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_____***Original Research***_____

# AN ASSESSMENT OF FACTORS AFFECTING ELECTRONIC WASTE MANAGEMENT WITHIN UNIVERSITY STUDENTS' ENVIRONMENT

*Authors*

Abdulaziz Mahmoud Raudha
Department of Information Technology
Toyota Tanzania Limited

and

Allan Msolla
Department of Informatics
Institute of Accountancy Arusha

**Abstract**
This study aimed at assessing factors affecting the awareness of electronic waste management at among University students. The study was conducted at a University located in Dar Es Salaam-Tanzania; the case for study is not disclosed for security reasons. In particular, the study focuses on factors such as user awareness, budgets and policy and their link to e-waste management. The study was motivated by the fact that students in higher learning Institutions are faced by the challenge of e-waste accumulation, with a steady increase. The study adopted the mixed research approach. In total, the study used 377 respondents in addressing its objective. In addition, the study used probability sampling technique to obtain the sample for study. Further to this, the study cleaned data, and used descriptive statistics (frequencies and percent) in responding to its objectives. The findings revealed that the University student awareness of electronic waste management is low. Also, findings revealed that the University does not have budget allocated for electronic waste management, and there is the lack of policy at the University to provide students on awareness of electronic waste management. Students should be empowered with electronic wastes management knowledge.

***Keywords: Electronic Waste Management, User awareness, e-waste, Tanzania***

## 1.0 INTRODUCTION

Many developing countries are faced with the problem of electronic waste management. The apex influx of technology to developing countries led to exponential growth and exacerbated the e-waste management situation. This is due to increased production and usage of computers and mobile devices to address the rising demand for electronic devices (Asiimwe & Ake, 2012). These have necessitated the vast purchases of electronics items by organisations and individuals (Nnorom & Odjango, 2007). Arguably, the increase of e-waste is due to many electronics devices quickly turning to obsolete and consequently obsolesce (Perkins et al., 2014). Obsolescence brings many challenges, including the management of e-waste that has undesirable impacts on human health and the associated environment (Luwungo, 2014).

Electronic waste affects mostly developing countries because of the importation of used electronic products from the European and big nations whose technological and economic powerful countries (Kumar, 2017). Managing electronic waste (e-waste) is still a challenge in Tanzania due to poor technology, lack of funding, inadequate competent personnel, and the lack of committed stakeholders (Magashi & Schluep, 2011). Numerous efforts by the government and environment stakeholders are in place to address the e-waste challenge; however, they are yet to bear fruits due to awareness of the general community and stakeholders (Kiaja, 2008).

Knowing that the growing use of Information and Communication Technology (ICT) generates e-waste stream not only in industrialised but also within countries like Tanzania, this study was instituted to assess the factors affecting proper electronic waste management in the Tanzanian context (Mbago, 2018). This study agrees with Kumar (2017) that electronic waste can become much worse if the community, which is the primary consumer of electronic equipment, lacks enough knowledge on how electronic waste can harm their wellbeing.

## 2.0 RESEARCH OBJECTIVE

The general objective was to assess factors affecting electronic waste management within University students' environment. The chosen case for study was in Dar Es Salaam, Tanzania. The study addresses the following specific questions: -

i. What is the contribution of the level of knowledge of users of electronic devices on proper e-waste management?
ii. What is the contribution of budget allocation on proper electronic waste management?
iii. How does the waste management policy affect electronic waste management?

## 3.0 LITERATURE REVIEW

Approximately 40 million metric tonnes of electronic waste (e-waste) are produced each year globally, and about 13 per cent of that weight is recycled, mostly in developing countries (United Nations Environmental Programme, 2011). Developing countries import e-wastes from developed countries and consume about 9 million tonnes of these wastes. These include discarded televisions, computers, cellphones, and other electronics produced by the European Union. Some of the discarded electronic gadgets contain highly toxic materials (Liu, 2009). The challenge of e-waste is of more significant concern in developing countries because most countries lack skills for handling and recycling hazardous materials in e-waste (United Nations Environmental Programme, 2011). This results in the disposal of both e-waste and other waste in dumpsites.

Within the East African Community (EAC), Asiimwe & Ake (2012) investigated the countries within the trade bloc and their role in electronic waste management. The results showed that EAC countries are taking the issues of e-waste into serious consideration. These considerations are outlined for each country in the table below:

**Table 1. Current and Future Initiatives & Strategies for e-waste in the EAC**

| Category | Country |
|---|---|
| **Current and future initiatives and strategies for e-waste** | **Kenya** – The government discourages old imports and works with NGOs to introduce a recycling and a take-back policy. |
| | **Uganda** – The government banned importing old electronics, waived taxes on computers, and worked closely with NGOs to introduce a take-back system. |
| | **Rwanda** – Controls the importation of old ICTs but with no laws. |
| | **Burundi** – No plans, initiatives and strategies. |

| | |
|---|---|
| | **Tanzania** – Old imports are discouraged, and the government is working closely with NGOs to introduce a take-back system as well as recycling |

**Source: Asiimwe and Ake (2012)**

It also indicated that EAC countries are attempting to mitigate that problem but still 'have not come up with the proper solution and suggest a more practical solution to resolve the problem (Asiimwe & Ake, 2012).

In Tanzania, Mbago (2018) identified the legal lacuna existence on the management of e-waste. Specifically, the study hypothesised whether there is a legal lacuna concerning statutory and regulatory frameworks dealing with e-waste disposal in Tanzania. Also, the study hypothesised whether the statutory and regulatory framework in Tanzania regarding e-waste disposal is sufficient and effective in protecting, preventing and controlling e-waste disposal and whether the establishment of specific legislation regarding e-waste disposal in Tanzania would amount to an equitable solution over e-waste management. Interviews and questionnaire were used during data collection. The literature indicates no specific legislation regarding the management of e-waste disposal (Gumbo & Kalegele, 2015). The issue of e-waste is covered in general with other solid waste. In such an environment, it is recommended that the establishment of e-waste policy, regulatory and performing of a specific policy to cover for the management of e-waste disposal (Bakari, 2014)

Following this, both Asiimwe & Ake (2012) and Mbago (2018) discuss electronic waste management in different magnitudes. Problems Asiimwe & Ake feel the solution to mitigate the electronic waste is yet to be accomplished, and Mbago believed the policy should be articulate on how to resolve the raising of electronic waste management. Based on this critic, Mbago has seen the positive and key issue that the researcher identifies as the factors affecting the awareness of managing electronic waste. Luwungo (2014) reviewed the challenges of electronic waste management specific to mobile phones and other related items from a regulatory framework perspective.

Similarly, a study conducted by Mgimba & Sanda (2016) concentrated on obtaining the regulatory challenges regarding the problem of electronic waste. The study suggested that the country must have an efficient regulatory system dealing with electronic waste as a possible solution. The study revealed that Tanzania lacked appropriate technology and knowledge for environmentally sound recycling of e-waste and the best legislation and regulatory documents to manage better the waste being generated. This is a conclusion also put forward by McKenzie (2019) in reviewing the challenges facing Tanzania. The study recommended for an efficient regulatory system in place for e-waste management is inevitable. A weakness in the study conducted by Luwungo

(2014) was a limited scope that did not address the awareness of a good use of mobiles, and he suggested the government should design a good policy to fight against the growth of ICT equipment particularly mobiles phones. This is a significant and robust suggestion because a policy is also part of the factors affecting electronic waste management, which the researcher intends to address.

Previous to the research conducted by Luwungo (2014), Magashi and Schluep (2011) had conducted a study that aimed at assessing electronic waste management in Tanzania. The study's overall objective was to get a reliable overview of the e-waste landscape in Tanzania through a baseline study focusing mainly on computers and other IT equipment, including mobile phones and TVs. The methodology used involved mainly data acquisition and analysis of the e-waste through literature review, consultations with stakeholders, field study questionnaires and observations by the expert team in the field, this is supported by Lubua (2019). The researchers stated that there is inadequate information on the existing practices and strategies on e-waste management in the country. They further stated that there will be an increasing growth of the e-waste stream in the country as more and more ICT equipment reaches its end-of-life, considering that the current disposal practice of e-waste in Tanzania is mainly storage.

To further understand the gaps highlighted as inadequate information on e-waste management, Okoye and Odoh (2013) carried out a study to ascertain the 'peoples' level of awareness of the regulation, the mode of disposal of the e-waste and their awareness of the dangers inherent in improper handling and disposal of waste. Data for this study were collected through the distribution of 247 well-structured questionnaires. Likert Scale was adopted for the analysis of the respondents, because it provides a range of choices for measurement (Lubua & Pretorius, 2018). The results revealed that awareness is critically low. Also, the public has minor concern for their environment; the majority disposes of their e-waste alongside municipal waste without knowing the implications.

The study further stated that public awareness is critical in achieving environmental attitudes, skills and behaviour consistent with sustainable development and environmental protection. Awareness is an essential tool for the sensitisation of public opinion to environmental issues and challenges. These trained people must inculcate into the populace strong feelings fundamental to developing a concern for e-waste management. The development of a community-based awareness programme on e-waste should consider the following aspects:

i. The programme should help the participants develop an interest in improving the quality of their immediate environment and increase the awareness of environmental health.

ii. The programme should increase the awareness of and knowledge about e-waste management, impart positive attitudes and motivate action.
iii. It should provide continuity and progression because behaviour modification is a long-term habit.
iv. It will be linked with community realities and cater to the ’community’s e-waste problems as best as they could.

### 3.1 Theoretical Review

According to Kothari (2004), a theory is a coherent group of tested propositions commonly regarded as correct that can be used as principles of explanation and prediction for a class of phenomena. In line with this definition, the study will use two theories that help explain the arguments advanced in this study. The theoretical framework presents the theories which explain why the problem under study exists and serves as a basis for conducting the present research (De Beer & Rensburg, 2011). The stakeholders’ theory guides the study.

Stakeholder theory considers how the ’company’s goals and objectives are aligned with stakeholders’ interests, who are affected by the company's operations (Moir et al. 2001). Moir et al. (2001) emphasise that companies dealing with the production and exportation of electronic materials to third world countries must take the responsibility of saving society from the threats caused by the accumulation of electronic waste. Furthermore, it is understood that stakeholders prefer the consumers as the primary stakeholders of the operation conducted by the electronic companies or the distributor of the electronic equipment. Hence, these companies and responsible authorities dealing with environmental and health issues are responsible for raising the consumers' awareness of electronic waste (Yukalang et al., 2018). Also, as the stakeholders affected by the electronic companies’ equipment, the consumers must demand information concerning the side effects of the products they used.

The theory suggests that the manufacturers of electronic devices are responsible for raising awareness of the negative impacts of their products. Also, the university administration must make sure that the students, as the stakeholders of the education services offered by the university, must be provided with knowledge concerning electronic wastes (Edumadze et al., 2013).

### 3.2 Implementation of Stakeholder Theory

Stakeholder theory explicitly illuminates the need for manufacturing companies of electronic waste devices such as computers, laptops, mobile phones, televisions, and refrigerators to ensure that there is no single shipment to developing countries with products already reached of life. Contrary, the country regulator authority must not accept any containers at a custom boarded warehouse containing used unapproved

electronic gadgets and devices. Observably, many developing countries are happily, and satisfactory accept used electronic devices. This is probably an awareness issue of the hazardous impacts of using those e-waste devices. Globally, this is a common exercise conducted by developed countries merely to pass on the problem to developing countries with little awareness of e-waste management.

For the distributor of electronic devices, they have the mandate to educate consumers about the end-of-life of an electronic device. Tanzania is one of the top victims of using used electronic devices, distributors of mobile phones, computers, and laptops are not aware of the life span of the device and the impact of using those devices that reached the end-of-life. Even with new sealed devices, there is a sign that alerts consumers not to dispose of the recycling bin. Users are not aware of this information. Either the distributor must also get educated by government officials or manufacturer. If we do not stop these acts, the impact of e-waste is far more critical.

In Tanzania, TCRA and TRA, collectively as regulatory authorities, must take action to stop the importation of e-waste devices. Authorised distributors of computers such as RED DOT, Mitsumi and Simply Computers must ensure they take responsibility for educating the consumers of electronic devices. Mobile phone distributors like Samsung, Techno and Infinix should be held responsible to educate consumers. Observation shows that most consumers purchase low-cost devices bound to reach the end-of-life easily. Consumers would not understand this concept; hence they pass on the problem to other consumers.

## 4.0 METHODOLOGY

The researcher used a mixed research approach involving qualitative and quantitative research approaches to facilitate the collection of primary data through structured questionnaires and secondary data through documentation.

### 4.1 Population and Sampling

The study involved a population comprising of 25,697 undergraduate students and lecturers from the university based in Dar Es Salaam, being 25,697 (UDSM Annual Report 2018). In this case, the university remains anonymous. The ongoing perception in society, which makes the university students perceived as an elite group in society, influenced university selection as the case study. The sample size identified was 377, based on the formula and table introduced by the National Education Association Research Bulletin (1960) for sample size determination.

The researchers employed a probability sampling technique of simple random sampling to obtain the university student respondents and a non-probability sampling technique (purposive sampling) to obtain the academic staff involved in the study.

### 4.2 Data Collection Methods

For the nature of this research, the researchers used structured questionnaires as the source of primary data collection. A structured questionnaire is a questionnaire that poses definite, concrete and preordained questions; that is, they are prepared in advance (Rwegoshora, 2006). The researcher then applied documentation as the secondary data collection tool – documents involving statistical and theoretical information concerning electronic waste management.

Data collection from multiple sources ensures the validity and the employment of the case study research design, both utilised by the researcher in this study (Yin, 2017). The data analysis tool used was Statistical Package for the Social Sciences (SPSS). The type of statistical analysis adopted was descriptive. The descriptive analysis allows the researcher to present a large volume of data collected in a summary form through charts and tables (Chenail, 2012). Therefore, based on the sample size, the most appropriate method presenting the findings is through charts and tables (Dixon-Woods et al., 2005).

## 5.0 PRESENTATION OF FINDINGS

This section analyses the findings from the field and makes a critical discussion on the factors affecting proper electronic waste management in Tanzania. Data presentation focuses on budget, policy issues, the awareness of stakeholders and how respondents descriptively associate them with e-waste management.

### 5.1 Contribution of the Level of Knowledge of Users of Electronic Devices on Proper E-Waste Management

The results from the field show that university students are only having the idea of electronic waste, but they are not having a sound understanding of the concept of electronic waste.

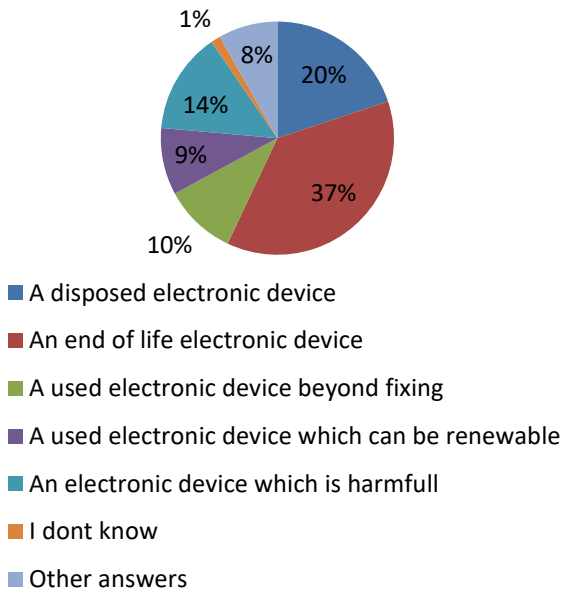


**Figure 1. University Students' Awareness on the Concept of Electronic Waste**

Out of the 377 respondents who participated in the study, 37.14% of respondents said that electronic waste refers to an end-of-life electronics product and 19.89% said that electronic waste refers to the disposal of electronic devices. The study reveals that university students know the side effects of not safely disposing of electronic waste. The field data show that 26.53% of the total respondents said that electronic waste needs to be disposed of safely due to the environmental hazard caused by electronic waste. Also, 22.55% said that electronic waste needs to be disposed of safely to avoid the side effects resulting from the accumulation of electronic waste.

The field shows that university students only have a general understanding of the signs of electronic products that have reached their end of life.

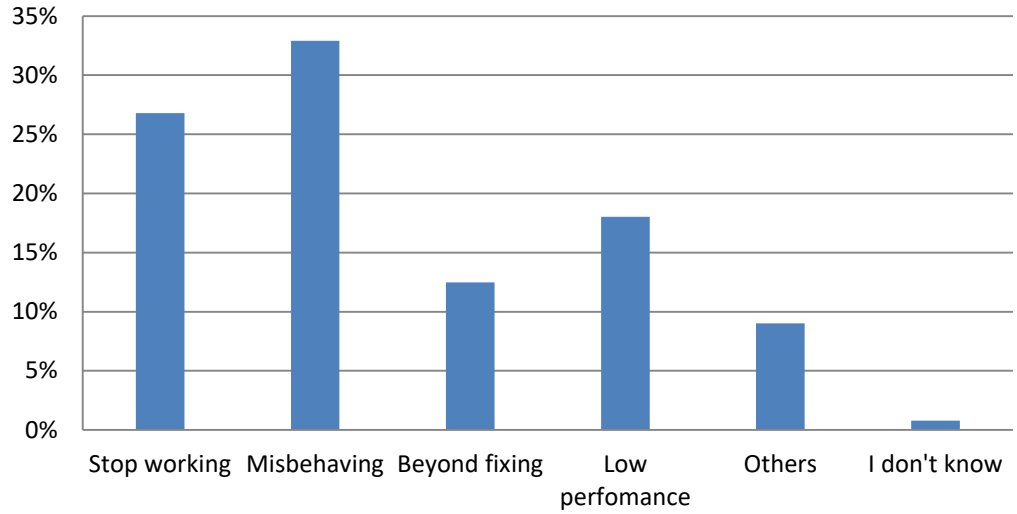


**Figure 2. Signs Show the Product Reached its End-of-Life**

Figure 2 shows that 32.89% of the respondents said they know the electronic device has reached its end-of-life when it starts to misbehave from the standard performance, and 26.79% said that they know the electronic device has reached its end-of-life when it stops working.

The field shows that respondents who used their electronic devices for more than 5 years are the ones who have little awareness of the signs of electronic devices which reached their end of life.

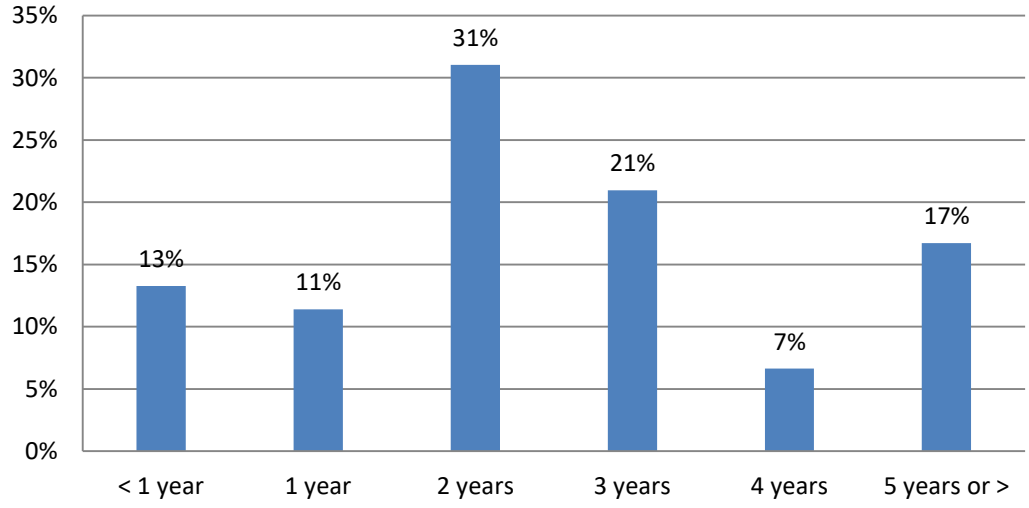


**Figure 3. The Length of Time the University Students have Been Using the Electronic Devices**

Figure 3 shows the length of time university students have been using electronic devices. Categorically, 31% of the total respondents said that they have been using electronic devices for two years since purchasing, 21% of the total number of respondents said they have been using electronic devices for three years since purchasing. Moreover, 17% said they have been using the electronic device for five years since they last purchased it.

The results delivered from the field show that although there is no special course on electronic waste management, the general knowledge provided by the university is effective in providing the student with electronic waste awareness.

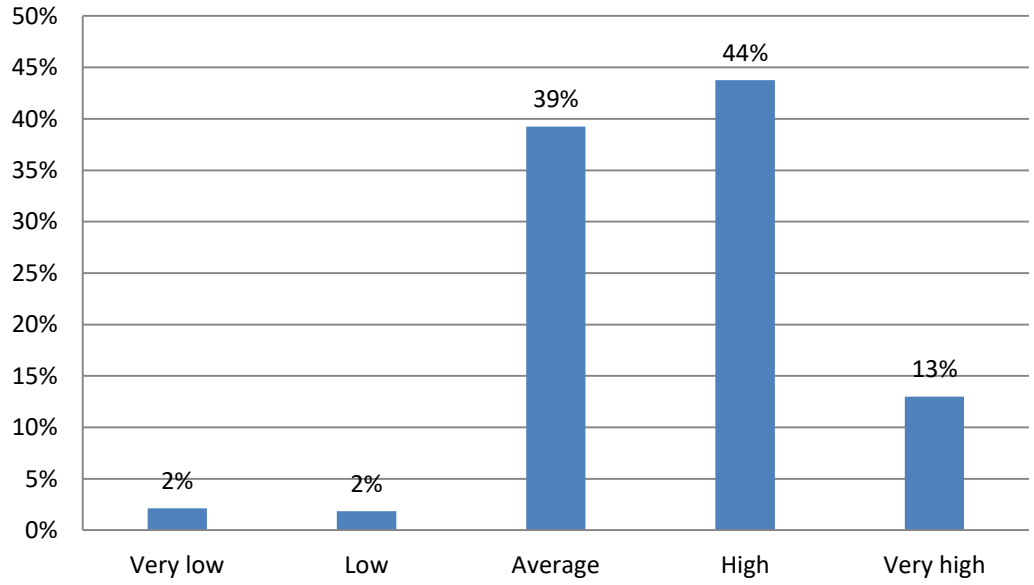


**Figure 4. Effectiveness of the Knowledge Provided by the University in Rising Electronic Waste Management Awareness**

Figure 4 shows that 44% of the respondents said that the effectiveness of the university's knowledge in rising electronic waste management awareness is high, 39% said the effectiveness is average, and 13% said the effectiveness is very high. Field results show that although 49% of the respondents said they prefer the used product, the level of awareness on the effects of using electronic devices which have reached their end-of-life is high.

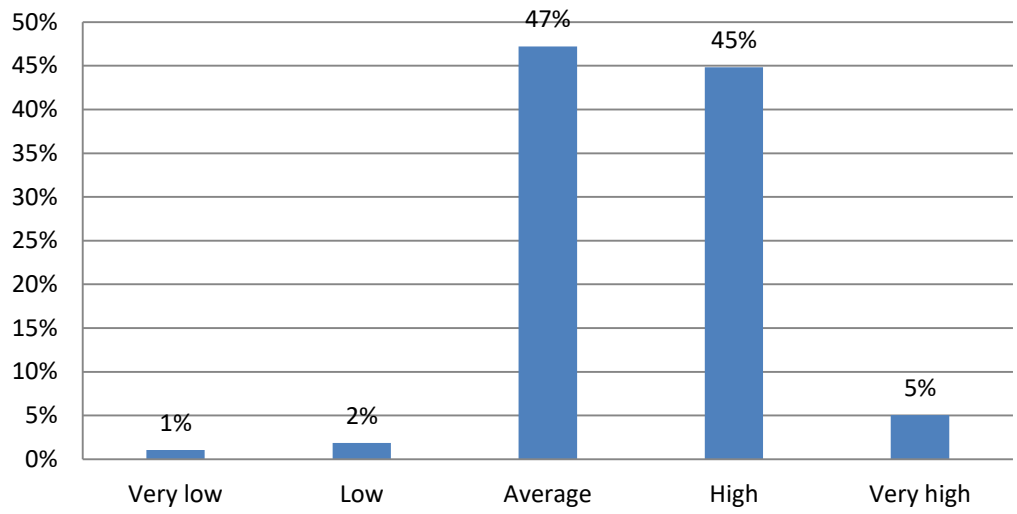


**Figure 5. Level of Awareness on the Effects of Using the Electronic Devices Reached their End-of-Life, Used and Refurbished Electronic Devices**

The results from the field show that 47% of the total number of respondents said that the level of awareness effects of using electronic devices which have reached their end-of-life, used and refurbished electronic devices are average, 45% said their level of awareness is high, and 5% said their level of awareness is very high.

### 5.2 Contribution of Budget Allocation on Proper Electronic Waste Management

To have an effective campaign of raising awareness on the impacts associated with the accumulation of electronic waste. It is crucial to have enough budget allocation that will smoothen the awareness campaign and initiatives. According to the Controller Auditor General Report (2018), among the factors hindering the effectiveness of electronic waste management is the unavailability of enough funds. Hence, this study aims at examining the contribution of the budget on electronic waste awareness management at the university.

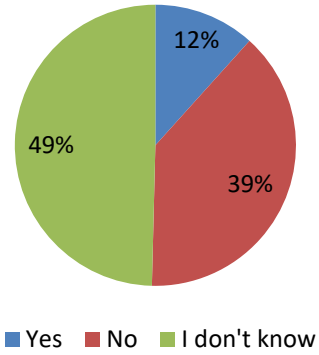


**Figure 6. Availability of Special Budget Allocation for Electronic Waste Awareness Management at the University**

Figure 6 shows that 49% of the total number of respondents who participated in the study argued they 'do not know if there is a special budget allocation for electronic waste awareness management, 39% said there is no special budget allocation. In comparison, the remaining 12% agreed that there is a special budget allocation for electronic waste awareness management.

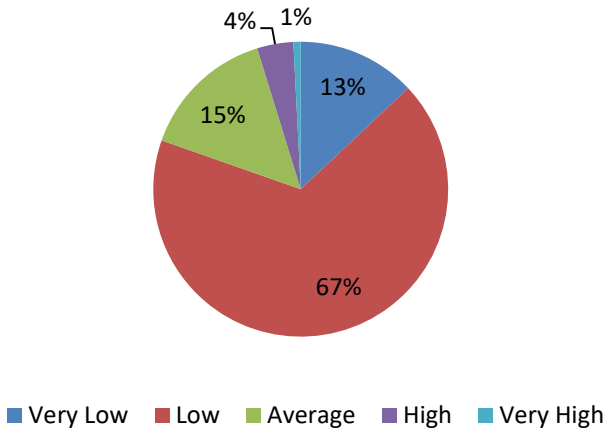


**Figure 7. Students' Perception of the Costs Associated with Electronic Waste Management Awareness.**

Based on the results from the field, 67% of the respondents said that the cost associated with managing electronic waste awareness at the university is low, 13% said the costs are low, while 15% said the cost is at the average level. 4% said the costs are high while 1%said the costs are very high. The results from the field show that most of the respondents perceive the costs of managing electronic waste among the university students are low and can be covered by the university administration.

### 5.3 The Effect of Policy on Electronic Waste Management

The results from the field show that even though most of the respondents are not sure if there is a specific policy for electronic waste awareness management. If there is a specific policy, the policy must not be effective enough to provide the university with electronic waste awareness.

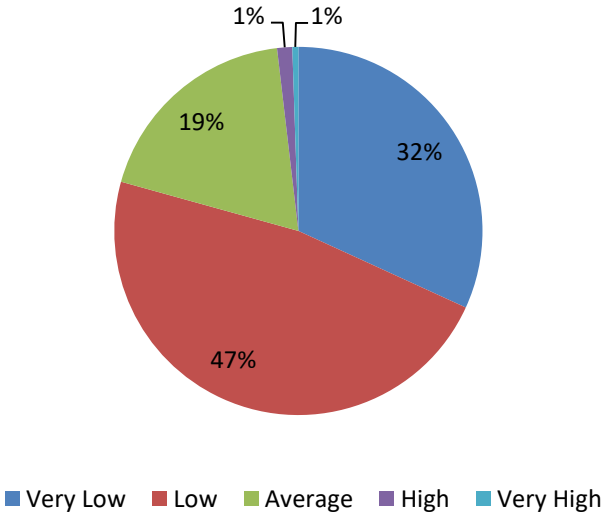


**Figure 8. Effectiveness of the Policies Implemented by the Administration of the University in Providing Students with Electronic Waste**

The findings from the field show that 47% said the effectiveness is low, 32% said the effectiveness is very low, while 19% said the effectiveness is at the average level. On the other hand, 1% said the effectiveness of the policies implemented by the university administration in providing students with electronic waste awareness is low, while the remaining 1% said the level of effectiveness is very low.

The results from the field show that most of the respondents are aware of the consequence of not having a specific policy for electronic waste awareness management. This shows the need to have a specific policy for electronic waste awareness management at the university.

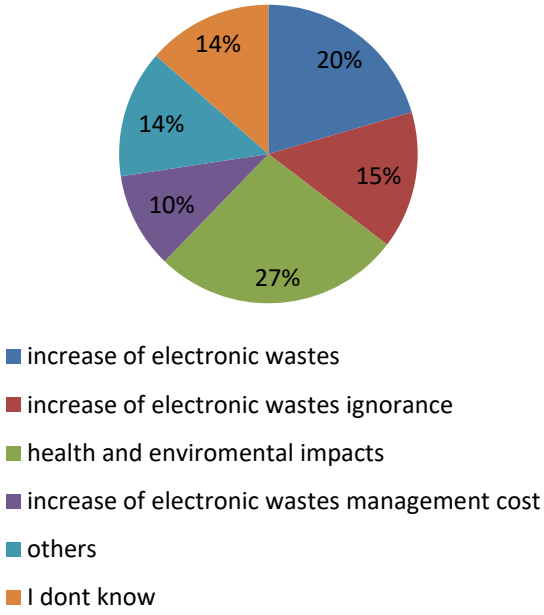


**Figure 9. The Consequence of not Having a Specific Policy for Electronic Waste Awareness Management**

Field results show that 27% of the respondents who participated in the study argued that the unavailability of a specific policy of managing electronic waste awareness at the university leads to increased health and environmental impacts in the society associated with the accumulation of electronic waste. 20% said the unavailability of the specific policy leads to the increase of electronic waste, while 15% said the specific policy's unavailability leads to an increase in electronic waste management costs.

## 6.0 DISCUSSION OF FINDINGS

The findings from the field are having similarities with the study of Mtebe (2017), who discovered that the knowledge and awareness of students about e-waste management were low. However, unlike the study of Mtebe (2017), this study found that university students and academic staff have a low and completely different direction of awareness of electronic waste. The results from the study show that university students are having awareness on the issues of electronic waste. However, based on the fact that university students are preferred as an intellectual group in society, their level of understanding should be higher than what the researchers discovered from the field.

The study also found out that most of the students who participated in the study know the reasons as to why the electronic waste needs to be disposed of. This finding is supported by Okoye and Odoh (2013) in a similar study carried out in Nigeria. Most of the respondents said that electronic waste needs to be disposed of safely to avoid environmental hazards and other side effects hazards. The minority of the respondents

said that electronic waste needs to be disposed of safely for recycling. The results from the field show that the university students are having different knowledge on how to determine the electronic device which has reached its end-of-life. Most of the respondents said that the factors that show the device has reached its end-of-life are when the electronic device stops working and starts to misbehave from normal performance.

The field results show that respondents are aware of the environmental and health impacts associated with the accumulation of electronic waste. This finding is supported by Ben-Enukora (2017) and Shah (2014), which demonstrated that students' perceptions on the issue of electronic waste were prevalent, and so was community perception on the matter and the role of media in improving community awareness on electronic waste.

The result from the field shows that although there are no special courses on electronic waste management, the general knowledge provided by the university is effective in providing the student with electronic waste awareness. The researcher discovered that most of the respondents, when making a buying decision 'do not consider whether to purchase from the authorised or unauthorised dealers despite having a good understanding of who are the authorised dealers. This puts doubts on the level of university students' awareness on the impact of using the products which are sold by the unauthorised dealers. This clearly shows that knowledge is not enough to manage electronic waste awareness since university students have knowledge concerning electronic waste. However, they still purchase end-of-life electronic devices named as refurbished, but in reality, they are the electronic devices that have reached the end of life.

Like any other campaign, there must be an allocation of budget to cover the costs of raising awareness on the particular catastrophe. The unavailability of a special budget to run special courses and seminars on electronic waste management shows that, to a great extent, students' awareness of electronic waste comes from exposures such as the internet and peer groups. This makes students have electronic waste awareness, which is low-level contrary to their intellectual status. The results found from the field reflect the verdicts of the Controller Auditor General (2018), which shows that among the factors hindering monitoring electronic waste in Tanzania is the absence of enough financial support. The report calls for the budget allocation of controlling the accumulation of electronic waste at the government institutions. The report states that the budget approval authorities are not considering the importance of electronic waste management in human health (Controller Auditor General, 2018).

The severity of the impacts associated with the accumulation of electronic waste shows the need for having a particular policy for monitoring the accumulation of electronic

waste. The field results show that most of the university students involved in the study are unsure if the university administration has a policy of electronic waste management. The findings from the study are supported by the verdict of the Controller Auditor General (2018), which states that the country is lacking the mechanism of controlling electronic waste in the country and the existing legal and institutional framework are not fully supporting the initiatives of controlling the growth of electronic waste in the country. The report further added that the lack of guidelines to manage electronic waste increases health risks among the people (Controller Auditor General, 2018).

The results from the field show that the absence of an electronic waste policy at the university results in many consequences, including little knowledge on electronic waste and the increase of electronic waste and its hazardous impacts. The fact that the government of Tanzania has not introduced the specific policy on the issue of electronic waste, as suggested by Magashi and Schluep (2011), leads to the low effort of the government sectors, including the education institutions, to establish policies of electronic waste management which will provide students with an awareness of electronic waste management. The field results relate to the verdicts of Mbago (2018), who identified the unavailability of clear policies and legislation for controlling electronic waste in Tanzania as among the key factors hindering the monitoring of electronic waste growth in Tanzania. Mbago (2018) recommended the establishment of an electronic waste policy and the regulatory framework to cover the specific policy of managing electronic waste disposal.

## 7.0 CONCLUSION & RECOMMENDATIONS

The results from the field show clearly that the university students have insufficient knowledge of electronic wastes. This is because the university does not have a special curriculum for providing students with electronic waste management awareness. Therefore, students adopted the knowledge from their exposures as well as from other subjects imparted at the university. The low awareness of electronic waste management shows precisely that there is no budget allocated for electronic waste management awareness at the university. Also, the university does not have a clear policy of recommending the electronic management course, which would be used as the benchmark for providing students with electronic waste management awareness. The field results show that students believe that the costs for running electronic waste management programmes at the university are very low; hence, the absence of an electronic waste management programme shows that the university administration does not give the matter high priority compared to the other issues.

Based on the findings from the study regarding the objectives of the study, the researcher recommends the following policy implications and an area for further studies.

i. The study recommends the special programmes be implemented at higher learning institutions to empower students with electronic waste management knowledge instead of relying on general programmes such as environmental courses to provide awareness of electronic waste.
ii. The study recommends a special budget allocation to support electronic waste awareness management at the higher learning institutions; this includes special campaigns and the publication involving electronic waste management information.
iii. The study also recommends that the government authorities dealing with regulating quality standards of electronic devices such as TBS and TCRA restrict the distribution of electronic devices which have reached their end of life.
iv. The researcher recommends that the government introduce proper and convenient ways of handling the collection of electronic waste device, even in household areas, so that the entire city can have one storage location for dumping all electronic waste gadgets.

The researcher recommends other studies that will suggest raising community awareness on the issue of electronic waste, especially in rural areas. Also, the researcher sees the need to conduct studies that will assess the weaknesses of the responsible authorities in solving the problem of electronic waste in Tanzania.

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