exploitation of non-renewable resources, requires novel strategies for the efficient recovery of valuable materials contained in the e-waste stream. To conceive the local management of these particular resources in a decentralized way, the patterns of consumption, use and disposal of electronic devices were analyzed in a higherlevel educational institution, the National University of Mar del Plata in Argentina, considered as a Distinctive Urban Mine (DUM).
A quantitative methodology was developed by distributing a self-administered survey on a sample of 400 university students, statistically distributed among the different faculties. The instrument was divided into the stages that condition the postconsumption paths of electronic waste in Mar del Plata city. Each phase – consumption, use and disposal of electronic devices – was analyzed based on the variables of habits, information and valorization.
The main results highlight the socio-cultural factors that characterize this particular DUM as replacement cycles of electronic devices, estimated between two to four years, in relation to the lack of maintenance, and valorization in terms of price and durability. It is the first study that makes a contribution on e-waste based on quantitative data on the territory of Mar del Plata. The conclusions emphasize the correlations between stages, which can be effectively measured and conducted to improve the variables to manage DUM sustainably..

Keywords: sustainable development, urban mining, e-waste, post-consumer, university students

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1. Introduction

Electronic waste linked to Information and Communication Technologies (EW-ICT), grows exponentially every year, due to the current urban dynamics, founded on the exchange of a large amount of information. Also, by the shorter rates of consumption and replacement of these devices. The dependence on its use for daily activities, in personal, professional and educational ways increased as a result of the isolation measures set up by governments around the world due to SARS COVID-19. In fact, sales of household appliances grew 50% during 2020 in Argentina, compared to the previous year (INDEC, 2021).

The environmentally safe management of this waste stream contributes to several of the Sustainable Development Goals (SDG), established by the United Nations in cooperation with its member states, to achieve a more sustainable planet by 2030. SDG 3 (Good health and well-being) and SDG 6 (Water and sanitation) are most relevant, since burning for recycling and using acids to obtain precious metals leads to health risks to those who treat them in an unsafe way, as well as lead to the effluents polluting the air, water and soil (Clinckspoor and Suarez, 2018). On the other hand, the effective recovery and reuse or recycling of EW-ICT contributes to a climate benefit linked to SDG 13 (Climate Action) (Clarke et al., 2019). Finally, SDG 12 (Responsible production and consumption), addressed by this study, recommends deepening research lines on these problem towards local actors and consumers of electronic devices. In this sense, the consumption, use and disposal of electronic devices is understood as a process in which each stage is directly related to the previous one and conditions the one that follows. Implying that is the same commodity, that changes its state depending on cultural nuances. According to Appadurai (1988), it is the cultural dimension that provides value to the exchange of commodities, and at the same time the exchange itself is the value that is conferred to them.

The potential impacts of e-waste can be understood in a simplified and ambivalent way. A small percentage of its composition contains elements that are toxic and unsafe for health and the environment. On the other hand, they contain abundant valuable resources, in some cases of high value in the international market. To efficiently recover the valuable materials, it is necessary to break with the traditional linear use of resources towards a closed cycle (Cossu, 2013). In this sense, the strategy proposed in this study considers the concept of Urban Mining (Cossu and Williams, 2015), specifically the theoretical perspective of the Distinct Urban Mines (DUM). DUM, analogous to extractive primary mines rich in a particular type of material, are understood as uniform spaces that comprise a high concentration of particular products or materials, therefore useful for different categories of waste and specific resources (Ongondo and Williams, 2011a; Ongondo and Williams, 2011b).

According to Mueller et al. (2015), this categorization is highly efficient and valid as an instrument to evaluate the potential for recovery of secondary resources within the anthroposphere (Ongondo et al., 2015). Because the anthroposphere comprises several different urban mines that can be contrasted by various criteria, such as product flows, material concentration and composition or external influences (e.g. demographics, consumption behaviour and product disposal, storage, etc.), which often interact with each other (Wallsten et al., 2015). Identify and categorize the different criteria of a DUM, allows recognize them according to their distinctive characteristics (Pierron et al., 2021), that make them unique.

1.1 Electronic waste in Mar del Plata, Argentina

There are important antecedents and approaches, from multiple contexts on the planet, (Ongondo and Williams, 2011a; Ongondo and Williams, 2011b; Afroz et al, 2013; Milovantseva and Saphores, 2013; Li et al., 2015; Ylä-Mella et al., 2015; Guo and Yan, 2017; Bai et al., 2018; Zhang et al., 2019; Wikinson and Williams, 2020) that analyze different aspects (such as generation of estimates, perceptions, attitudes, among others) of the consumption, use and disposal of electronic devices based on consumers, such as university students. Nevertheless, no study so far has analyzed the stages jointly,

neither are they located in Latin America.

To understand how this type of waste spreads in the territory, it should be noted that the legal framework that regulates electrical and electronic waste in Argentina does not yet have a specific minimum budget law for this particular type of waste. However, other laws are taken into consideration in a supplementary manner in the absence of a specific law. Also, some regulations are associated with the correct treatments that should be offered after consumption.

Law No. 25,675: General Environment: establishes the minimum budgets for achieving sustainable and adequate management of the environment, the preservation and protection of biological diversity and the implementation of sustainable development. Furthermore, it establishes that its interpretation and application will be subject to compliance with the principles of congruence, prevention, precaution, intergenerational equity, progressivity, responsibility, subsidiarity, sustainability, solidarity and cooperation. The different levels of government must ensure compliance with all these principles. Likewise, it defines environmental damage as any relevant alteration that negatively modifies the environment, its resources, the balance of ecosystems, or collective goods or values. The responsibility of anyone who causes environmental damage is also established, who must restore it to the state prior to its production. If this is not feasible, compensation must be provided as determined by the intervening ordinary justice system.

Bill 5563-D-2018 Comprehensive Management of Electrical and Electronic Devices and their Waste was presented in 2011 and establishes the minimum environmental protection budgets for the management of WEEE throughout the Nation. The main objective is the protection and preservation of the environment from the pollution that they may generate, by reducing the danger of the EEE components; making its recovery, reuse and recycling and reducing its final disposal. To achieve these objectives, it is important to train the population that is part of the life cycle of EEE so that they can see the importance that their comprehensive management has for the environment and the health of the population.

Bill 0072-D -2018 Minimum Environmental Protection Budgets for Waste Management through Extended Producer Responsibility (EPR) establishes the minimum environmental protection budgets for the comprehensive management of waste through the establishment of the principle of extended producer responsibility, promoting minimization in generation, reuse, recycling and other types of recovery, with the aim of protecting the health of people and the environment. Obligations are established for both producers and users/consumers and for the marketer/distributor/retailer.

The existence of jurisdictional regulations on WEEE and the lack of a national regulatory framework entails a certain risk for the location of investments in the different districts. Furthermore, the existing regulations in the jurisdictions are incomplete and none incorporate the principle of Extended Producer Responsibility (EPR).

In territories where there are no regulations, WEEE are considered within the scope of the legislation on hazardous waste, which complicates and increases the cost of its treatment and the same happens in its interjurisdictional traffic (Ruzzo et al., 2022).

Focusing on the city scale, this article proposes to apply the concept of DUM at the National University of Mar del Plata, located in a city of Argentina, in the Global South. Mar del Plata, with 610,909 inhabitants (Mar del Plata Entre Todos, 2018) ranks eighth among the 15 largest urban agglomerates in Argentina (Ferraro et al., 2013). Due to its extension and number of inhabitants, it constitutes the third urbanization of medium scale, in Buenos Aires State. Likewise, it houses 95% of the inhabitants of the General Pueyrredon District and acts as a concentrator of activities, goods and services for its total population (Ares and Mikkelsen, 2015).

As explained above, there is no management plan or legislation in force that contains or guides what to do with technological waste in the post-consumer stage, so it is valuable to know the perspective of young consumers regarding their consumption habits on behalf of the trends that are currently practiced. On the other hand, data on the current generation of this waste at the national level are imprecise and with variations between different authors, so this study considers the estimate of a recent work that stipulates that in Argentina about 465,000 tons of e-waste per year are produced (OIT, 2019). For the specific territory of the city of Mar del Plata, this information is non-existent. Therefore, this work is considered relevant in view of the fact that in some future this particular type

of waste can be managed in a sustainable way.

The hypothesis of this work, shared with a previous study in this territory (Clinckspoor and Ferraro, 2020), is that the entry to the possible routes of post-consumption of e-waste depend directly on the previous phases of the commodity, before it becomes waste. In other words, the consumption, use and disposal of electronic devices directly condition the management of post-consumption. Therefore, consumers are key actors in these processes, since the collection and recycling systems cannot function properly without their contribution. Similarly, the regulations that contain effective practices or the ones regarding the treatment and disposal of technological devices depend on the socio-cultural habits of each society (Clinckspoor, et al, 2021).

1.2 Distinctive Urban Mine in a higher education institution

The DUM concept may be used in educational establishments, such as the National University of Mar del Plata (UNMDP), since they have large populations of similar age, resource consumption and disposal habits. Also, they reside in that urban space for a comparable amount of time. During that period, students will consume and dispose of large amounts of resources (Li et al., 2012; Ongondo et al., 2015). As a consequence, they present a high concentration of consumer electronics and ICT technologies.

The UNMDP is a public university, created in 1975. In 2016, it had an enrolment of 30.313 students, spread over 33 undergraduate and 35 graduate degrees taught at the university. It is made up of ten academic faculties: Architecture, Urbanism and Design; Agricultural Sciences; Economic and Social Sciences; Exact and Natural Sciences; Health Sciences and Social Service; Law; Humanities; Engineering; Psychology and recently, the Higher School of Medicine. Not all academic units are concentrated in the University Complex; rather, some (where the surveys were also conducted) are located in different parts of the city. Among them, the Faculty of Law, in the centre of the city 3km from the Complex; the Faculty of Engineering, located 1.3km from the Complex; the Faculty of Agrarian Sciences and the furthest one, located in the city of Balcarce, 78km from the Complex. Although the Higher School of Medicine has a very high rate of students and is close to the Complex, it has not been considered in this study because this Faculty began in 2016, and no registration information could be provided.

On the other hand, a national study by the National Institute of Statistics and Censuses (INDEC) of Argentine, on access and use of Information and Communication Technologies (ICT), ensures that the use of ICT predominates among the young population of the country, mainly among young university students. Thus, these actors, which comprise groups between 18 and 29 years of age, with complete and incomplete higher education, concentrate the highest percentages of use of ICT goods and services, using 80.7% (Laptops) and 99.6% (Smartphones), compared to other age groups (INDEC, 2018). Beyond numerical estimates, ICT should be seen as a profound cultural change whose main actors are young people.

Therefore, this study focuses on a young and university-attending population; as well as on certain specific technological devices used by that population. In particular, smartphones and laptops, due to certain characteristics that qualify them as the most widely used ICT devices and that concentrate the greatest number of activities carried out by the population studied.

The aim of this article is to analyze the patterns of consumption, use and disposal of electronic devices and waste, of the students of the National University of Mar del Plata, from the variables of habits, valuation and information. In particular, this study tries to inquire about current consumer habits and preferences, as well as to estimate the generation and replacement cycles of EW-ICT, and to determine how these stages are related to the post-consumer stage.

From here, the structure of this paper consists of three sections. The first one introduces our quantitative methodology: the data source used, analysis techniques, the instrument that was implemented, the procedure and the data processing features. In the second section, the main results of the survey are presented. And, finally, the conclusions are outlined, with recommendations to continue this line of research.

2. Materials and methods

For this study, the work developed by Ongondo and Williams (2011) was taken as a model and adapted. The authors also carried out a survey on electronic devices on a university student population. However, in this paper, an economic prospecting approach was not developed.

Generally, studies of consumer behaviour focus on purchases and acquisitions in the trade. However, according to Jacoby, Berning and Dietvorst (1977, p. 22) who established that consumer behaviours imply the "acquisition, consumption and disposal of goods, services, time and ideas by decision-making units", consumer behaviour includes not only the acquisition of goods, but also their use and disposal, as a support to study current patterns. Hence, from the complete life cycle of an electronic device (from the extraction of its materials, its manufacture, distribution, sale, consumption, use, disposal and post-consumption or final disposal), three phases are estimated, where devices depend directly on consumers.

2.1 Analysis categories

To evaluate each of the stages of consumption, use and disposal of electronic devices, three categories of analysis are proposed, which allow establishing criteria linked to the sociocultural structure processes of the population. From this perspective, the surveys carried out here have been interpreted to analyze consumer behaviours, recognizing the set of factors that influence their decisions when acquiring, using and disposing of certain items. Thus, they allow us to understand cultural behaviours around the objects studied and applied to current sociocultural dynamics.

2.1.1 Habits

The first variable or category of analysis is 'habits', which aims to identify customs and procedures around electronic devices and waste, in a tangible way. In other words, it seeks to recognize those aspects that influence the integral sustainability of the commodity, from the practices in each of the stages. In relation to the phase of acquisition, it is specified where, in what state (new or used) and by what means the students obtained their technological devices. Among the options contemplated in the survey, it may be in their city, in another Argentine city or in another country; if they bought it or someone gave it to them. In the use phase, the temporal dimension stands out as a fundamental quality to think about the EW generation times and therefore the cycles of availability of its resources. Therefore, it is asked how often these devices are replaced and the maintenance periodicity carried out on them. Finally, in discarding, the causes and ways of replacement of gadgets are investigated, as well as the willingness to donate or exchange the e-waste for economic benefits.

2.1.2 Information or knowledge

This second variable understands information as data and facts that represent an immediate and clear meaning for all respondents. In this case, it could be instructed in a popular way by the state or by another community organization or entrepreneurship. On the other hand, literature refers to knowledge, broadly, as an ability to understand and operate in a given domain. Knowing means understanding something at such a level that it becomes possible to evaluate and therefore decide on it. In this sense, knowledge in general is recognized as a subsequent step to information, through which data are processed according to previously established criteria and needs. For this reason, it can be said that information, once contextualized and endowed with meaning in a population, becomes knowledge. This variable intends to investigate the transfer of personal information to collective knowledge. First, it is asked if they identify the materials that compound their electronic commodities when acquiring them, since it can directly influence or not whether they associate their ICT waste with hazardous waste. During the use of smartphones, there are various negative impacts, from psychological nature, social and physical behaviour and due to electromagnetic pollution. Because of this, it is important to recognize if students distinguished or recognized them,

to understand the degree of knowledge they have about their devices. At the disposal stage, this category of analysis examines whether consumers recognize the particularities of this waste stream with specific legislation or with a company that treats them locally.

2.1.3 Valorization

The value associated with a commodity is essential to understand the preferences of users. These values are observed or "revealed" in real circumstances of purchase, use and disposal and need to be measured. There are indicators of this variable studied in the literature, such as willingness to pay (WTP), the maximum amount of money a consumer is willing to offer (and therefore reflects their valorization) for a good or service or for a specific treatment of a good or service. In this paper, the estimation of prices is not considered, but in the acquisition stage the valorization of the characteristics of the product that is consumed is made. Understanding that the WTP for the product will be modified if any attribute is added or increased; that includes price, brand, performance, durability, capacity, recommendations from other people, after-sales service, and ecological aspects. Then, the uses those consumers give to their electronic devices and the activities that they allow to carry out are addressed. Finally, the consideration if there should be a particular legislation is presented. This is due to the fact that specific regulation on e-waste may raise the price of these devices, by including in it the costs of the sustainable treatment of its polluting parts.

2.2 The instrument

To achieve the proposed objective, a self-managed survey was prepared and divided into the stages that predispose and condition the post-consumer paths of electronic waste linked to information and communication technologies in Mar del Plata city. As previously stated, each phase of consumption, use and disposal of electronic devices is analyzed based on the variables of habits, information and valuation.

The questionnaire is mainly made up of predetermined questions that, to facilitate subsequent coding, are answered by choosing a specific option among all those offered. In cases of closed questions, they can be identified with crosses or with numerical evaluations (to establish quantities or years). For the five open questions, space was left to freely write opinions.

The survey is structured into 21 questions distributed in 6 sections: 1) general data linked to the confusion variables that in this case the majority of students share similar socioeconomic levels, as well as age ranges that do not make a substantial difference in the modes to buy, use and dispose of electronic devices, in the same way with distinctions by gender; 2) An attempt was made to estimate the quantities of devices in use and not in use in homes; 3) the consumption stage; 4) Use; 5) Disposition, and 6 and 6) Faculty or Academic Unit. Points 3, 4 and 5 are addressed from the three different categories of analysis, explained above.

In the process of developing the survey questions, the researchers began by reviewing existing literature to obtain relevant information and evaluated the specific objectives of the research. The types of questions that best suited these objectives were carefully selected, such as closed-ended or multiple-choice questions. The questions were then reviewed by a panel of experts to ensure relevance and clarity. Subsequently, a pilot test was carried out with a representative group to identify potential problems and adjust the questions accordingly. Reliability and validity analyses were conducted to assess internal consistency and the scope of what the questions were intended to measure. After making adjustments based on feedback and test results, the questions were considered ready to be administered to the representative sample of the target population, thus ensuring their validity and reliability.

It is important to note that in a pilot stage of the development of this instrument, researchers and academic experts on the subject participated, as well as various young ICT users who provided suggestions to update the content before applying it. Groups of young people, selected at random, also participated to validate their understanding. About fifty surveys were carried out, useful for adapting the final, but they were discarded in the final results.

Below, in Table 1, some of the questions and their possible answers to choose from are detailed.

Table 1. Examples of questions and predetermined answers

If you keep your electronic devices, indicate the reasons why you store them	Keep it as a spare Old technology is collectible Unsure what to do with the device To sell Unsure where to take it Waiting for a plan to arrange it Valuable information on the device Do not know, no answer Other. Which?
How did you get your current electronic device?	Bought it new Bought it used Someone gave it to me new Someone gave it to me used From government help Other
Do you know of any company, organization or institution that treats electronic waste in your city?	Yes No

Source: Authors' elaboration.

2.3 Sampling, procedure and processing with SPSS

Regarding the limitations of the study, it focuses on the Argentine population that concentrates the highest percentages of use of ICT goods and services, which mainly corresponds to young university students, between 18 and 29 years old (INDEC, 2018). And due to the conditions that the University Complex presents as the central nucleus in the city of Mar del Plata, the sample was estimated on the local Public University.

Based on the data provided by the Rector's Office, nine of the ten Faculties of the UNMDP were included. The sample of 400 respondents was established by two experts from the Faculty of Economic Sciences (UNMDP), based on the total number of students. It was 1.55% of the total of 25,805 students. The sampling was stratified by academic units, according to values per Faculty, for the correct distribution of cases for each cluster. In this manner, the statistical representativeness of the different disciplines was considered.

Population was divided into several groups with similar characteristics (year of study, Faculties and subjects) and then they were analyzed. Each cluster is assumed to hold significant variation, but the different clusters are similar (Casal and Matheu, 2003). To collect random sampling by clusters, cluster theory was used (Lohr, 1999), consequently the clusters were ordered by races distributed in the different years of each race and by the time of the race (between morning, afternoon and night), making a random selection of them. The questionnaires were administered to the participants in closed and complete classrooms, during the months of August and September of 2017.

Although these data were collected on a total sample of 403 students, only 400 of them were considered. To systematize the data, each survey was manually loaded into the IBM Statistical Package for Social Sciences (SPSS programme).

The data were analyzed in search of the matches expected by the variables at each stage and some variables that were recognized during the loading of the surveys were added. Then, the results were systematized in tables and the main results were charted. The most relevant ones will be shown in this article.

Chi-square tests were performed, applied whenever both variables analyzed were categorical, under the null hypothesis of independence between them. Likewise, ANOVA F-Tests were carried out whenever differences in means are analyzed for a quantitative variable between different levels of a categorical variable, under the null hypothesis of equality of means. They were also used to control confusion variables, which is essential to establish more precise and robust causal relationships in the research, since it allows isolating the true impact of the independent variable on the dependent variable by considering and controlling other factors that could influence the results.

3. Patterns of consumption, use and disposal of electronic devices at the National University of Mar del Plata

The characterization of the surveyed population shows that a vast majority (88.5%) are between 18 and 29 years old, and more than half (65.4%) identify with the female gender. These data were collated with the original databases of students of the university rector's office and they correspond quite accurately. 65.7% live with their family and perceive themselves as having an average socioeconomic level (SES).

After establishing the basic attributes of the sample, the survey inquires about household electronics. More than 40% have a desktop or laptop in use and over 30% have only one smartphone. While without use, 40% indicated that they have electronic devices but do not know how many they have stored. Only 7.6% assured that they do not keep any device without use.

The results of the surveys are organized below in order of the life cycle stages and each of them, according to the established variables.

3.1 Purchase or acquisition

There are different ways of appropriating an electronic device (ED), in other words, different ways that outset the consumption, use and disposal patterns. It is possible to refer to commodity transaction from the monetary exchange agreed for it. On the other hand, consumption also encompasses non-material aspects that influence consumer behaviour. In fact, classical consumption is based on demand, as the need to appropriate desired commodities or services. This desire that drives consumption depends on the immaterial cultural dimension, since it embodies the collective values of a society.

Appadurai (1988) conceives consumption and the demand that makes it possible as a double way of emission and reception of meaningful messages to and from society, in such a way that demand determines and is determined by social and economic forces that influence each other. This is significant in terms of promoting sustainable and collective consumption habits, in which demand is influenced as a socially regulated impulse over the mechanisms that produce taste or fashion, and that determine sustainable consumption. Thus, the consumer and their possible influence on the previous stage my be related, by conditioning the production of electronic devices with their demand.

The concept of socially responsible consumer has been defined by multiple authors, linked to the "rational and efficient use of resources with respect to the world human population" (Fisk, 1975, p. 24), detailed as "a person whose values, attitudes, intentions or behaviours exhibit and reflect a relatively constant and conscious concern for the environmental consequences related to the purchase, ownership, use or disposal of particular products or services "(Henion, cited in Henion, II, 1982, p. 282), among others. Also, this term designates one who "takes into account the public consequences of his private consumption or who tries to use his purchasing power to achieve social change" (Webster, 1975, p. 188).

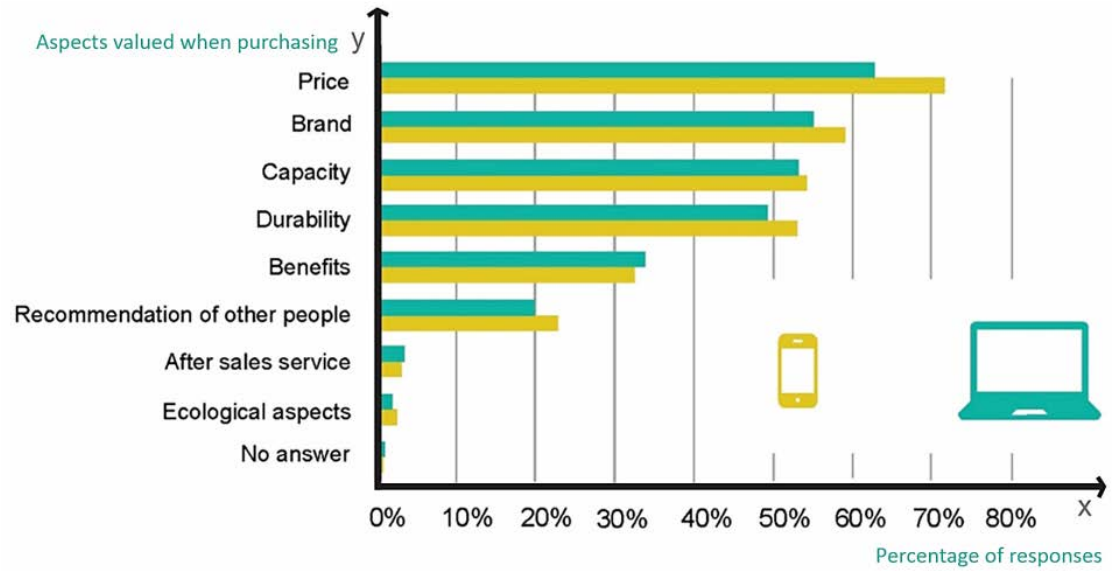
Regarding habits in the acquisition phase, 68% of the students indicated that they acquire their electronic devices in their own city; while 19.2% buy them in other countries, 10.3% in other Argentine cities (which makes sense, since many students come from other urban centres) and finally, 2.5% do not know or do not know answer. On the other hand, 70% indicated that they bought or

someone gave the electronic devices to them as new; only 12% used. This denotes the potential post-consumer market or a second-life circulation of the devices, outside of the percentages that indicates those acquired as new. Only for laptops, 7% indicated that they received them for help from the government through the *Conectar Igualdad* plan.

In relation to the information that students have at this stage, they were asked about the knowledge of the materials that compound their ED. 22% indicated that they know nothing; 38% very little, 29% some, 9% a lot, and only 2% all. However, 59.4% showed interest in knowing about them.

Regarding the attributes that are valorized when acquiring a smartphone and a laptop, which are shown in Figure 1, respondents mainly indicate the price, brand, capacity and durability of these devices; followed by recommendations by other people. Lastly, the after-sales service and ecological aspects are mentioned.

Figure 1. Valorization of aspects when acquiring Smartphones and Laptops



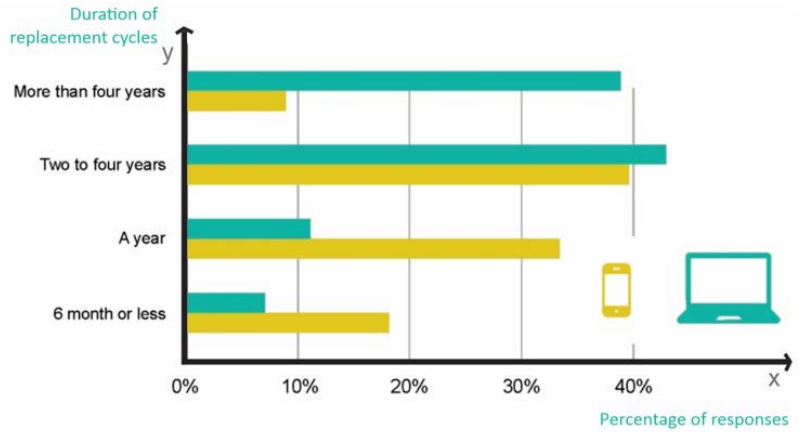
Source: Authors' elaboration.

3.2 Use and maintenance

For the use and maintenance stage, no academic source were found that clearly establishes when the stage of using a product begins. However, keeping up with the guidelines described previously in this study, the maintenance stage is considered to begin the moment it is removed from its packaging (if it is a new device) or, in case it is a device with a previous owner, there is an estimate of when it reached its new acquirer and is operated for the first time. From those precise moments, the market value of the product drops abruptly, and then continues decreasing due to being used continuously.

In the first instance the replacement cycles are explored. In other countries, this data has been estimated based on the number of new phones that are consumed each year. However, this information was not available in this case, and there are other variables that may influence the shortening of use cycles. Students were directly asked how long they had used their latest smartphones and laptops. They indicated, as shown in Figure 2, that in both cases the duration in use is most common between two and four years.

Figure 2. Time in use of your latest electronic devices



Source: Authors' elaboration.

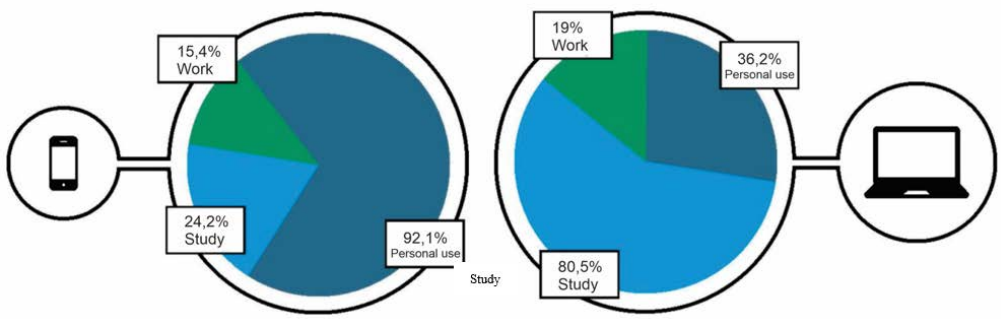
Regarding the frequency of review by technicians of their smartphones and laptops, the lack of maintenance on these devices is noticeable. Upon acquisition of other electrical and electronic devices, retailers and guarantees encourage these practices (for example for washing machines, refrigerators, vacuum cleaners, among others). Maintenance carried out on computers is greater, especially at least once a year, in relation to smartphones.

When it comes to knowledge about the negative impacts on health due to the use of smartphones, 51% of students recognized that there are impacts; and in practically equal proportions the other half indicated that there are no effects or that they do not know/do not answer. Smartphones have characteristics and functionalities necessary for the development of university students' social life. They even share a very close relationship with the human body, as an extension of it when it is used with all the senses, or when it is not used but remains in close proximity (such as in pockets, under pillows, or near tables).

These bearings are important, as studies on the subject show that negative impacts represent different phenomena harmful to health. Due to the addiction and overuse that they generate, particularly in university students who use telephone an average of ten hours a day (Leonard, 2015). With physiological consequences, causing a sedentary lifestyle, vision problems or chronic fatigue and a decrease in the quality of sleep (Boumosleh and Doris, 2017); also, muscular atrophies (Kendra, 2018) such as thumb, shoulder or back contractures. On the other hand, electromagnetic radiation that smartphones emit produce mutations at the cellular level (of iodine and in brain cells) that in the long run and with a lot of exposure may lead to cancer (Miller, 2017). There are other types of negative effects, such as psychological or sociability consequences, such as anxiety or depression, influencing mood due to the constant flow of information on their phones, or conversely leading to social disconnection such as in family homes (Parasuraman et al., 2017). Finally, accidents caused by distractions caused by the use of these telephones stand out (Gowthami and Kumar, 2016).

On the contrary, from the perspective of the beneficial impacts of ED, students say that they use the laptop much more for studying, although the percentage who have one is lower than that of smartphone owners. Both devices are used in practically equal measure for work.

Figure 3. Percentage of uses



Source: Authors' elaboration.

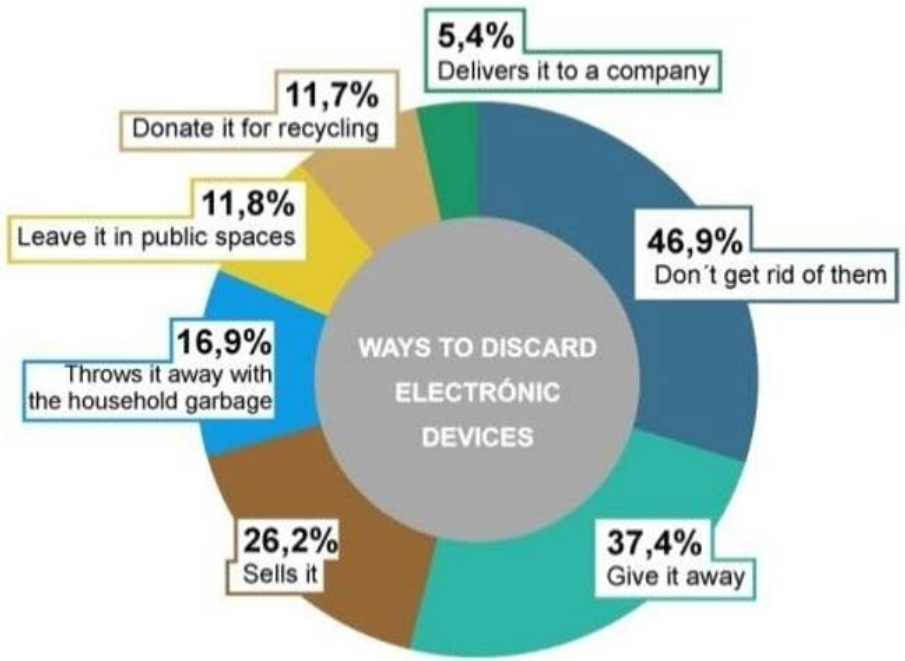
3.3 Discard or disposal

This is the phase when desire comes to an end, and it becomes rejection. It is when discarding is facilitated. This can be initiated by multiple subjective (from the user) and objective (the product itself) reasons. In both cases, planned obsolescence can be a critical factor. It is therefore complex to specify the moment when an ED becomes scrap. Hence, some authors describe e-waste as unused devices, implying that they can be re-functionalized in some cases. This change of state is one of the most radical ones in the life cycle of a product, and is directly linked to the management of its post-consumption. It transcends a more or less formal sphere of exchanges such as ED, towards another, in the form of EW, with its own cultural processes of circulation of values. And these trade structures are addressed in this study, according to the valorization and traceability schemes of waste commercialized as objects (in sales, donations, gifts, exchanges and thefts.)

In this way, it is possible to identify different categories of exchanges of disused appliances in the post-consumer market: monetary ones, barters, gifts and donations. Exchange typologies turn out fundamental to understand the useful life of the product and to identify in a sustainable way when it becomes waste. In this final phase of the social life of ICT ED, selling, bartering and gifts are associated as exchanges governed by the structure of economic speculation, since there are parallels in the social codes regarding the exchange of gifts, as a form of commercial circulation (Bourdieu, 1977).

When directing the following query on the technological devices in disuse, and what happens with them, as Figure 4 indicates, a large percentage is stored (46.9%), another important percentage is given away or sold. Also, some students affirm that they leave it in public spaces, or next to domestic solid waste, among other options.

Figure 4. Disposal routes of e-waste



Source: Authors' elaboration.

Nearly 50% of the respondents affirm that they do not know what to do with their unused appliances, and 23.9% added that they do not know where to dispose of them, which is why they keep them indefinitely. 46.3% keep them as spare parts. At this point, it can be assumed that they are stored for devices that still work were replaced by new ones or others in better condition. This assumption relies on the fact that ED ICT, especially smartphones, are hardly replaced by the same model. Since

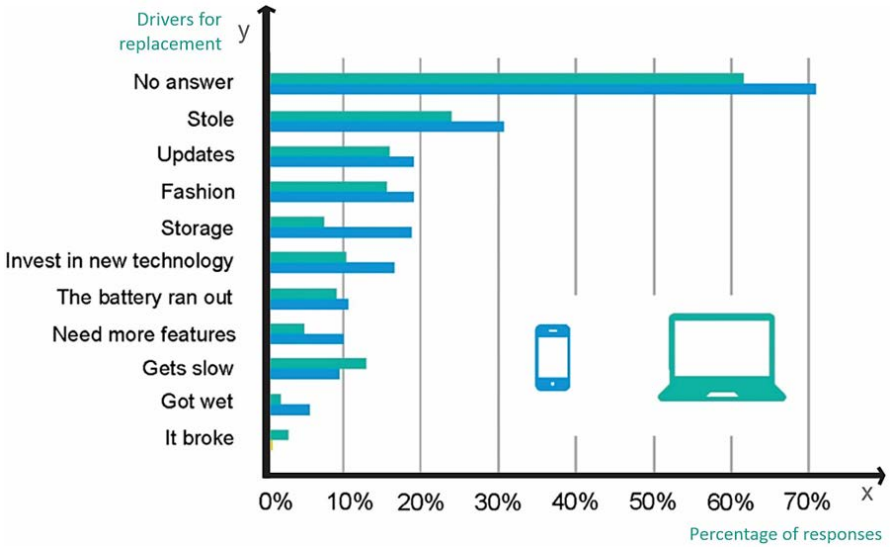
technological advancement occurs after 6-12 months of use, each device offers modifications in order to maintain active aftermarket. For this reason, the definition of 'spare' ED is corresponds to the whole equipment, rather than the use of spare parts of its sub-components in another device.

Of the total number of respondents, 21% do not discard their idle ED because they contain valuable information. This issue is becoming more controversial in the world sphere of urban mining, since it is true that when a device is delivered, to a greater or lesser extent, it has references, documentation and even passwords of its previous owners. There are campaigns that fight against this new variety of international virtual crime, associated with the duplication of people's documents or identities.

In Mar del Plata, alike some other cities in Argentina, there are currently no government programmes tackling the sustainable treatment of this type of waste. Yes, there are some social organizations and private companies responsible for recovering a few valuable components in the market, mainly metals. The rest of the components are buried, like all domestic waste (except for a low percentage of cardboard, glass and paper that is recycled), in landfills, both large volume plastics and those containing toxic substances.

Consumer preferences driving the replacement of appliances are analyzed in another question. These are based in the first measure due to breakages or failure to operate, or because they become slow and need more storage. Lastly, to invest in new technology. Only for smartphones, the fifth most common reason is theft. A high percentage expresses that they do not know why they acquire new devices. Then, several answers indicate that what influence the decision to replace are internal and external issues intrinsic to the qualities of the device itself. The least frequent ones are due to theft, social trends in fashion or investment in new technologies. The internal motives can be differentiated into those that respond to material issues (physical, the so-called hardware of the device) or to immaterial issues (software). Material issues are mainly associated with deterioration due to breakage or water damage. Finally, to battery depletion. Although it is a component that is often replaceable, either there is no habit associated with replacing this part, or the new devices have their batteries internally integrated. Regarding those related to the internal functioning, they respond to updates, storage capacity (which often decreases in correspondence to the required updates), the need for more features in new models or because it becomes slow, or as a very general definition, but which is directly related to the lack of maintenance of the devices shown in Figure 5. It should be noted that in this option the respondents marked more than one answer box to indicate the causes of replacement.

Figure 5. Causes of replacement of smartphones and laptops



Source: Authors' elaboration.

Regarding the question that analyzes the trends to donate or exchange their old devices for some

benefit or economic discount, 74.2% affirm that if they would donate them and 50% would give them to some charity.

As shown in Figure 5, one of the main causes of turnover is theft. Although updated systematized data is not available, according to information obtained from the Citizen Security Observatory[1], cell phones are the most stolen assets in Argentina, representing close to 30% in the categories of assets stolen through personal or home theft.

In relation to regulations, practically all the responses warn of the lack of knowledge of legislation that regulates electronic waste, however, the same percentage of students consider that there should be specific regulations on the subject.

This probably explains that the vast majority understand electronic devices as hazardous waste, which makes sense, because in Argentina currently e-waste is treated as dangerous waste (by National Law 24.501). It is striking that despite this possible coincidence, in the previous question, 95% are unaware of laws related to e-waste. Only 20.9% acknowledge its economic value and 6.7% express recognising the complexity of this stream of waste, in its valuable and unsafe qualities at the same time.

4. Conclusions

The main conclusions show that it is indeed sociocultural factors that characterize a DUM, which condition the possible political management strategies to treat the post-consumption of electronic waste, as well as to improve the comprehensive treatment of ED from the moment it is consumed, until they are discarded.

Specifically, the following aspects can be highlighted as possible influences to sustainable patterns of consumption, use and disposal of electronic devices, for each stage.

At the time of consumption, the option for purchase of used devices, in the city itself, with greater awareness of the component materials and consideration of their durability, after-sales and ecological aspects. The results of the surveys guide the aspects that must be improved, hoping to carry out future measurements, improving the percentages – only 12% purchase used devices, 22% do not know any of the materials they contain and 38% recognize very few materials. Likewise, those who value the ecological impacts that they may generate are less than 5%.

That the period of use is longer than two years, and that during this time technical maintenance should be carried out on the device every six months or every year, to increase its durability and quality of use. That users recognize two or more negative impacts in the use of their smartphones, and that they also concentrate the greatest number of activities (personal, work or academic) on the smallest possible number of devices. It should be noted that only 51% of students recognize negative impacts on their health due to the use of these devices, making awareness campaigns essential to address the proliferation of their consequences in the future.

Regarding the methods of disposal, possible avenues include sale, gift, disposal on public roads, delivering to a company or donating for recycling. In the survey, this aspect stands out as the most worrisome, since in 46.9% of cases unused devices are stored indefinitely and do not even reach possible disposal routes. And that the reasons for replacement are because the device has become slow, requires more features, storage or updates, a new battery is required, due to fashion or because they decide to invest in a new one; and in turn, these are associated with the predisposition to exchange it for an economic benefit or donate it. Knowledge of companies and laws that regulate them is necessary, as well as understanding the valuable and dangerous quality of this type of waste, which needs particular legislation.

From the point of view of the proper management of this waste, and how disposal patterns are applied, to implement an Urban Mine in the city, changes linked to education and legislation are needed. Therefore, a specific national law is essential to unify criteria throughout the country, give clear definitions, prohibit common discard with other waste, regulate the comprehensive management

1 https://www.seguridadciudadana.org.ar/el-observatorio/institucional

of WEEE, in particular Computer Waste, in order to prevent and minimize its generation, establish the value chain and hierarchy in waste management and incorporate the principle of expanded producer responsibility.

Likewise, at the local level, new opportunities can be opened for markets that function in an articulated manner with consumers, to whom awareness plans regarding the issue should be applied.

As the results indicate, the majority of respondents (70%) indicate that they buy new devices and 68% of this purchase happens in their own city. With such a high percentage, this implies that they can be refunctionalized in some cases. In this sense, an opportunity opens up for a social market for refunctionalized devices, prior to being dismantled to make their materials profitable.

Regarding the evaluation made, although price is the most valued factor, almost no maintenance is carried out by the users to extend the life of these devices. In this sense, we proposed in future studies to delve deeper into the concept of "right to repair", which in countries like the United States is highly debated, mainly due to the increase in costs. It is an important issue to consider, since repairs shorten the replacement times of these devices and improve their quality in a second cycle of life. Furthermore, the obtained results show the importance of further analyzing the factors that affect the consumption, use and disposal patterns of electronic devices.

It is from the different states in which the disused devices are found that the different types of exchange are articulated within the particular social structure, which can be applied to the large quantities of ED that are stored due to uncertainty about what to do with them. Exchange typologies are essential to understand the useful life of a product and sustainably identify when it becomes waste.

These social practices, in terms of actions, activities and experiences, are essential to outline appropriate e-waste management strategies at the local scale. Callen (2013) highlights the ineffectiveness of top-down e-waste management models, in which consumers and waste generators do not have clear instructions on how to proceed with them, nor do they actively participate in post-processing processes and responsibilities. e-waste consumer destinations.

In line with the theoretical and practical framework established by the DUM concept, a decentralized waste management strategy is proposed at the local level, to concentrate the logistics of collecting the differential flow in institutions or organizations understood as DUM, which may be located in different parts of the city territory. The specified perspective is applicable both to special waste of universal generation, as electronic waste should be considered, as well as to various fractions of municipal solid waste that are generated in different types of DUM (used vegetable oils, packaging, medicines, production waste beer, organic, among others).

In a similar way to the studies carried out by Ongondo, Williams and Whitlock, (2015), even though the they took place in very different cities in the global north and south, DUMs can facilitate the transition to the selective and separate collection of high-value goods. In both scenarios, concentrating waste/ resources within the anthroposphere presents good potential to maximize resource recovery within the anthroposphere.

These steps would be fundamental to advance in terms of waste management in Argentina, given that until now the majority of waste of different types is buried without recovery. By concentrating the types of materials by type of waste, it would be possible to think of new horizons where not only is waste generation reduced, but it can also be valued, becoming new products in industrial value chains.

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