Co-design, with two South African villages, of a prototype for an e-waste management mobile app

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Abstract
Electronic waste (e-waste) contains toxic elements that, if not carefully disposed of, can harm the environment and human health. It is imperative that e-waste is handled in a correct, safe manner. The study engaged with two rural South African villages, Mantunzeleni and Mpeta in the Eastern Cape Province, to determine their current e-waste disposal practices and to co-design a cloud-based mobile application (app) for improved e-waste management. Twenty-six participants, 13 from each village, participated in the study. A focus group discussion with participants explored the communities' existing e-waste disposal behaviours, which were found to be harmful to the environment. Participants were then introduced to, and guided through, the co-design process, which resulted in development of a prototype cloud-based mobile app that would, if implemented, allow households to request the collection of e-waste items by the local municipality. The authors argue that, because of the co-design process, the app (if implemented by the municipality) will be well-suited to the needs of, and widely used by, the two target communities, who will feel a sense of ownership of the technological solution that they helped to create.

Keywords
electrical and electronic equipment (EEE), electronic waste (e-waste), environment, health, rural villages, under-resourced areas, mobile application (app), cloud computing, Eastern Cape Province, South Africa

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1. Introduction

Consumer products such as refrigerators, radios, electric fans, washing machines, televisions, cell phones, and computers play an important role in people's lives. The ownership of such products is widespread, in both developed and developing countries. Due to feature improvements or breakdowns, consumers frequently buy new models of these products and discard old ones (Ylä-Mella et al., 2022). The discarded goods become e-waste, which is electrical and electronic waste, including discarded consumer electronics, information and communication technology (ICT) equipment, and small and large electronic household appliances (eWASA, n.d.).

E-waste contains toxic elements such as copper, lead, cadmium, and mercury (Abalansa et al., 2021) that, if carelessly discarded, pose hazards to human health and the environment (when the toxic elements are released into the air, water, and soil) (DeVroom, 2019). People living in under-resourced settlements often lack basic services such as sanitation and access to safe water. In such communities, many people source their drinking water from rivers, streams, and dams. The sources of their water can be exposed to contamination released by e-waste (Bhat & Savale, 2019).

This study, which took place in South Africa's Eastern Cape Province, had two main aims: (1) to canvas the existing level of e-waste awareness among residents of under-resourced communities where unsafe dumping of e-waste was present; and (2) to collaborate with these residents in the design and testing of a cloud-based mobile application (app) focused on building e-waste awareness and safe management. The development of the app was guided by a co-design approach, which allows end-users to collaborate with experts to design a system based on the end-users' experiences and expectations (Slattery et al., 2020). The study participants were 26 residents of the Eastern Cape villages of Mantunzeleni and Mpeta.

Research questions

The study was guided by the following questions:

- What is the extent of residents' knowledge and awareness of e-waste?
- Which features of a cloud-based mobile app would be useful to support safe e-waste management in the villages?

2. Literature review

E-waste in Africa

African countries are often the recipients of developed countries' electrical and electronic equipment (EEE) donations, which, according to Avis (2021), African countries accept in an effort to bridge the digital divide. The EEE exported to Africa is often mislabelled as used and usable, when in fact it is e-waste (Williams & Adetuyi, 2022). As William and Adetuyi (2022) point out, such mislabelling is practised to avoid rules against transboundary trade in e-waste. Perunding Good Earth (2021) also notes that developed countries make these donations to developing countries to offload some of their e-waste. Accordingly, as Avis (2021) explains, the EEE imported into Africa increases e-waste levels on the continent. The World Economic Forum (WEF, 2021) states that developed countries export about 60% of their e-waste to Africa. The e-waste received from developed countries litters villages and towns, impacting the environment and health in those places (Bazilian, 2020).

In most African countries, there is poor handling of e-waste, and this is attributed to poor collection mechanisms, poor recycling, poor public awareness, and a lack of government policies (Godfrey et al., 2019). The result is that e-waste is often disposed of in landfills with general waste, or burnt (Sahle-Demessie et al., 2018), resulting in negative impacts on the environment and human health (Forti et al., 2020; UNEP, 2018).

In 1991, in an effort to prevent developed countries from exporting e-waste to Africa, 12 African countries negotiated and approved the Bamako Convention on Hazardous Wastes, which came into force in 1998 (Bamako Convention, 1991). The Convention requires that when African countries trade in e-waste between themselves, there must be signed consent between the countries (Kaminsky, 1992), with the signed consent stating how the receiving country will manage the imported e-waste. The Convention also prohibits the export of e-waste to Africa by developed countries (UNEP, n.d.-b). South Africa is not a signatory to the Bamako Convention but is a signatory to the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention, 1989).

The implementation of the Bamako Convention is relatively weak on the continent, due to a lack of resources (Umenze, 2019). Furthermore, Umenze (2019) states that although the Convention was initiated to protect the environment and health on the continent, developed-world e-waste is still finding its way into African countries and is not properly managed. In the *Global E-waste Monitor 2020* report, Forti et al. (2020) state that only 13 African countries have national e-waste policy, legislation, or regulation in place (Table 1).

Table 1: African nations with national e-waste policies, laws, or regulations, 2020

North Africa	West Africa	Central Africa	East Africa	Southern Africa
Egypt	Cote d'Ivoire Ghana Nigeria	Cameroon Sao Tome & Principe	Kenya Rwanda Tanzania Uganda	Madagascar South Africa Zambia

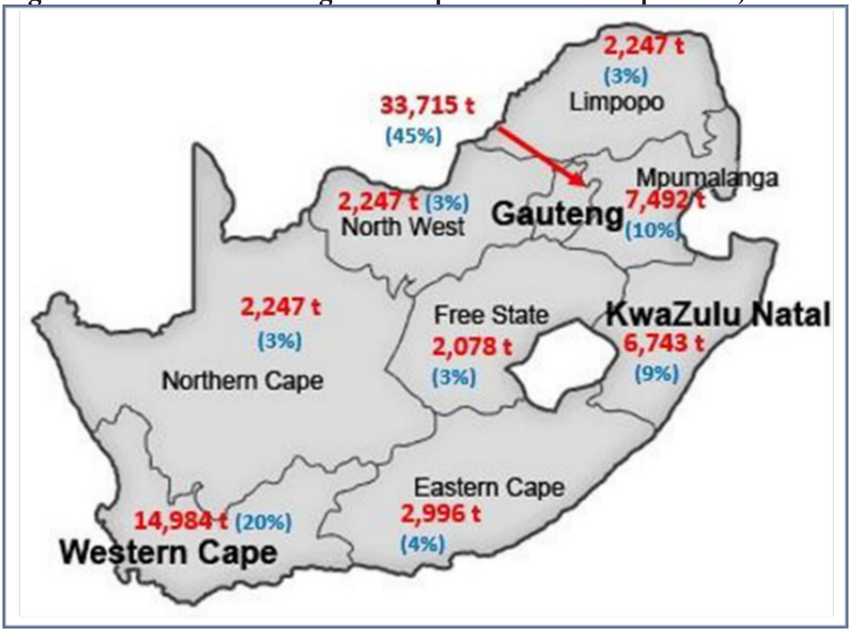
Note. Sourced from Forti et al. (2020).

Avis (2021) argues that even in the African countries that have policies, laws, or regulations in place to regulate e-waste management, e-waste is still not properly handled due to poor implementation, particularly in under-resourced rural areas.

E-waste in South Africa

South Africans' use of technology has grown significantly in recent decades (Stats SA, 2019), thus increasing the amounts of e-waste generated. According to Ludek (2024), 360,000 tonnes of e-waste are generated in the country each year; only around 12% is reclyced, with the rest dumped in landfills. Figure 1 below provides 2015 estimates for the amount of e-waste generated by each of South Africa's nine provinces.

Figure 1: Estimated e-waste generated per South African province, 2015



Note. Figure sourced from Lydall et al. (2017, p. 6).

In South Africa, the services available in urban and rural areas differ greatly. In urban areas there is access to basic services such as health, education, and sanitation. In contrast, in many rural areas, under-resourced villages have poor access to basic services. Life in these parts of the country is extremely difficult (Gazana, 2016). Technology use is quite high in both urban and rural areas. According to Jeftha (2023), South Africa is, in the African continental context, one of the countries with the highest levels of technology usage, and thus high levels of e-waste generation are also found. Meanwhile, according to Lydall et al. (2017) and Jeftha (2023), e-waste handling in the country is poor, and e-waste is often disposed of in landfills or burnt. While South Africa has policy, legal, and regulatory instruments dealing with how e-waste should be handled, much of its e-waste still ends up in landfills (Avis, 2021). Table 2 below lists South African instruments that are relevant to e-waste. A key recent instrument featured in the table is the Extended Producer Responsibility (EPR) Regulations of 2020, which came into force in 2021 and regulate how out-of-life electronic products should be handled in the country.

Table 2: South African instruments relevant to e-waste

Instrument	Details	Year
White Paper on Integrated Pollution and Waste Management	Proposes development of waste management strategy for land pollution; developed by the Department of Environmental Affairs and Tourism (now the Department of Forestry, Fisheries and the Environment).	2000
National Environmental Management: Waste Act (NEMWA)	Addresses matters such as air quality, environmental assessment, biodiversity, and waste; falls under the Department of Forestry, Fisheries and the Environment.	2008
Waste Picker Integration Guideline for South Africa	Guidelines for all stakeholders involved in waste picking processes, including those buying from pickers; developed by the Department of Forestry, Fisheries and the Environment and the Department of Science and Innovation.	2020
National Waste Management Strategy	Prioritises waste management and the establishment of a circular economy; developed by the Department of Forestry, Fisheries and the Environment.	2020
Extended Producer Responsibility (EPR) Regulations	Ensure that out-of-life EEE products are safely managed; under the Department of Forestry, Fisheries and the Environment.	2020

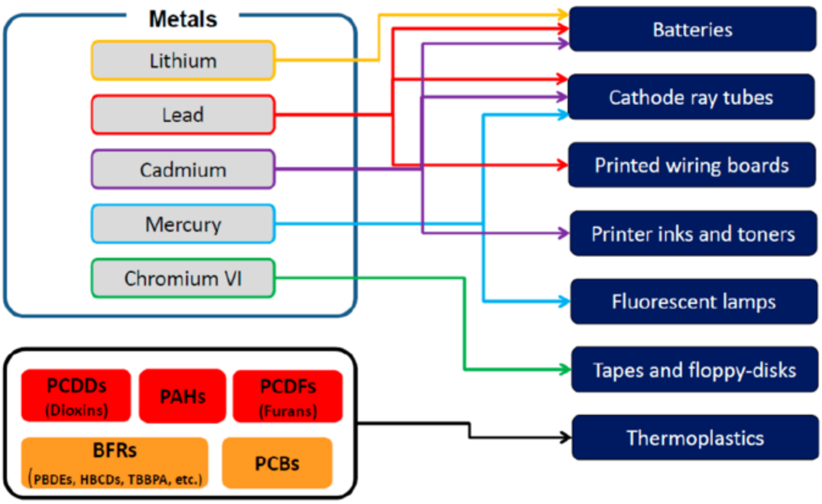
Impacts of e-waste on health and the environment

Disposing of EEE in landfills puts people's lives at risk, as the air, water, and land become contaminated. In developing countries, where people live near or work with discarded EEE, there have been cases of diseases recorded in the literature (WHO, 2021). Birth complications, developmental issues in children, brain cancer, and respiratory infections have been found in people living near e-waste dumping sites or e-waste-contaminated land (Grant et al., 2013; Ichikowitz & Hattingh, 2020).

A study done in South Africa found mercury, arsenic, and cadmium in the blood of elders and children living near dumping sites and those working in informal recycling sites (Machete, 2017). WHO (2021) has found that the foetuses and children of mothers living near e-waste dumping sites or working with discarded EEE can be exposed to diseases associated with e-waste, including, in the case of babies, through breast-feeding.

With respect to environmental risks, e-waste, when disposed of in landfills, leaches through the soil to the underground water, which ends up in drinking water in under-resourced settings. The burning of e-waste contaminates the air that people breathe, causing respiratory infections. Toxic elements found in the soil where the burning and dumping of e-waste occur include lead, copper, zinc, antimony, cadmium, and manganese (Avis, 2021; Lebbie et al., 2021). The figure below, from Lebbie et al. (2021), shows the toxic elements found where there is careless disposal of e-waste.

Figure 2: Toxins released by e-waste



Note. Figure sourced from Lebbie et al. (2021, p. 4).

Cloud computing

Cloud computing provides convenient, on-demand access to network resources (Berg et al., 2020). The network resources can be applications, network services, and/or storage systems (Berg et al., 2020). With regard to e-waste management, cloud computing can store data received from sensers and, accordingly, inform collection systems (Berg et al., 2020). Abdulazeez et al. (2018) posit that cloud computing's core advantages are that it is cost-effective and can be used by many users simultaneously. Cloud computing includes service models and deployment models.

Service models

Service models include software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) (Namasudra, 2021). SaaS enables end-users to access software applications provided via the internet. PaaS provides deployment platforms for software applications. IaaS provides virtual networking resources (Mohammed & Zeebaree, 2021). (The prototype cloud solution developed in this study was an SaaS service model, so that end-users could access it from anywhere, at any time, via their mobile phones.)

Deployment models

Deployment models include private cloud, public cloud, community cloud, and hybrid cloud (Namasudra, 2021). Private cloud deployments are owned by a single entity or organisation. Only authorised people can access the services. Advantages of the private cloud include flexibility, control, effective performance, and high security (Golightly et al., 2022). Public cloud deployments are available to the general public. Anyone can gain access to the resources, and the model contains minimal security mechanisms (Golightly et al., 2022). An example is Google Drive (Shaptunova, 2024). Community cloud deployments mimic the private model, with the difference being that the community model is owned by more than one entity. Hybrid cloud deployments are composed of two or three of the aforementioned deployment models. (The prototype cloud solution developed in this study was a private cloud model, chosen because of its high security (IBM, n.d.; Red Hat, 2019).)

3. Research design

Methodology

The research deployed the qualitative co-design methodology. A co-design session was conducted with 26 participants living in the two villages, Mantunzeleni and Mpeta, which were the focus of the study. The decision to focus on these two rural communities was based on previous observation, by the researcher (the first-listed author), that e-waste was being disposed of in the villages' landfills and next to household gardens. Items that were being disposed of in an unsafe manner included washing machines, electrical bulbs, electrical stoves, irons, cell phones, and batteries. It was also observed that e-waste was not being collected by the local municipality.

The co-design method was chosen because it allows end-users to collaborate with experts in the design phase. End-users provide the functional specifications for what they would like the system to do. Co-design emphasises designing *with* rather than *for*. Such design aims to build end-user satisfaction, adoption, and use, with the end-users feeling a sense of ownership based on their participation in the design of the system. As Burkett (2021) writes, co-design seeks to address complex social problems through incorporating the skills, knowledge, and experiences of the people impacted by the problem.

Sampling

Purposive sampling was used to choose participants from the two villages. The sampling comprised 13 residents from each village, aged 18 or older. Each participant owned, or had owned, at least one electronic item. Of the 26 participants, 14 were males and 12 were females.

Ethical clearance, permissions, and informed consent

Ethical clearance for the study was obtained from the applicable research ethics committee of the authors' academic institution, Cape Peninsula University of Technology in Cape Town.

Before the data collection began, the researcher approached the chiefs of the two villages to obtain permission for data collection to take place through interactions with residents of their villages. Consent forms explaining the study were signed by both chiefs, permitting the study to be done in their villages. One of the conventions followed by the chiefs is to call monthly meetings to update villagers on what is currently happening, or will happen, in their villages. Any developments happening in the villages are addressed in these monthly meetings. The researcher is from Mantunzeleni and knows the culture of the villages as they are close to each other. Each participant signed an informed consent form before the data collection process began.

Data collection

The participants from the two villages gathered with the researcher at a community hall where the data collection and co-design session took place. To establish the current e-waste management practices in the villages, questions were verbally posed to the participants in a focus group discussion (FGD) format. The FGD questionnaire was written in English (see Appendix 1), but the questions were verbally posed in isiXhosa, which is the dominant language in the two villages. Audio-recording was used to capture the participants' verbal inputs, which were provided in isiXhosa. (The English-language FGD quotations that are provided later in this article are the researcher's translations of the participants' isiXhosa statements.)

After completion of the FGD, the co-design session took place, conducted in isiXhosa. For this session, participants were given post-it notes and pencils, and videos were played to explain what was required of them. Participants wrote in isiXhosa, on the post-it notes, the features that they wanted in the app, and posted the notes on a whiteboard (see Appendix 2). The researcher, who facilitated the co-design session, also contributed ideas during the co-design session. This co-design data collection process ended when saturation point was reached, i.e., when no new data was coming from participants. All the participants ultimately agreed on what they wanted from the mobile app. Thus, consensus among all 26 participants was achieved.

Data analysis

The data from the audio-recorded FGD on knowledge and awareness of e-waste was analysed thematically. In analysing the data, six stages of thematic analysis, guided by the work of Braun and Clarke (2012), were followed:

- familiarisation with the data by taking notes;
- generation of initial codes, by coding the most compelling parts of the data;
- grouping of codes into potential themes;
- reviewing of themes, checking them against the data to ensure that no potential themes had been missed;
- finalisation of the naming of the themes; and
- production of a research report, setting out the themes and the data linked to each theme.

With respect to the development of the app, participants' design options were combined to provide an overall picture of what was required.

4. Findings on current e-waste management practices in the villages

In the FGD with the 26 participants, it was initially found that none of them knew about the concept of e-waste. In the words of one participant: "[I]t is my first time hearing about of this kind of waste." All other participants said that they were in the same position. Thus, the researcher provided an explanation of what e-waste is, the toxins that it can release, the potential health and environmental implications from unsafe disposal in landfills, and the potential safe disposal methods.

Disposal practices

It was found that no special measures were being taken in either village with respect to the disposal of e-waste, with e-waste being dumped near homes or in landfills in the same manner as other waste. The following statements, by three different FGD participants, were typical of the responses to the question of disposal:

> I personally just throw my non-functioning electrical stuff away in the fields because I do not know what to do with [it].

> I agree with the previous speaker. I do the same, and I do not care what happens to them [the discarded items] as long as they [are] out of my yard, as they no longer do what I bought them for.

> Well for me, throwing in landfills is the only option I have as I do not know where to take them. As we speak here now, a lot of this e-waste is scattered in landfills and around households in the village.

Potential environmental and health impacts

After being made aware, by the researchers, of e-waste's potential harmful environmental impacts and, in turn, the harmful health impacts for both humans and animals, participants discussed some of the practices in their villages that they now realised were dangerous. In the words of one FGD participant:

> To be honest, all of us here did not know about the impact on the environment. What we do is, […] if it no longer works, we get rid of it. Nobody cared how and where one disposed [of] it.

Participants discussed the fact that they grow food, including maize and vegetables, in their gardens, while at the same time burying e-waste items—such as old batteries, old radios, and device motherboards—in the soil near the gardens. They acknowledged that such practices were dangerous, potentially poisoning the food that people ate. They also acknowledged the dangers of burning e-waste, because of the pollutants released into the air that can cause respiratory infections. Participants also pointed to the fact that people in the villages drink from the rivers and streams, and yet some e-waste could be found next to some of these bodies of water. Concern was also expressed about the potential e-waste contamination of lands where the villagers' livestock grazed. According to one FGD participant:

> Since we dispose of these [e-waste items] into landfills, dams and rivers, we are in danger. Also, for example, cows might eat these and die. Also, children are in danger because they go to these places to find something they can play with. They can get cuts, and at times they bring these [e-waste items] back to households to play with.

At the conclusion of the discussion, the participants expressed gratitude for having received the necessary information about e-waste, and they expressed a desire to spread awareness in their villages. Accordingly, the participants strongly supported the proposal to co-design a mobile app that their communities could use for e-waste management.

Summary of FGD findings

There was a clear lack of e-waste awareness in the two under-resourced communities. Disposal methods for e-waste were inappropriate, as e-waste was being disposed of in landfills and next to water sources such as rivers and streams. Another disposal method was the burning of e-waste. Only when the researcher made the participants aware of the risks associated with the unsafe disposal of e-waste did the participants identify the need to change disposal practices in their villages.

5. Co-design of the e-waste management app

Identification of functions

Through the co-design process, the participants, in collaboration with the researchers, identified several functions that needed to be included in an e-waste mobile app for use in the villages. It was determined that the app needed to be able to do the following:

- send short message service (SMS) messages reminding people about the dangers of e-waste and how to manage e-waste;
- allow residents to enter a request, and receive confirmation of the successful entering of the request, for collection of an e-waste item; and
- send (based on an e-waste collection request) an SMS to municipal employees responsible for waste collection—with details of the item(s) to be collected and the place of collection.

Accordingly, there was consensus that the app would eventually need to be integrated with the operations of the municipality, so that local government would know when e-waste items were ready to be collected. (The municipality had been consulted to determine how it managed e-waste, and the municipality was found to lack e-waste awareness. There was also no policy on how e-waste should be managed, and the municipality disposed of e-waste together with general waste in a landfill.)

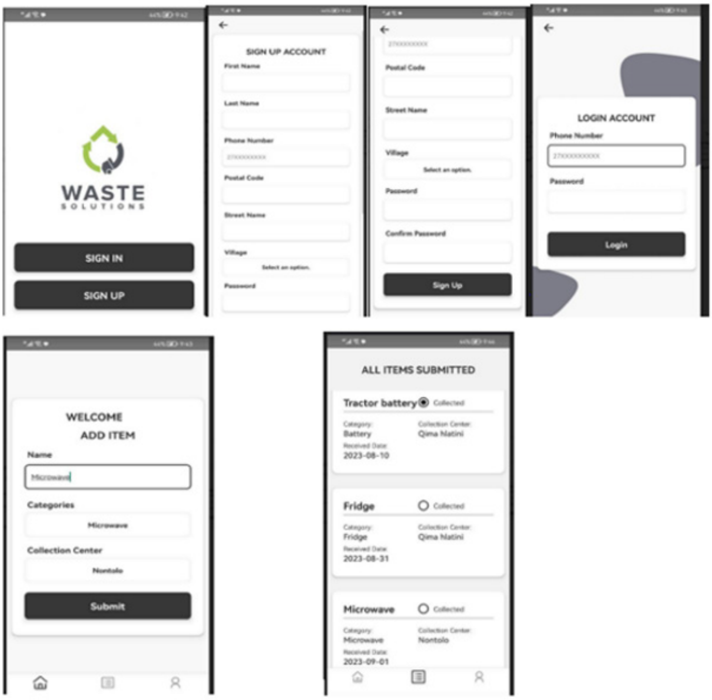
Development of the prototype

Based on the functions identified as necessary during the co-design session, a prototype app was developed. For the user interface (UI), reactive node was used. The back end was developed with Node JS. The data format used between the UI and back end was JavaScript object notation (JSON). For generating SMSs, the Vonage Application Programming Language (API) was integrated with the prototype, and the integrating was done via an http call to Vonage API. For the database, Mango DB, which is an open-source database, was used. The prototype app had three user categories:

- **Village user**: A user who can submit requests for e-waste collection. The user registers, and thereafter can log in at any time and submit requests for items to be collected.
- **Employee**: A user, employed by the local municipality, who receives, and ensures fulfilment of, collection requests from Village users.
- **Administrator:** A user (the most powerful of the three) who can create, read, update, and delete (CRUD) in the app. This user can, among other things, see what has been collected, by whom, and at what time, and can also see where the item has been taken.

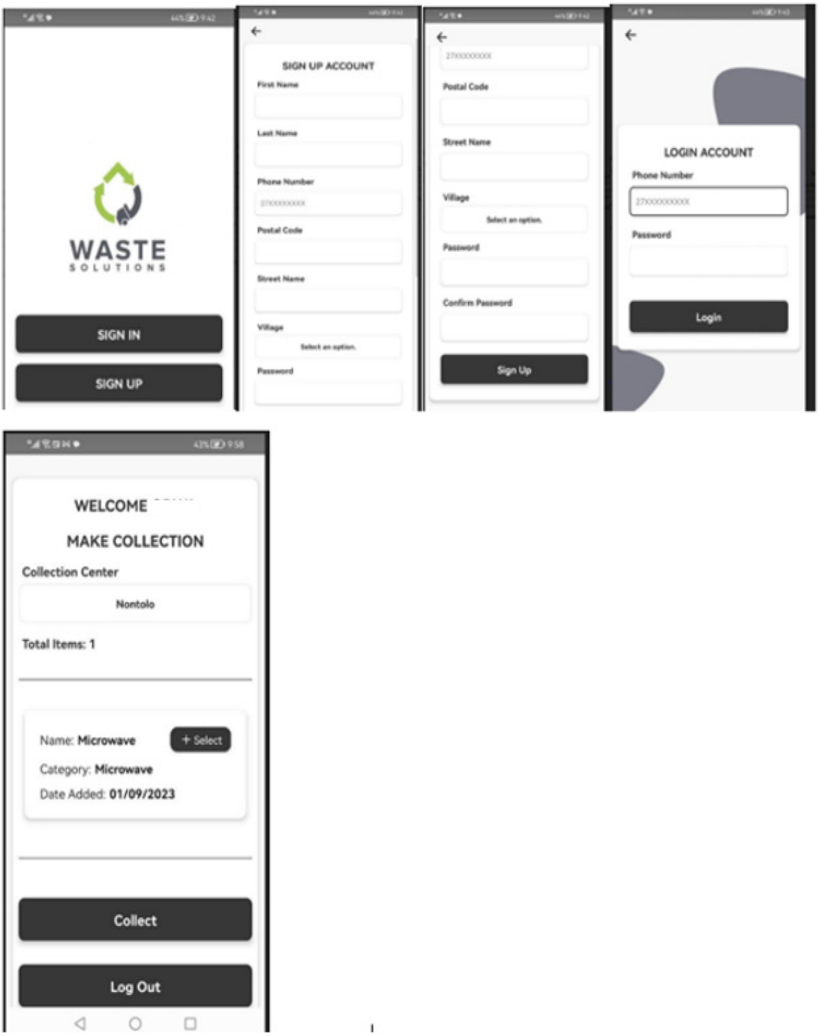
The app uses English as a communication medium. One reason for this was that participants stated that they were using this as a learning opportunity; they wanted to use this app to help them learn how to use other apps, and the majority of apps use English. Another reason that they gave was that, should the app be successful in terms of adoption and rollout to other places, this would put the two villages on the map as the ones to have successfully built an e-waste app now being used by other places. The participants stated that they wanted to make history, and having the app in English would help with that objective. Below are screenshots of the interfaces developed for the three user categories.

Figure 3: Village user screens



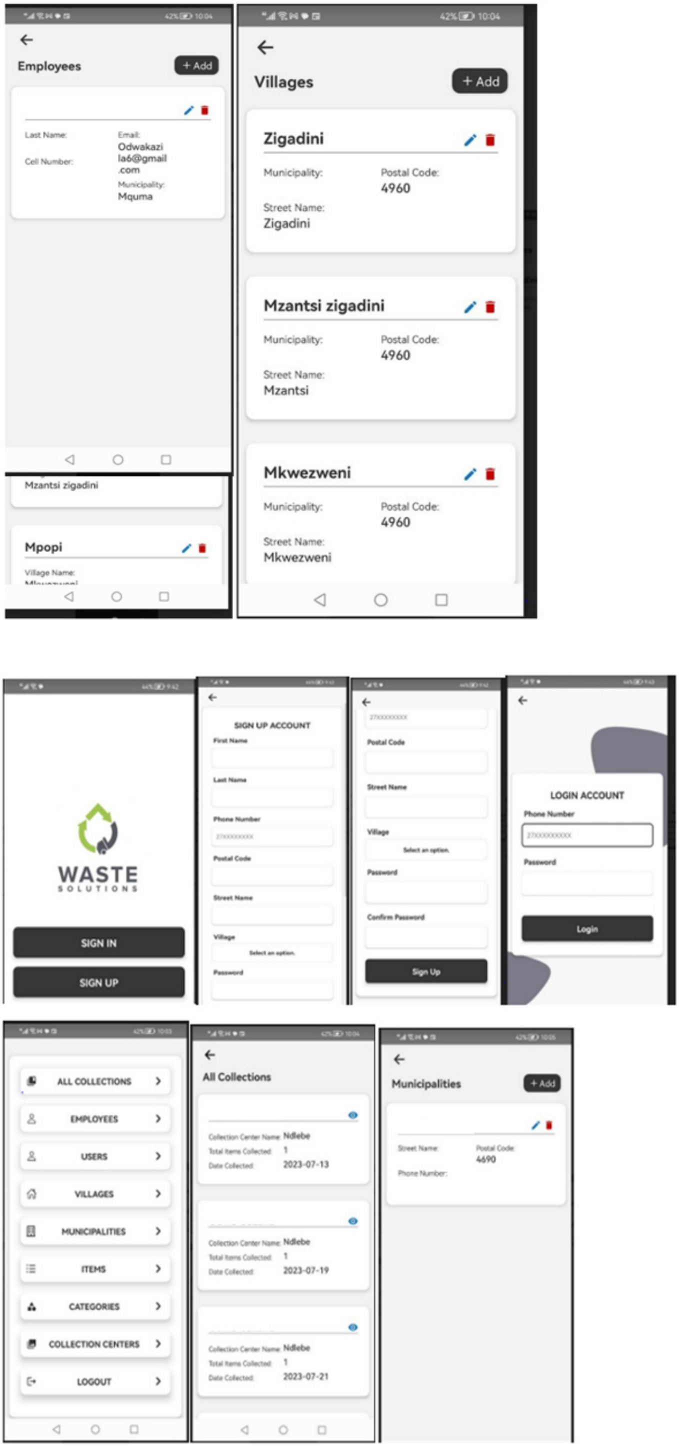
The Village users must first register before using the app. Once the village users register, they can log in to the system at any time and from anywhere. The users can then submit requests for items to be collected at their houses. The users can also see a history of the requests that they have submitted. Once a user captures what needs to be collected and presses “submit”, an SMS is sent to the user confirming that their item has been registered for collection and will be collected as soon as the collecting entity is able to do so. The following categories of items can be selected on the app: batteries, computer screens and keyboards, televisions, fridges, stoves, and mobile phones.

Figure 4: Employee user screens



Via the screens shown above, the municipal Employee user registers, and can log in at any time to view Village user requests for items to be collected. When the Employee user selects an item and clicks on "collect", an SMS is sent to the Village user who submitted the request to indicate that collection will occur.

Figure 5: Administrator user screens



Administrator users can create, update, view, and delete villages, Village users, Employee users, and municipalities. An Administrator can see what items were collected and when they were collected. The Administrator can also see submitted items that still need to be collected and can alert the collecting entity.

Testing of app prototype

The researcher, who is a software developer by profession, asked colleagues to assist with the testing of the app, to ensure that it worked as required. The testing, as seen in the results in Table 3, was successful. The app was then shown to the Chief of Mantunzeleni village, as a way of reporting back on the progress made. The Chief stated that, during a community meeting, he would notify his subjects of the outcomes of the study. The Chief of Mpeta village was not available when the researcher went there to showcase the app.

Table 3: Test results

Test ID	Test case	Expected result	Result
1	Village user registers	Village user registered	successful
2	Village user logs in	Village user can log in	successful
3	Village user submits e-waste item(s)	E-waste item(s) submitted	successful
4	Village user receives SMS upon submitting items	Confirmation SMS received	successful
5	Employee user receives SMS to collect	Employee SMS for collection received	successful
6	Employee marks collection	Collection marked	successful
7	Village user receives SMS that e-waste item(s) have arrived in the collection centre	Confirmation SMS received by Village user	successful
8	Admin (Administrator user) creates Employees/collection centres/villages/categories/municipalities	Employees/collection centres/villages/categories/municipalities created	successful
9	Admin edits Employees/collection centres/villages/categories/municipalities	Employees/collection centres/villages/categories/municipalities edited	successful
10	Admin deletes an Employee/collection centre/village/category/municipality	Employee/collection centre/village/category/municipality deleted	successful
11	Admin views Employees/collection centres/villages/categories/municipalities in the system	Admin viewed Employees/collection centres/villages/categories/municipalities in the system	successful
12	Admin deletes user	User deleted	successful
13	Admin receives SMS if threshold of items is reached	SMS received	successful

Test ID	Test case	Expected result	Result
14	Admin views list of collected e-waste items	Admin viewed list of collected e-waste items	successful
15	Admin views list of uncollected e-waste items	Admin viewed list of uncollected e-waste items	successful
16	Village user receives SMS about e-waste awareness twice a month	SMS about e-waste awareness received by registered Village users	successful
17	Village user logs out of the system	Village user logged out	successful
18	Employee user logs out of the system	Employee user logged out	successful
19	Admin logs out of the system	Admin logged out	successful

6. Conclusions

The aims of this study were to engage a group of 26 residents from two South African rural communities to (1) determine current e-waste management practices in the two rural South African villages studied; and (2) facilitate a co-design process for a cloud-based mobile app that can improve e-waste management. The study participants, upon being made aware of the phenomenon of e-waste and its potential to generate harmful environmental and health impacts, pointed to widespread unsafe e-waste disposal practices in their communities. The participants also expressed an interest in ensuring e-waste awareness in their communities and welcomed the opportunity to work with the researchers to co-design a prototype mobile app to facilitate the safe disposal of such waste.

It is hoped that, if the app can be adopted by the local municipality, the study participants—the target communities—will find that the app directly suits their needs, and they will also feel a sense of ownership of the app because of the co-design process. Indeed, the study participants voiced happiness with the app that they had designed, assuring the researchers that they will be happy to use it once it goes through the necessary approvals. The study also found that the participants were grateful for the education and awareness that they had gained from the study. This study contributes to the body of knowledge on the use of mobile apps for the purposes of community-driven management of local environmental matters, and it also contributes to exploration of the role of co-design in the development of community-driven solutions to environmental problems.

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Data availability
The ethical clearance granted was on the basis that the data collected would be accessible only to the researchers. With provision subject to secondary ethical clearance, the data can requested, in writing, from the corresponding author, Odwa Gazana, at odwakazila6@gmail.com

AI declaration
AI tools were not used in the process of the study.

Authors' contributions
O.G.: Conceptualisation, methodology, data collection, sample analysis, data analysis, validation, data curation, writing – the initial draft; writing – revisions, project management and funding acquisition.
T.G.N.: Methodology, writing – revisions, student supervision, project leadership, project management and funding acquisition.
Both authors read and approved the final manuscript.

Competing interests
The authors have no competing interests to declare.

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Appendix 1: FGD questionnaire

Introduction

Thank you very much for attending. Let us start by getting to know each other, with just a brief introduction, like your name, surname and your village.

Questions

Do you know what e-waste is?

Can you define e-waste in your own words?

Are there any dedicated places for the village people to throw e-waste?

If yes, where are they?

If no, where do you throw it?

Anything else to add?

List the different categories of e-waste you have at home.

How can e-waste affect your health?

How can it affect children's health?

How can it affect the environment (river flows, vegetation, grazing land)?

What do you think should be done to help with e-waste handling?

If the municipality provided means for you to safely dispose of e-waste, would you make use of such a service?

Are you aware of any legislation that deals with e-waste disposal?

Do you own a smartphone or computer/laptop?

Do you know what is meant by the term internet?
Do you connect to the internet using your smartphone/computer/laptop?

Closing
This is the end. Let me thank you again for your input.

Appendix 2: Co-design post-it notes, in isiXhosa, on the whiteboard