

# INTEGRATING SUSTAINABLE E-WASTE MANAGEMENT INTO THE SCHOOL CURRICULUM: A RESPONSE TO LIMITED INSTITUTIONAL SUPPORT

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## Abstract

The growing demand for integrating technology into education has introduced effective teaching and learning strategies, aligning with the United Nations' Sustainable Development Agenda 2030. The intensifying digitalization of basic and higher education has accelerated the turnover of electronic devices, producing growing stocks of unused, obsolete and broken equipment at schools and education offices. Electronic devices used in education institutions are frequently replaced due to software and hardware upgrades or their short life span. This results in an increased intake of new devices without proper disposal of old or unused ones, leading to a rise in electronic waste (e-waste). A qualitative explanatory case approach was employed to gather data through individual interviews with asset managers or ICT teachers/specialists from four schools, three district offices and one provincial education department on how unused or broken electronic devices are managed or discarded in schools. Despite the health and environmental risks of unsound e-waste handling, findings revealed that there was no institutional plan for sustainable e-waste management. As a result, most institutions store devices for years or hire ad hoc private collectors. Furthermore, there was no support from other educational stakeholders to address this issue. This study showed how policy–practice gaps and resource asymmetries shape disposal behaviours. The implications are that the accumulation of e-waste and the use of unsustainable disposal methods will persist, leading to further challenges. This study therefore proposes a theoretical frame that combines Education for Sustainable Development (ESD) competencies, Institutional Theory (coercive/normative/mimetic pressures), and a Circular Economy/EPR (Extended Producer Responsibility) lens. We recommend (1) embedding e-waste across the curriculum (Grades R–12) with assessable competencies; (2) establishing provincial/district take-back arrangements aligned to South Africa's EPR Regulations; and (3) funded support for under-resourced schools to avoid environmental harm.

**Keywords:** *Education for Sustainable Development (ESD), e-waste, institutional support, management strategies, school curriculum.*

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## 1. Introduction

The fast integration of information and communication technologies (ICTs) into education has transformed teaching and learning worldwide. Laptops, tablets, interactive whiteboards, and projectors are increasingly viewed as critical tools for improving learner engagement and equipping young people to participate in knowledge-based economies. This transition involves not only replacing traditional teaching techniques but also improving the educational experience by making it more accessible, engaging, and personalised (Hemajothi & Kumar Jain, 2022; Kumbo et al., 2023; Murcia et al., 2018). However, technological advancement, upgrading, and increased demand for electrical and electronic equipment (EEE) have contributed to a decrease in the average life cycles of new computers, resulting in a significant reduction in their lifespan (Perkins et al., 2014; Moyo et al., 2020; Ichikowitz and Hattingh, 2020), resulting in uncontrollable electronic waste. Electronic waste includes a wide range of electrical or electronic equipment that has reached the end of its useful life (i.e., is obsolete) and is no longer required by its owners (Moyo et al., 2020). It is one of the world's fastest-growing waste sources, driven by increased digitalisation and shorter gadget lifecycles. 44.7 million tonnes (Mt) of e-waste were generated globally by 2016 and climbed significantly to 53.3 Mt in 2019, translating to an average of 7.3 kg per capita (Forti et al., 2020). This growth is expected to reach a high level of 74.7 Mt (three to four percent growth each year) by 2050 (Forti et al., 2020; Ichikowitz and Hattingh, 2020), unless interventions are implemented to slow it. This means that e-waste has nearly tripled the rate of municipal solid trash worldwide (Samarakoon, 2014; Ichikowitz & Hattingh, 2020).

E-waste is acknowledged as a resource due to the possible recovery of precious materials such as iron, aluminium, copper, gold, silver, platinum, palladium, and rare metals from the periodic table's 69 elements (Heacock et al., 2016; Torres et al., 2016; Forti et al., 2020). However, it poses considerable environmental and public health risks due to its complex composition, which includes toxic compounds such as lead, mercury, and brominated flame retardants (Forti et al., 2020). Some governments strive to regulate e-waste. South Africa, for example, has implemented Extended Producer Responsibility (EPR) regulations under the National Environmental Management: Waste Act (NEM:WA) to require electrical and electronic equipment (EEE) manufacturers to fund collection and environmentally sound management (EPR Regulations, 2020, as amended 2021). Despite increased policy attention to sustainability and waste management, many schools, particularly those in historically disadvantaged and resource-constrained communities, lack the institutional support required to successfully integrate e-waste education into daily instruction.

Schools have a dual role in the e-waste challenge. On the one hand, they contribute to e-waste development through regular technological upgrades prompted by curriculum reforms, digital learning initiatives, and legislative demands. On the other hand, schools have an important role in influencing students' environmental awareness, beliefs, and behaviours. Rapid device turnover due to software/hardware obsolescence and digitisation imperatives exacerbates the situation of e-waste in schools. These institutions require institutional support such as leadership commitment, curriculum guidance, professional development, infrastructure for safe storage and disposal, and collaborations with accredited recyclers (Fullan, 2016).

Integrating sustainable e-waste management into the school curriculum provides a strategic opportunity to solve environmental issues while also improving educational goals such as citizenship, sustainability, and systems thinking. This achieves the Education for Sustainable Development goal of empowering learners to make educated decisions and behave responsibly for environmental integrity, economic viability, and a just society for current and future generations (UNESCO, 2017). This allows them to build information, skills, beliefs, and attitudes that will help them maintain long-term solutions to issues affecting their education and lives. This paper addresses this gap by investigating how sustainable e-waste management might be included into the school curriculum in environments with inadequate institutional support. The study focuses on South African schools and addresses the following research question:

*How can sustainable e-waste management be integrated into the school curriculum in contexts with limited institutional support?*

## 2. Methodology

A qualitative, explanatory case study approach was used to investigate how schools and education offices manage e-waste under present constraints. An explanatory case study is used to address a question about the hypothesised causal relationships in real-life interventions that are too complicated for survey or experimental methods (Yin, 2003). People who have faced issues related to e-waste management in schools can provide a more detailed explanation. Eight participants (asset managers or ICT teachers/specialists) were purposefully selected from four public township schools in underserved areas, three district offices where the sampled schools were located, and one education provincial office that served both the sampled schools and the district offices. Schools that provide either computer application technology (CAT), information technology (IT), or both topics were chosen because they have more technical tools than other schools. Two of the schools (A and B) were public and funded by the Department of Education, while the other two (C and D) were privately owned. One of the schools, B, is an ICT school of specialisation, with the majority of students taking IT and CAT. They sampled to determine how they disposed of their e-waste and the type of support they received. The district and provincial offices were sampled to determine their role in assisting schools in dealing with e-waste. Semi-structured risk displacement, concerns about data security, potential health risks, and perceived restrictions. Transcripts from interviews were coded to generate inductive themes. Institutional permits were secured; informed consent was gained; institutions and people were anonymised; no photos of serial numbers were captured; and a safety note was recorded where e waste burial was mentioned. Teachers were coded based on their schools.

## 3. Results

### 3.1. Inventory status

Table 1 below tabulates the number of digital resources that were available at the sample's schools.

Table 1.

| School                | Number of usable technological resources | Type of technological gadgets                                |
|-----------------------|------------------------------------------|--------------------------------------------------------------|
| School A (public)     | 150                                      | Desktop computers and Laptops, 3 printers, 5 data projectors |
| School B (public ICT) | 1600                                     | Photocopier machines, projectors, Teacher laptops, desktops  |
| School C (private)    | 118                                      | 100 desktops , 2 projectors, 10 laptops, 5 printers.         |
| School C (private)    | 43                                       | 40 computers, 3 photocopying machines                        |

### 3.2. Awareness of policy

Findings indicated that there is no institutional plan across levels. Participants reported absence of formal plans at school, district, and provincial levels for sustainable e-waste management. District/provincial offices indicated that when their e-waste is removed, accredited companies transport to a central warehouse/facility, but schools are *not* included in that pipeline. Staff were unaware of any education-sector guidelines or standard operating procedures. For example, School B: School B teacher indicated that he was not aware of any policy guiding e-waste management. He said: “No, we don't have such a policy”. District and provincial officials did not seem to know how they could assist schools.

### 3.3. Disposal practices of technological devices that are no longer in use

From the findings, public schools stored obsolete/broken devices for years due to perceived legal/liability barriers and lack of budget for removal, while private schools took their e-waste to formal recyclers or where they initially bought gadgets. **Teacher B** indicated that they didn't have a system in place for technological devices used for teaching on how to dispose unused technological devices. He indicated that they stored everything unused in a certain room, and some teachers kept their old and broken laptops in their offices. His response was: “*They just remain there. Then it's a matter of maybe we'll recycle them somehow or someone just takes them and put them somewhere in their office or something of that nature*”. His frustration was that unused gadgets were piling and even though they were told that there will be arrangements to collect them and take them for recycling, this was not done for almost three years, causing storage challenges as other equipment broke or became outdated. However, since the school for **Teacher B** is an ICT school, he indicated that they are required to give an account of every gadget provided by the department of education, broken or in good condition. As a result, learner devices are always retrieved every year that is at the end of the year. So he supposed that suppliers took learners' devices every year in order to upgrade them somehow, while they are given new upgrade learner gadgets every year. Nevertheless, where schools made a plan to get rid of e-waste, this information was not accessible to the person allocated the responsibility of technology gadgets asset manager. When asked why they didn't take broken gadgets for recycling the teacher indicated that he does not make that decision, but he was never consulted about decision made. His response was: “*I remember last year we had a bunch of computers in the computer that I'm currently using. I'm not sure how they dispose those. They're very old computers and they were not working. So I'm not 100% sure what they actually did with those computers*”.

Private schools did not have challenges with storage since they solved their e-waste challenges. **Teacher B** indicated that they didn't have a system in place for technological devices used for teaching on how to dispose unused technological devices. He indicated that they stored everything unused in a certain room, and some teachers kept their old and broken laptops in their offices. His response was: “*They just remain there. So otherwise then, yeah, they just remain there. Or otherwise then it's a matter of maybe we'll recycle them somehow or someone just takes them and put them somewhere in their office or something of that nature*”. His frustration was that unused gadgets were piling and even though they were told that there will be arrangements to collect them and take them for recycling, this was not done for almost three years, causing storage challenges as other equipments broke or became outdated.

### 3.4. Risk displacement, data security anxieties and possible health hazards

One of the fears that led to prolonged storage of technological devices was data breaches from discarded devices which led them to retaining technological equipment in schools indefinitely—compounding storage hazards. Using classrooms as storages because of lack of storage rooms was also a source of concern. The challenge with storing e waste affected the other activities in the school and presented a potential health hazard for teachers and learners. **In school A**, the teacher mentioned that it would assist if he knew what to do with e-waste on time, because they present a challenge of space.

His response was: *“Really, though, we don’t have space for them. Because for instance, those devices that I was speaking about that were disposed last year, they had been there for quite some time and no one really actually knew what to do with them. Some teachers were actually using the classroom to teach so it was it was that the challenge of storage”*. This practice conflict with health guidance on toxic constituents and exposure pathways. Additionally, in communities where crime is rife, when unused technological gadgets are stored at school, they may attract thieves. **Teacher B**’s response was: *“if we keep them for too long, they end up being damaged or they end up being vandalized. If unused gadgets are just sitting there, they end up attracting thieves”*.

### 3.5. Perceived barriers

The lack of guidelines frustrated both schoolteachers and district officials which implied that schools had to continue with their struggles of lack of storage and exposure to hazards from e-waste. **Teacher A** indicated that he was not aware of the role of the district /provincial office regarding e-waste accumulating at their school, but indicated that perhaps school managers knew since there would be removal of old and unused gadgets at certain times-although he was not aware of the procedures followed, despite his allocated duties as an ICT asset manager at the school. He also indicated that he didn’t ask what happened with the e-waste. For private schools, electronic waste was costly for them since they didn’t receive any assistance from the department of Education. **Teacher C** indicated that the challenge in their school was the frequent upgrading of softwares, which is costly for them since they are not funded by the department of Education. He said: *“The technology that changes every two, three years. We have that challenge because we find that we purchase computers, then they tell us after two or three years, the windows change. Like for 2025, they said as of October, Windows 10 is no longer going to operate, and now we are faced with a serious challenge where we must make sure all the computers have Windows 11. And also pertaining to the upgrades of those desktops, we need to upgrade all of them so that they can be able to use Windows 11. It affects the school financially because we have to make sure every desktop is up to date, and then it works on Windows 11”*.

## 4. Conclusion and recommendations

The schools sampled for this study had adequate technology resources and required a competent e-waste management plan. This study identified deficiencies in e-waste management in schools, with no assistance from district and provincial offices. Private schools that did not receive funds from the department of education did not have to account to anyone or ask for authorisation to dispose of their e-waste, therefore they got rid of it sooner than public schools. Despite a national EPR framework, schools suffer a support gap: without sector-specific guidance, operational arrangements, and equity-minded financing, they rely on storage. While the curriculum and assessment policy statement (CAPS) might include e-waste management into the curriculum, this is not the case, and schools are not prepared to do so. There does not appear to be a solution for e-waste management in the near future, nor is there any intervention or preventive strategy that could benefit all schools simultaneously. Embedding ESD-aligned e trash education and developing producer-funded collection routes can help to reduce the policy-practice gap, safeguard health, and model circularity for future decision-makers. As a result, this study suggests that schools adopt and monitor e-waste management policies and system activities. A longitudinal follow-up study should also be conducted (three years after the guidelines are implemented) to assess changes in stocks, procedures, and health/safety issues. This can be accomplished using a theoretical framework that blends ESD competences, Institutional Theory (coercive/normative/mimetic pressures), and a Circular Economy/EPR perspective. E-waste management should also be integrated into the curriculum (Grades R-12) with assessable competencies, and the province/district should ensure that the South African EPR Regulations are applied and monitored in schools. Furthermore, to avoid environmental damage, under-resourced schools should receive subsidised support.

## References

- Extended Producer Responsibility (EPR) Regulations (2020). *Government Notice R.118 in Government Gazette 43879* (published on November 5, 2020).
- Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). *The Global E-Waste Monitor 2020: Quantities, Flows, and the Circular Economy Potential*. Vienna, Austria: United Nations University. Retrieved from [http://ewastemonitor.info/wp-content/uploads/2020/07/GEM\\_2020\\_def\\_july1\\_low.pdf](http://ewastemonitor.info/wp-content/uploads/2020/07/GEM_2020_def_july1_low.pdf)
- Fullan, M. (2016). *The new meaning of educational change* (5th ed.). Teachers College Press.

- Heacock, M., Kelly, C. B., Asante, K. A., Birnbaum, L. S., Bergman, A. L.,... Suk, W. A. (2016). E-waste and harm to vulnerable populations: a growing global problem. *Environmental Health Perspectives*, 124(5), 550-555. <https://doi.org/10.1289/ehp.1509699>
- Hemajothi, S., & Kumar Jain, S. (2022). Challenges of e-learning during the pandemic and its implications in education. *Technoarete Transactions on Applications of Information and Communication Technology (ICT) in Education*, 1, 1–6. doi: 10.36647/TTAICTE/01.04.A001
- Ichikowitz, R., & Hattingh, T. S. (2020). Consumer E-waste Recycling in South Africa. *South African Journal of Industrial Engineering*, 31(3), Special Editon, 44-57. <https://doi.org/10.7166/31-3-2416>
- Kumbo, L., Mero, R. F., & Hayuma, B. J. (2023). Navigating the digital frontier: innovative pedagogies for effective technology integration in education. *Journal of Informatics*, 3, 14–33. doi: 10.59645/tji.v3i1.142
- Moyo, T. P., Lubbe, S., Klopper, R., & Meyer, J. (2020). The Development of a Framework for Green Information Technology Implementation in South African Organisations. *Alternation Special Edition*, 25, 125-175. <https://doi.org/10.29086/2519-5476/2019/sp25.3a7>
- Murcia, K., Campbell, C., & Aranda, G. (2018). Trends in early childhood education practice and professional learning with digital technologies. *Pedagogika*, 68, 235–250. doi: 10.14712/23362189.2018.858
- Perkins, D. N. Drisse, M. N. B., Nxele, T., & Sly. P. D. (2014). E-Waste: A global hazard. *Annals of Global Health*, 80, 286-295.
- Samarakoon, M. B. (2014). A Review of Electrical and Electronic Waste Management in Sri Lanka. *International Conference of Chemical, Civil and Environmental Engineering (CCEE'2014)*, Nov 18-19. Singapore.
- Torres, D., Guzman, S., Kuehr, R., Magalini, F., Devia, L., Cueva, A., Basiniani, I. V. (2016). Sustainable management of waste electrical and electronic equipment in Latin America. Retrieved 10 January 2023, from [https://www.unclearn.org/wpcontent/uploads/library/integrated\\_weee\\_management\\_and\\_disposal-395429-nor mal-e.pdf](https://www.unclearn.org/wpcontent/uploads/library/integrated_weee_management_and_disposal-395429-nor mal-e.pdf)
- UNESCO. (2017). *Education for Sustainable Development Goals: Learning Objectives*. UNESCO. <https://doi.org/10.54675/CGBA9153>
- Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: Sage.