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To Sell or Recycle Electronic Waste; Evidence from a Survey Experiment in Mumbai

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ABSTRACT

E-waste is a growing concern in many cities, but little is known about how much people participate in certain waste streams with their previous products. The question which this research paper will be talking about is 'What are the barriers to responsible electronic waste reuse and recycling in Mumbai?'. Matters will also be discussed such as why studying electronic waste is important, what the large environmental concerns of electronic waste consist of, and the problems that electronic waste causes in the city of Mumbai. A survey has also been conducted. Around 100 people have filled out the survey. All of the people who have filled out this survey are situated in the city of Mumbai, India. This survey asks basic questions about electronic waste such as what effect it has on us humans and on the environment. A survey experiment about an old TV was also conducted in the survey. In this experiment, the resale price of the old TV constantly decreases and the people filling out the survey decide whether they want to give/throw away the old TV, sell the TV at a particular resale price or keep the TV as backup. If they chose to give/throw away the TV or sell it at the given resale price, they would be directed to another section where they would be told that the resale value of the TV actually increased to \$150 from the original resale price. The user would then be asked whether they regretted their decision of not keeping the TV. The results from the survey show that when the respondent does not keep the old TV at a lower price and when they find out that the resale value has changed \$150, they tend to regret their decision more. In this survey when the initial resale value of the old TV was \$10, most of the respondents did not keep it, but when they were told that the resale value of the old TV was actually \$150, many of them regretted their decision of not keeping the old TV. This implies that the price determines the fate of old electronics. The higher the value, the more likely someone is willing to keep the old electronics.

KEYWORDS: Economics, Electronic Waste, Recycle, Mumbai, Survey, Experiment

1. INTRODUCTION

The question which this research paper will be covering is 'What are the barriers to responsible electronic waste reuse and recycling in Mumbai?'

What is the importance of studying electronic waste?

Studying electronic waste is important for several reasons such as:

Studying electronic waste is extremely crucial for addressing its multifaceted impacts on human health, the economy, and more importantly the environment. E-waste poses major environmental risks due to the presence of various contaminants such as lead, mercury and cadmium which can have negative implications on soil, air and water if they are not properly treated. Recognising these environmental consequences is essential for developing sustainable waste management processes. Simultaneously, electronic devices contain valuable resources, and the investigation of e-waste provides an insight into recycling and recovery opportunities, which further reduces the need for the extraction of resources, that leads to a reduction of the environmental footprint from new electronics. The health risks that are associated with the recycling and disposal processes of e-waste, particularly in developing countries, further underscore the importance of studying e-waste. Awareness spread about the hazardous conditions faced by workers can encourage the development of more efficient and safer recycling practices and measures in order to aid the protection of workers. Additionally, regulatory and legal compliance is a critical aspect, considering the varying regulations across different countries.

Research of e-waste helps in ensuring adherence to these laws and also helps in the formulation of effective guidelines and policies. Research and development can drive technological advancement in recycling and disposal methods of e-waste, fostering innovation for environmentally friendly and efficient approaches.

The concept of a circular economy can be embraced, in order to achieve integral sustainable electronic consumption and conduct processes to minimise waste, reuse materials, and recycle products. Furthermore, e-waste management is a key component of implementing a circular economy within the electronics industry. Additionally, the proper disposal of electronic devices is essential for protecting sensitive data. A major component of e-waste is storage devices that hold valuable information, emphasising the need for more efficient and secure disposal methods. Public awareness plays an important role in promoting responsible consumption and disposal of electronics. By studying e-waste consumers are encouraged to make sustainable choices and actively participate in e-waste management and recycling programs. Economic opportunities arise from the e-waste refurbishing and recycling industry, which creates jobs and stimulates economic growth. Recognising the value of e-waste as a resource enables businesses and governments to invest in sustainable and ethical management practices. In summary, the overarching study of e-waste is indispensable for mitigating the impacts it has on human health and the environment, complying with regulations, conserving valuable resources as well as advancing technology and economic opportunities. This approach can contribute to a more responsible and sustainable paradigm for the consumption and disposal of electronic waste. In summary, studying electronic waste is extremely important because it addresses environmental, resource, health and economic concerns associated with the exponential amount of discarded electronic devices. By understanding the impacts and implications of e-waste and finding solutions in order to combat them, we can reduce its negative consequences and transition to a more socially and environmentally friendly approach to the disposal and consumption of electronics.

What are the various environmental apprehensions that electronic waste can cause?

Incorrect disposal of electronic waste (e-waste) poses numerous environmental threats. When e-waste is discarded in landfills, it releases various toxic chemicals into the groundwater and soil which has a major impact on plant and animal life, that can further lead to the disruption of ecosystems and could potentially endanger human health through contaminated water and food. Incineration of e-waste contributes to air pollution, by releasing heavy metals and toxic substances, that cause respiratory problems and other health implications. These health issues have been common among developing regions with improper recycling practices. Furthermore, the failure to efficiently recycle e-waste leads to depletion of resources, as valuable materials such as rare elements and metals are astray, therefore increasing the demand for extraction and contributing to the destruction of habitats. Significant energy is already consumed through the production of electronic devices, and when e-waste is not properly managed, it illustrates a wasteful loss of the resources and energy that are necessary for the manufacturing of these products. Furthermore, the disruption of ecosystems can occur due to the improper disposal of e-waste, as it introduces toxic elements. The long decomposition time of certain electronic components in landfills results in a long-lasting burden on the environment, that further emphasises on the urgent requirement for responsible e-waste management, adequate methods of recycling, safe disposal practices and refurbishing. Mitigating these concerns requires a comprehensive approach, which involves a new product design that reduces waste, extends product life cycles, and fosters awareness about the environmental concerns of e-waste.

Efforts must be made in order to combat these environmental concerns which include the development of responsible recycling and disposal practices, the implementation of regulations for the management of e-waste as well as promoting a circular economy approach that emphasises the reusing and recycling of electronic components to reduce the demand for newer resources. Education along with public awareness are also extremely crucial in order to encourage sustainable e-waste practices and reduce the environmental footprint of electronic devices.

What are the various concerns that electronic waste can cause to the city of Mumbai?

The inadequate disposal and improper recycling of e-waste in Mumbai pose various health and environmental concerns. The numerous hazardous materials such as lead, mercury, cadmium, and flame retardants that e-waste possesses can contaminate soil and groundwater if they are not managed properly. Improper burning of e-waste releases harmful fumes which contribute to respiratory problems and pollution. Contamination of groundwater further contributes to this issue, especially since Mumbai's population is heavily reliant on groundwater for drinking water. Informal e-waste activities expose the population and workers to dangerous toxins, which can lead to multiple implications on their health. The use of child labour in Mumbai's inadequate e-waste sector further exacerbates these concerns, affecting the education, health and well-being of these young workers. The lack of the public's awareness about proper disposal methods contributes to the problem, and inefficient recovery of resources from e-waste leads to the wastage of valuable resources and materials. Furthermore, improper regulation of the informal e-waste sector obstructs the enforcement of responsible practices, continuing the health and environmental hazards in the region.

Additionally, attempts at addressing these challenges are being made in Mumbai. For example, the city has implemented initiatives to raise awareness about recycling of e-waste, the establishment of formal recycling centre, as well as the implementation of regulations concerning e-waste. However, the scale of the implications of e-waste in large cities like Mumbai, combined with economic pressures, can make it an extremely complicated issue to resolve entirely. Government regulations, public awareness and collaboration among stakeholders are the key to resolving problems related to e-waste in the city of Mumbai.

LITERATURE REVIEW

Research has also been done on similar lines.

The two articles shown down below have used similar methods such as questionnaires/surveys but they were not identical to methods that have been used in this research paper. In the first article, a questionnaire survey was conducted which only included questions in relation to the people's awareness of the damages that electronic waste can cause to us humans and to the environment. The survey that is portrayed in this research paper solely focuses on how price determines the fate of electronic waste, but the first section of the survey includes questions based on the awareness of the damages that electronic waste can cause, so there is a similarity between this research paper and the first article. In the second article, a completely different method has been used to receive data i.e., primary and secondary research was conducted on current literature on electronic waste flows and recycling.

Two articles contribute insights into electronic waste awareness and flows in China.

Renata Dagiliūtė’s study which has been cited by both Dagiliūtė et al and Ramzan et al, showcases the awareness of students of electronic waste in certain cities in China. Their research indicates that 79% of the respondents were aware of the impact of electronic waste, which aligned with the existing literature trends. In order for the program to be successful, the understanding of collection and recycling schemes is crucial. Dagiliūtė et al and Ramzan et al offer comparative data from Lithuania and broader China, respectively, shedding light on diverse awareness levels. In her research on electronic waste flows in China, Sabrina Orlins reveals the emergence of an informal shadow economy in urban areas, involving individuals and small enterprises operating with minimal regulation. Collectors of e-waste have used methods to gain an assessment, such as primary research and analysis of existing literature, navigation of cities on bikes, weighing products for prices and often refurbishing items for resale. Orlins showcases the inefficiencies that occur when addressing environmental and health concerns, in relation to electronic waste by the examination of news reports, international electronic waste legislations, academic information, and relevant Chinese Laws. The methods that both the studies employed, included surveys and comprehensive literature reviews, which highlighted the significance of understanding the public's awareness of e-waste as well as intricate informal economies that electronic waste is surrounded by.

3. METHODS

The method used in this research paper is a survey. This survey was made using Google Forms. The survey was then sent out to friends and family on various group chats via social media, mainly being WhatsApp. Approximately 120 people were requested to fill out this survey and out of those, a total of 101 people filled it out (approximately 84%).

This survey was undertaken to acquire a deeper understanding of the awareness among the residents of Mumbai regarding electronic waste. The survey starts with demographic information and very basic questions such as asking the respondent the amount of damage that they think electronic waste can cause to the environment.

A social experiment was also conducted via the survey, which captures the main part of the survey. This experiment was based around an old TV and the user has to decide what they want to do with the old TV. The responder has a variety of options which include throwing away or giving away the old TV, keeping the old TV, or selling the old TV at a certain resale value. If the responder chose to either give away, throw away or sell the old TV at the particular resale value, they will be directed to another section of the survey. The user would then be provided with information about how the actual resale value of the old TV is \$150. The responder will then be questioned about whether they regretted their decision of not keeping the old TV. This experiment has been conducted thrice, where the original resale value of the old TV was first \$100, then \$50 and finally just \$10.

4. RESULTS

Demographics

All the respondents of the survey are based in the city of Mumbai. Most of the respondents are based in the South of Mumbai. This part of Mumbai is a more affluent area and the people who live there are highly educated. The average age of the respondents is around 38 years old. The careers that the respondents have are vast. 95% of the respondents have professional careers ranging from doctors to counsellors and the remaining 5% of the respondents are either in college or high school. 70% of the respondents are female and 30% are male. This was a good sample because these respondents represent the sector of the city who would actually take action about recycling electronic waste because they likely have disposable income due to being on average in their prime working age, and having a wide variety of jobs. Given below is a diagram of whether an individual would sell the TV for \$100.

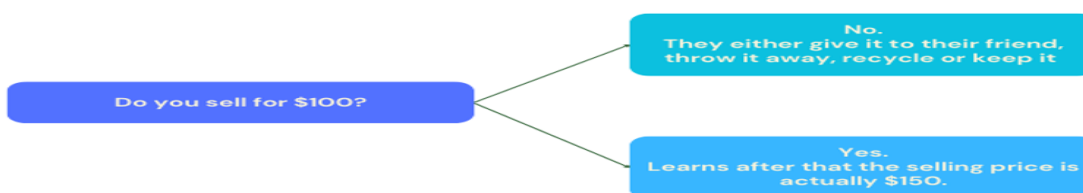


Figure 1. - You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV? (When the resale value is initially at \$100)

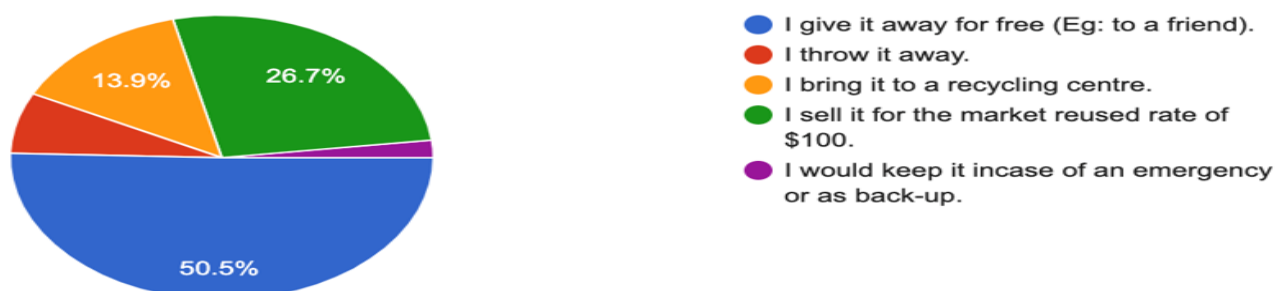


Figure 1 represents the first part of the TV experiment that was conducted in the survey. The respondent was asked the question, 'You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV?'. The respondent then had to decide what he/she wanted to do with the old TV. The individuals had to choose whether they wanted to keep the TV or not. They were provided with various ways of discarding the TV. These options included possibilities of them throwing it away, bringing it to a recycling centre or selling it at a certain resale value. \$100 was the particular resale value that was provided for the options of this question. The respondent also had the option of keeping the TV as back up or in case of an emergency. In the pie chart showcased below, the blue section represents the fact that TV has been given away by the respondent, for free. Additionally, the colour red showcases the fact that the old TV has been thrown away by the respondent. Furthermore, the colour yellow represents that fact that the old TV has been brought to a recycling centre, by the respondent. The colour green indicates the fact that the old TV has been sold by the respondent, at the resale value of \$100. Finally, the colour purple represents the fact that the old TV has been kept by the respondent.

Figure 2. - You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV? (When the resale value is initially at \$50)



Figure 2 represents the first part of the TV experiment that was conducted in the survey. The respondent was asked the question, 'You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV?'. The respondent then had to decide what he/she wanted to do with the old TV. The individuals had to choose whether they wanted to keep the TV or not. They were provided with various ways of discarding the TV. These options included possibilities of them throwing it away, bringing it to a recycling centre or selling it at a certain resale value. The resale value that was provided in the options for this particular question is \$50. The respondent also had the option of just keeping the TV in case of an emergency or as backup. In Figure 2, the colour blue represents the fact that the respondent gave away the old TV for free, the colour red represents the fact that the respondent threw away the old TV, the colour yellow represents the fact that the respondent brought the old TV to a recycling centre, the colour green represents the fact that the respondent sold the old TV at the resale value of \$50, and the colour purple represents the fact that the respondent kept the old TV.

Figure 3. - You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV? (When the resale value of the TV is \$10)

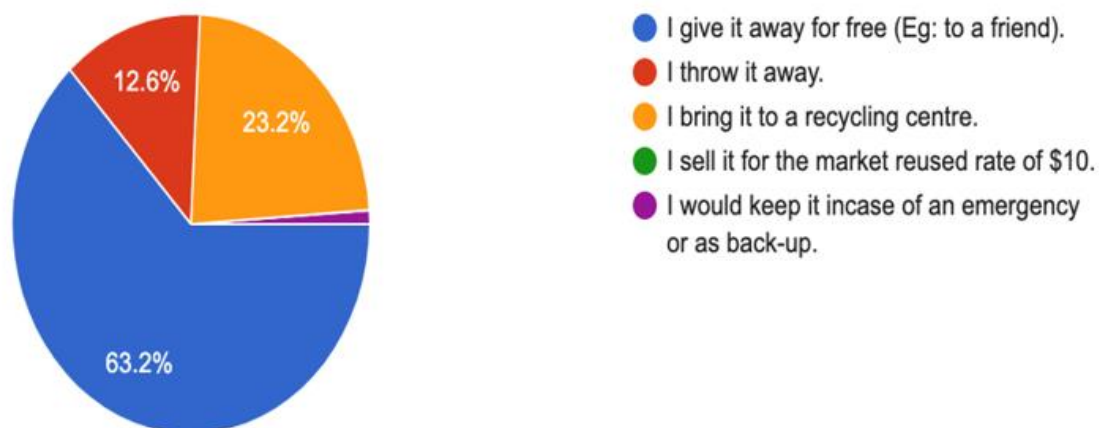


Figure 3 represents the first part of the TV experiment that was conducted in the survey. The respondent was asked the question, 'You are replacing your TV of 10 years that you originally bought for \$500. Your new TV is higher quality, bigger and better fits your lifestyle. You have no use for it anymore. What do you do with the old TV?'. The respondent then had to decide what he/she wanted to do with the old TV. The individuals had to choose whether they wanted to keep the TV or not. They were provided with various ways of discarding the TV. These options included possibilities of them throwing it away, bringing it to a recycling centre or selling it at a certain resale value. The resale value that was provided in the options for this particular question is \$10. The respondent also had the option of just keeping the TV in case of an emergency or as backup. In Figure 3, the colour blue represents

the fact that the respondent gave away the old TV for free, the colour red represents the fact that the respondent threw away the old TV, the colour yellow represents the fact that the respondent brought the old TV to a recycling centre, the colour green represents the fact that the respondent sold the old TV at the resale value of \$10, and the colour purple represents the fact that the respondent kept the old TV.

Figure 4. - You learn that the real market rate of your used TV is \$150 instead of \$100. Do you still regret your decision?

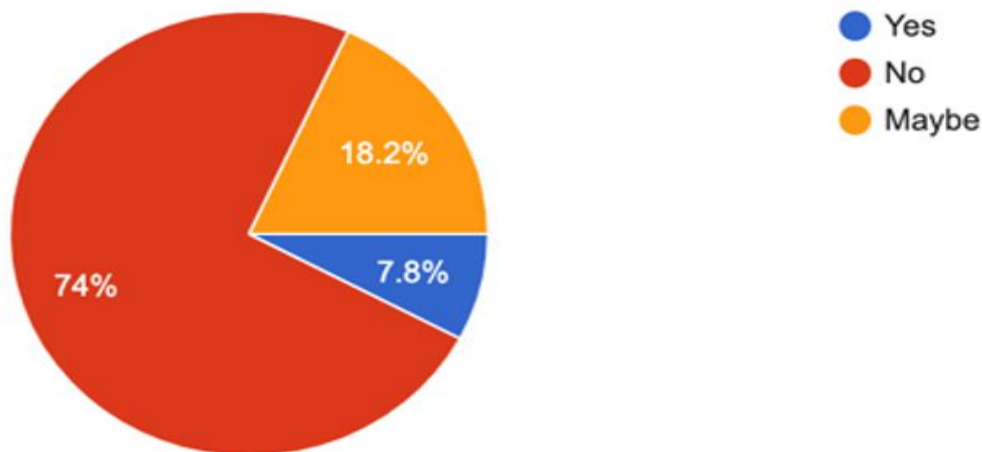


Figure 4 represents the first part of the TV experiment which was included in the survey. The respondent was directed to this particular section only if they decided to throw/give away the old TV or sell the old TV at the given resale value, i.e., \$100. The respondent was provided with new information in this section, which stated that the resale value of the TV was actually \$150. They were then asked whether they regretted their decision or not. The colour red in the pie chart shown in Figure 4 represents the fact that the respondent did not regret their decision of selling the old TV, the colour blue represents the fact that the respondent did regret their decision and the colour yellow represents the fact that the respondent was unsure about their decision. In the pie chart shown in Figure 4, one can see that approximately 75% of the respondents did not regret their decision, approximately 6.5% regretted their decision and approximately 18% were unsure of their decision.

Figure 5. - You learn that the real market rate of your used TV is \$150 instead of \$50. Do you still regret your decision?

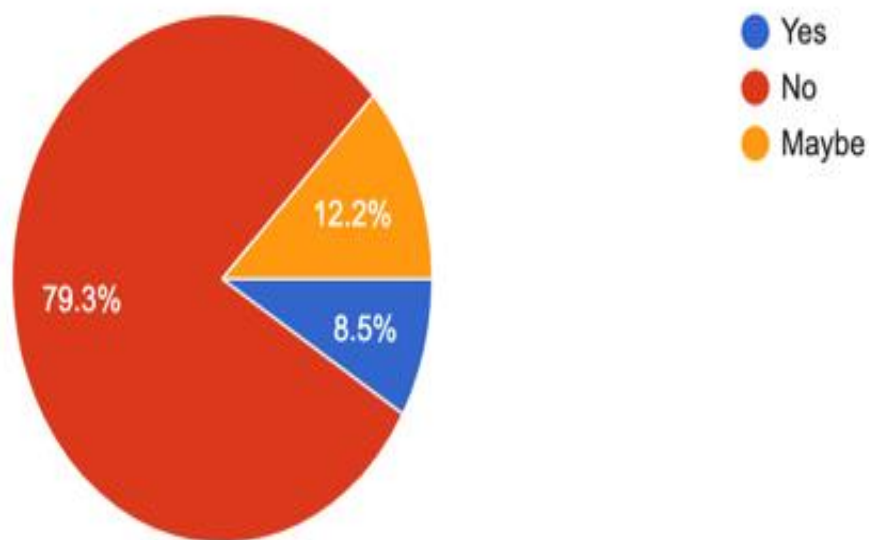


Figure 5 represents the second part of the TV experiment which was included in the survey. The respondent was directed to this particular section only if they decided to throw/give away the old TV or sell the old TV at the given resale value, i.e., \$50. The respondent was provided with new information in this section, which stated that the resale value of the TV was actually \$150. They were then asked whether they regretted their decision or not. The colour red in the pie chart shown in Figure 5 represents the fact that the respondent did not regret their decision of selling the old TV, the colour blue represents the fact that the respondent did regret their decision and the colour yellow represents the fact that the respondent was unsure about their decision. In the pie chart shown in Figure 5, one can see that approximately 78% of the respondents did not regret their decision, approximately 8.5% regretted their decision and approximately 12% were unsure of their decision.

Figure 6. - You stated that you would give away, recycle, or throw away the TV, instead of selling it for \$10. Do you regret your decision?

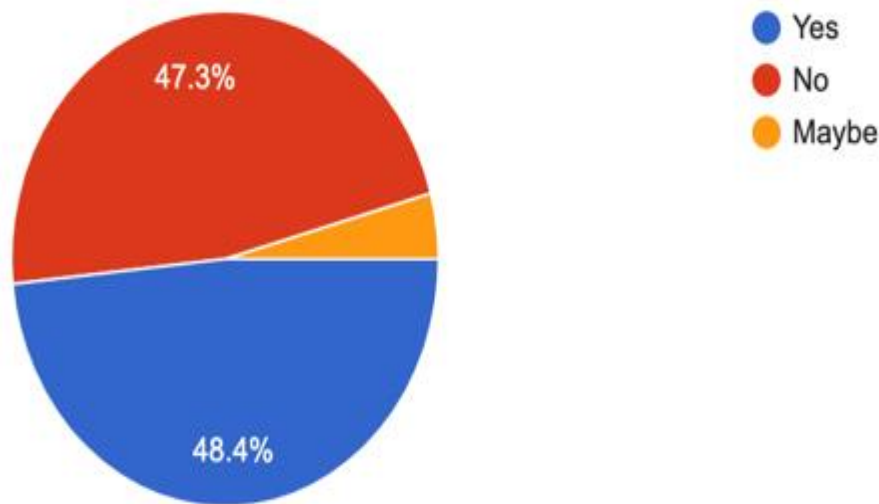


Figure 6 represents the first part of the TV experiment which was included in the survey. The respondent was directed to this particular section only if they decided to throw/give away the old TV or sell the old TV at the given resale value, i.e., \$10. The respondent was provided with new information in this section, which stated that the resale value of the TV was actually \$150. They were then asked whether they regretted their decision or not. The colour red in the pie chart shown in Figure 6 represents the fact that the respondent did not regret their decision of selling the old TV, the colour blue represents the fact that the respondent did regret their decision and the colour yellow represents the fact that the respondent was unsure about their decision. In the pie chart shown in Figure 6, one can see that approximately 46% of the respondents did not regret their decision, approximately 45.2% regretted their decision and approximately 9% were unsure of their decision.

Figure 7.

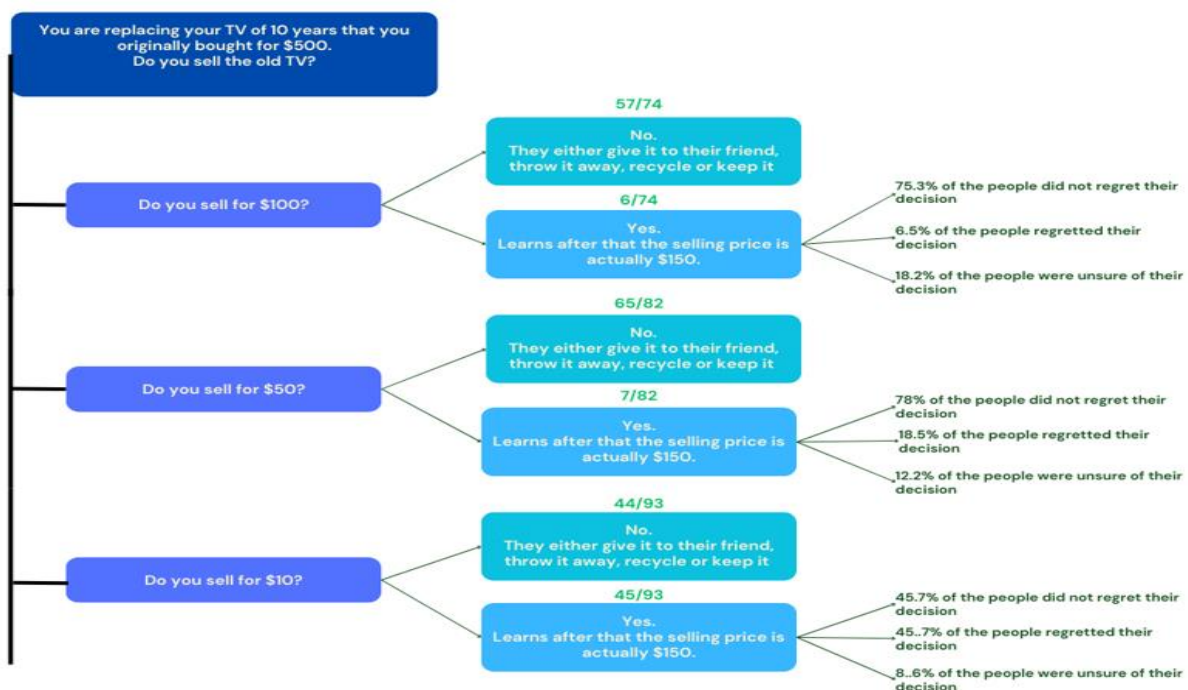


Figure 7 brings together the details from Figures 1, 2, and 3. It gives us an overview of the number of respondents involved in the old TV experiment and their responses about each component of the experiment. This combination of data helps one to see the bigger picture and understand how different aspects are connected. Figure 7 is like a roadmap that guides one through the experiment's details, making it simpler to grasp the results.

5. DISCUSSION

These numbers imply that as the given resale value of the old TV decreases, the respondents are more willing to give/throw away the old TV. This behaviour was actually expected because the price of an article, regardless of what it may be, will always determine the fate of that object. To us humans' prices are very deceiving and our decision can change quite easily based on the price of an article. I would consider this rational behaviour because regardless of our background, we will always make decisions based on prices but only if they are provided. When the respondents find out that the actual resale value of the TV is \$150, they regret their decision more if they did not keep the old TV when the resale value given to them was \$10. The respondents did not really regret their decision when the given resale values of the old TV were \$100 and \$50 but the number of respondents who regretted their decision drastically increased when they did not keep the old TV when the resale value was \$10. So, this shows us that the resale value of old electronics also matters. The higher the resale value, the more likely people are willing to keep the old electronics instead of just discarding them. The usefulness of the old electronic does matter as well but the value also plays a huge role in the fate of that old electronic.

6. CONCLUSION

In conclusion, this research paper has summarised matters such as why studying electronic waste is important, what the environmental concerns that electronic waste can cause, and what issues electronic waste can cause to the city of Mumbai. The survey that was conducted has also been discussed. The survey that was conducted tested the respondent's awareness about the damage that electronic waste can cause to the environment and to us humans. The old TV experiment, which was a big fragment of the survey, gave the respondent a particular resale value and then questioned them whether they would throw/give away the old TV, keep the old TV, or sell the old TV at the given resale value. If the respondent chose not to keep the old TV, then they would be taken to another section which stated that the resale value of the TV was actually \$150. They would then be asked whether they regretted their decision of not keeping the TV. These findings in the survey show us that as the higher the resale value of an old electronic, the more likely people are willing to keep the old electronic instead of just discarding it. The usefulness of the old electronic does matter as well but the value also plays a huge role in the fate of that old electronic.

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