ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

STUDENTS' EXPERIENCES WITH E-WASTE AND SUSTAINABLE DIGITAL PRACTICES: A THEMATIC ANALYSIS

** Trupti Matele & **Prof. Sunita Magre*

** Research Scholar & **Research Guide, Department of Education, University of Mumbai .*

Abstract:

The rapid integration of digital technologies in educational contexts has resulted in unprecedented benefits for students but has also raised pressing concerns about electronic waste (e-waste) and sustainable digital practices. This study explores trainee teachers' awareness, perceptions, and practices regarding the disposal of electronic devices, updating and maintaining digital infrastructure, and adopting environmentally responsible behaviors in technology use. Data were collected through open-ended survey questions administered to 25 trainee teachers. A thematic analysis approach was employed to identify recurring patterns in the responses, focusing particularly on issues of device disposal, software updates, and app installation practices. Three overarching themes emerged: (i) Awareness of Environmental and Digital Risks, (ii) Responsible and Sustainable Digital Practices, and (iii) Emergent Gaps in Digital Citizenship and Sustainability Awareness. Word cloud visualizations and code-theme matrices were used to illustrate participant responses. The findings indicate that while many students recognize the importance of secure and sustainable digital behaviors, gaps persist in structured knowledge and systematic e-waste management practices. The study highlights the need to integrate sustainability-oriented digital literacy modules within teacher education curricula to cultivate environmentally conscious digital citizens.

Keywords: *E-Waste, Digital Sustainability, Trainee Teachers, Thematic Analysis, Digital Citizenship*.

Introduction:

The integration of digital technologies into education has transformed the ways in which students and teachers engage with learning, communication, and professional development. Mobile devices, laptops, and online platforms have become indispensable, offering access to a wide range of information and resources. However, alongside these benefits, a less-discussed yet pressing issue has emerged **electronic waste (e-waste)**. With rapid technological advancements, shorter device lifespans, and frequent software updates, educational institutions and individuals alike face mounting challenges related to the disposal and responsible management of digital tools.

Globally, the e-waste problem has been recognized as one of the fastest-growing waste streams (Forti et al., 2020). The Global E-waste Monitor 2020 reported that approximately 53.6 million metric tonnes of e-waste were generated in 2019, with projections showing a steep increase in subsequent years. Developing countries, including India, are disproportionately affected due to limited infrastructure for e-waste collection and recycling (Gupta & Sinha, 2021). The environmental consequences of improper e-waste disposal such as soil contamination, toxic emissions, and water pollution pose significant threats not only to ecosystems but also to human health (Kahhat & Williams, 2019). Within this context, the role of digital sustainability and responsible digital practices becomes crucial.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

In the Indian context, digital inclusion has expanded rapidly, particularly in education, where digital tools are now integral to teaching and learning. While this transformation has brought opportunities, it has also amplified the sustainability paradox of increased reliance on digital devices leading to environmental burdens (Chaturvedi & Singh, 2022). Students, especially trainee teachers, are positioned at the forefront of this paradox. As future educators, their awareness and practices regarding e-waste management and digital responsibility hold implications not only for themselves but also for the values they impart to future generations of learners.

Existing literature has largely focused on digital citizenship, online safety, and responsible use of technology (Ribble, 2015; Livingstone, 2016). However, sustainable digital practices, including awareness of e-waste and environmentally conscious use of digital devices, remain underexplored particularly within teacher education programs in India. Few studies explicitly examine how trainee teachers perceive and practice sustainability in their digital lives, leaving a gap in understanding how digital literacy can be broadened to include environmental responsibility.

Addressing this gap, the present study investigates trainee teachers' experiences and practices related to e-waste management and sustainable digital behaviors. By analyzing open-ended responses to questions on device disposal, software updates, and safety measures in digital practices, the study aims to uncover not only levels of awareness but also the challenges and opportunities in embedding sustainability into digital citizenship education.

Research objectives:

1. To explore trainee teachers' awareness and practices regarding the disposal of electronic devices.
2. To examine their attitudes toward sustainable digital behaviors such as updating and maintaining devices.
3. To identify gaps in knowledge and practices that hinder environmentally responsible digital citizenship.

Through this analysis, the paper seeks to contribute to the discourse on digital sustainability in education by highlighting the need for structured interventions in teacher training programs.

Literature Review:

Digital Citizenship and Sustainability:

The concept of digital citizenship has been widely studied in educational contexts, emphasizing responsible, ethical, and informed participation in digital environments (Ribble, 2015). Initially framed around safety, etiquette, and literacy, the scope of digital citizenship has gradually expanded to include dimensions of digital well-being and sustainability (Jones & Mitchell, 2016). Scholars have argued that digital citizenship education must go beyond technical competencies to embed awareness of environmental impacts associated with digital technology use (Choi, 2018). This shift reflects a growing recognition that the digital world is not disconnected from the physical one; unsustainable digital behaviors such as frequent device replacement or improper disposal directly contribute to ecological degradation.

E-Waste: A Global and Local Concern:

E-waste has emerged as one of the fastest-growing global waste streams, with the United Nations reporting over 53 million metric tonnes generated in 2019, only 17.4% of which was officially documented as collected and recycled (Forti et al., 2020). Improper e-waste disposal leads to significant risks, including soil and groundwater contamination from heavy metals and toxic substances (Kahhat & Williams, 2019). In India, the problem is particularly acute. With rapid digitalization and mobile penetration, the country

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

generated an estimated 3.2 million metric tonnes of e-waste in 2020, ranking among the top five generators worldwide (Gupta & Sinha, 2021). Yet, recycling systems remain fragmented and heavily reliant on informal sectors, often lacking safe practices (Dwivedy & Mittal, 2019).

Awareness and Practices among Students:

Several studies suggest that young adults, including university students, are often aware of the environmental hazards of e-waste but lack consistent practices in disposal and recycling. Kumar (2017) found that while engineering students in India demonstrated high knowledge about e-waste toxicity, only a minority reported using formal recycling channels. Similarly, Awasthi and Li (2018) highlighted gaps in consumer behavior, where awareness does not necessarily translate into action due to convenience, lack of infrastructure, or limited knowledge of collection points. Research also shows that in educational settings, sustainability topics are often underrepresented in digital literacy and ICT curricula, leaving students with fragmented or incidental understanding of e-waste (Chaturvedi & Singh, 2022).

Sustainable Digital Practices:

Emerging scholarship emphasizes the role of sustainable digital practices; actions that minimize environmental impacts of technology use while maintaining efficiency and safety. Such practices include prolonging device lifespans through regular maintenance, responsibly updating software, using energy-efficient settings, and ensuring safe disposal (Balde et al., 2017). In higher education, sustainable digital practices are increasingly tied to the broader agenda of **Education for Sustainable Development (ESD)**, which integrates environmental responsibility into teaching and learning (UNESCO, 2020). Studies show that students and trainee teachers who are exposed to ESD frameworks are more likely to adopt eco-friendly behaviors, including responsible consumption and disposal of electronic devices (Leicht, Heiss, & Byun, 2018).

Teacher Education and Future Directions:

As future educators, trainee teachers play a critical role in shaping the digital citizenship of upcoming generations. Yet, research suggests a gap in teacher preparation programs regarding sustainability in digital contexts. Mishra and Koehler (2019) argue that while technological pedagogical content knowledge (TPACK) equips teachers to integrate technology into learning, sustainability remains an overlooked dimension. Incorporating sustainability into digital citizenship frameworks could empower teachers not only to model responsible practices but also to cultivate eco-consciousness among students. Addressing this gap requires targeted curricular interventions and institutional policies that position digital sustainability alongside ethics and safety as core pillars of teacher education.

The literature reveals that while digital citizenship has gained prominence in educational discourse, sustainable digital practices remain underexplored, particularly in the Indian context. E-waste management emerges as both a global challenge and a local urgency, yet educational responses are fragmented. Trainee teachers' practices and experiences present a unique opportunity to study how sustainability can be integrated into digital literacy and citizenship. This study addresses the gap by thematically analyzing responses from trainee teachers on e-waste disposal, device maintenance, and responsible use, offering insights into how sustainability can be positioned within digital education.

Methodology:

1. **Research Design**

   The present study employed a qualitative research design, specifically using thematic analysis, to explore trainee teachers' experiences and practices concerning e-waste management and sustainable

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

digital behaviors. A qualitative approach was deemed appropriate as it enables an in-depth understanding of participants' perspectives, values, and behaviors, which may not be fully captured through quantitative measures (Braun & Clarke, 2006). The focus was on capturing the nuanced ways in which trainee teachers conceptualize sustainability in the digital context and how their lived practices align or fail to align with sustainable digital citizenship.

2. Sample

The study was conducted with 25 trainee teachers enrolled in a teacher education program in India. The participants were selected using purposive sampling, as they represent a group directly engaged in both digital practices and future educational responsibilities. Their responses provide critical insights into how sustainability can be embedded within digital citizenship education. To preserve anonymity, participants' identities were coded numerically (e.g., P1, P2, P3, …, P25). This ensured confidentiality while enabling the tracing of quotes to specific responses.

3. Data Analysis and Interpretation

Data were collected through open-ended questionnaire responses directly relevant to e-waste and sustainability for this paper:

- **Q1**: *What steps do you take to properly dispose of old electronic devices to reduce their environmental impact?*
- **Q2**: *Why do you think it is important to regularly update the software and apps on your devices?*
- **Q3**: *What precautions do you take when installing new apps or extensions to ensure they are safe?*

These questions were designed to elicit reflections on device disposal, maintenance practices, and responsible technology use, all of which intersect with the broader concept of sustainable digital practices.

The data were analyzed using **thematic analysis** following the six-step framework of Braun and Clarke (2006):

1. **Familiarization with data**: reading and re-reading participant responses.
2. **Generating initial codes**: identifying meaningful words, phrases, and ideas.
3. **Searching for themes**: grouping related codes into subthemes and broader themes.
4. **Reviewing themes**: refining categories to ensure coherence and consistency.
5. **Defining and naming themes**: assigning descriptive titles to reflect the essence of each theme.
6. **Producing the report**: presenting findings through tables, word clouds, and narrative discussion.

To aid visualization, word clouds were generated to highlight the frequency of keywords within responses, while tables summarized codes, subthemes, and themes. This approach allowed both a descriptive and interpretive understanding of the data.

4. Trustworthiness of the Study

To ensure credibility, multiple strategies were adopted:

- **Triangulation**: Data were cross-checked across multiple questions to identify consistent patterns.
- **Peer review**: The analysis was reviewed by peers to minimize researcher bias in coding.
- **Thick description**: Direct quotations from participants were included in the results to represent authentic voices.
- **Audit trail**: Detailed records of coding and theme development were maintained for transparency.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

Results and Discussion:

The results of the thematic analysis are presented question by question. Each subsection contains:

1. **A table** (codes → subthemes → themes).
2. **A word cloud** showing the most frequent words.
3. **Interpretation**, where findings are explained with direct participant quotes.
4. A **thematic map** representing the overall findings

1. Thematic Analysis of Q1

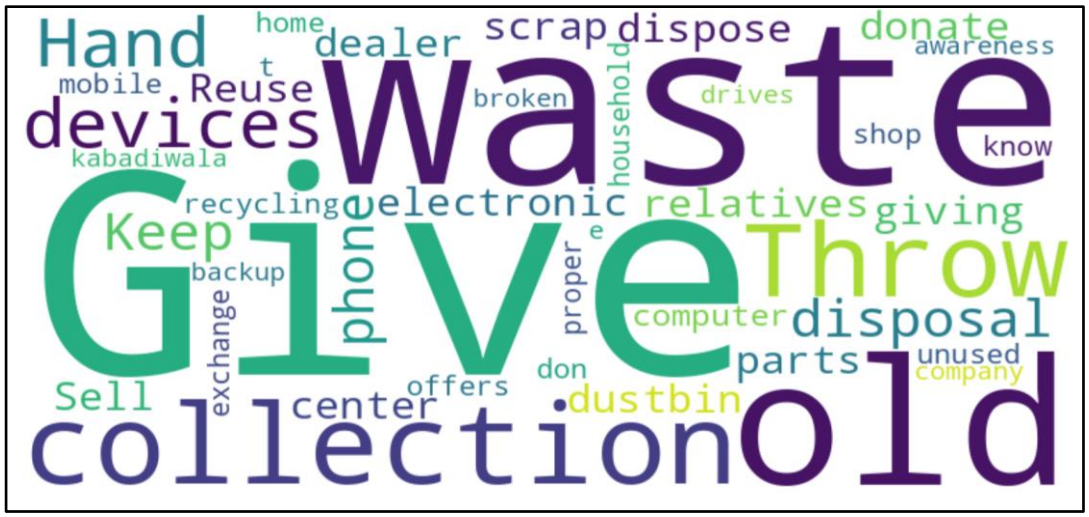
What steps do you take to properly dispose of old electronic devices to reduce their environmental impact?

Table 4.1 Thematic analysis of textual responses to Q1

Sl.	Codes	Subthemes	Themes
1	Give to scrap dealer	Recycling Practices	Sustainable E-Waste Management
2	Sell to shop	Recycling Practices	Sustainable E-Waste Management
3	Handover to company programs	Formal Recycling Initiatives	Sustainable E-Waste Management
4	Donation	Reuse & Extended Device Life	Sustainable E-Waste Management
5	Keep at home unused	Improper Storage	Unsustainable Practices
6	Throw away with household waste	Unsafe Disposal	Unsustainable Practices
7	No idea / don't bother	Lack of Awareness	Gaps in Sustainable Literacy

N = 25

Word Cloud for Q1



Interpretation:

The responses revealed two contrasting orientations. A majority of participants reported eco-friendly actions such as giving devices to scrap dealers (P3), selling them to local shops (P5), or donating for reuse (P11). These practices reflect emerging awareness of sustainability.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

However, a notable proportion admitted to improper storage or unsafe disposal, such as keeping devices unused at home (P8) or discarding them with household waste (P13). A few (P20, P22) openly admitted they had "no idea" how to dispose of e-waste, highlighting gaps in sustainable digital literacy.

This mixed response underscores the urgent need for structured awareness programs on e-waste disposal in teacher training institutions.

2. Thematic Analysis of Q2

Why do you think it is important to regularly update the software and apps on your devices?

Table 4.2 Thematic analysis of textual responses to Q2

Sl.	Codes	Subthemes	Themes
1	Security protection	Cybersecurity Awareness	Awareness of Digital Risks
2	Bug fixing	**Improved Functionality**	Responsible Digital Practices
3	New features	**Improved Functionality**	Responsible Digital Practices
4	Device runs smoothly	**Maintenance & Performance**	Responsible Digital Practices
5	Protect personal data	Cybersecurity Awareness	Awareness of Digital Risks
6	Never thought about it	Lack of Awareness	Gaps in Sustainable Literacy

N = 25

Word Cloud for Q2

Interpretation:

Most participants recognized updates as critical to cyber security, noting that updates protect personal data (P6) and shield devices from viruses (P15). Others valued improved functionality, highlighting bug fixes (P9) and new features (P18) as motivators for updates.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

However, a minority admitted indifference or ignorance (P20: *"I never thought it mattered"*), reflecting a gap in sustainable awareness. Regular updating is not just a technical matter but a sustainable practice, as it extends the useful life of devices, reducing the frequency of hardware replacement and thereby contributing indirectly to e-waste reduction.

3. Thematic Analysis of Q3

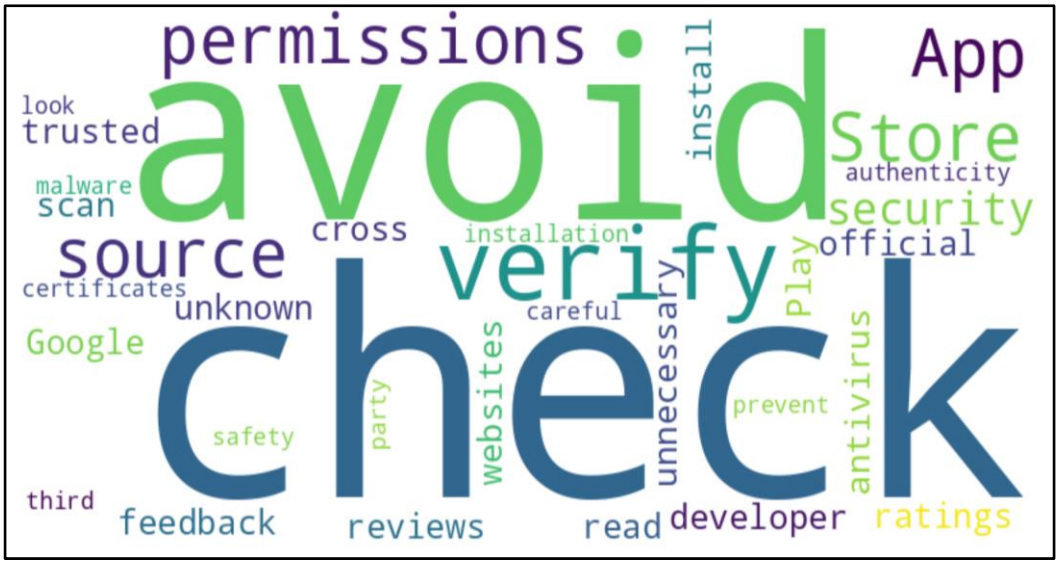
What precautions do you take when installing new apps or extensions to ensure they are safe?

Table 4.3 Thematic analysis of textual responses to Q3

Sl.	Codes	Subthemes	Themes
1	Check reviews	User Caution	Responsible Digital Practices
2	Verify permissions	Privacy Protection	Awareness of Digital Risks
3	Install from trusted sources	User Caution	Responsible Digital Practices
4	Antivirus scanning	Device Safety	Awareness of Digital Risks
5	No precautions	Lack of Awareness	Gaps in Sustainable Literacy

N = 25

Word Cloud for Q3



Interpretation:

Participants exhibited a generally responsible approach to app installation. Many checked reviews (P7), verified permissions (P10), or installed only from trusted sources (P2). A few even reported scanning with antivirus software (P12). These practices reflect an emerging habit of cautious and informed digital behavior, directly aligned with sustainability in digital citizenship.

Yet, some participants admitted to taking "no precautions" (P19, P22), underscoring persistent gaps. Careless installation not only compromises personal data and privacy but can also add to device damage and e-waste generation.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

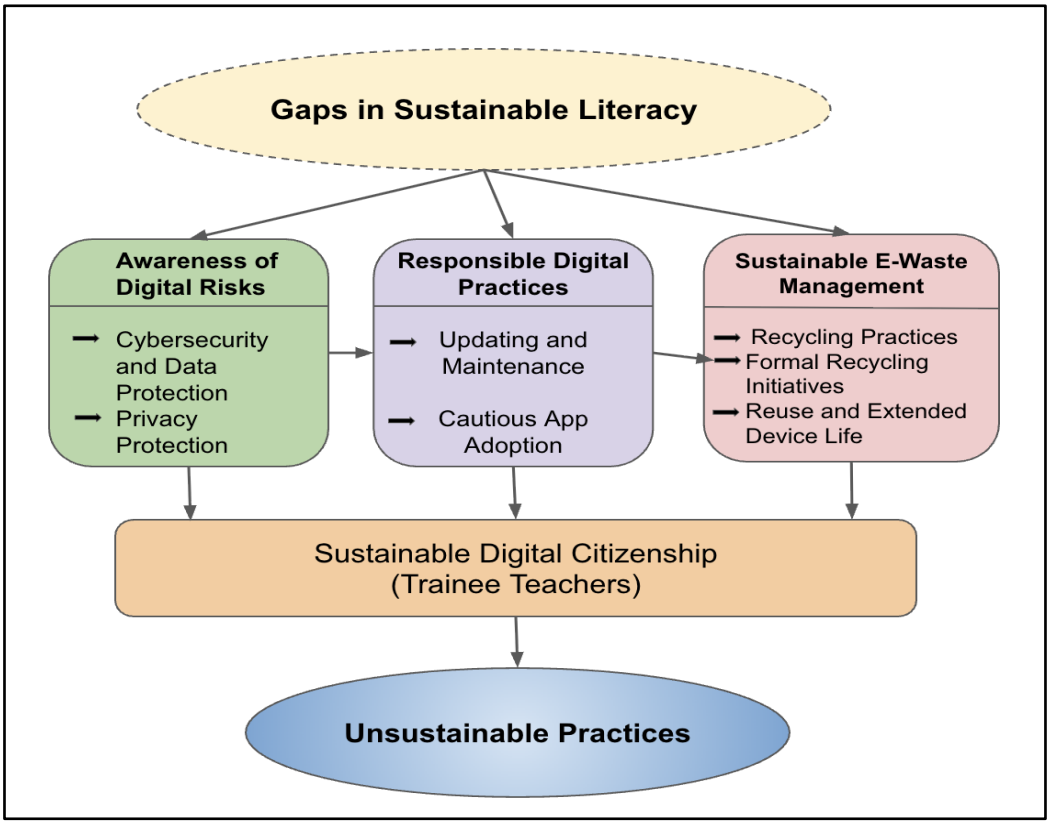
4. Consolidated Themes across the three questions:

The three questions collectively point to **three overarching themes**:

1. **Sustainable E-Waste Management** (recycling, donation, proper disposal).
2. **Awareness of Digital Risks** (security, privacy, protection).
3. **Responsible Digital Practices** (updating, careful installation, device maintenance).

A fourth theme, **Gaps in Sustainable Literacy**, emerged from responses indicating ignorance or lack of action. These findings emphasize that while many trainee teachers are developing sustainable digital practices, there remain significant gaps that need structured intervention in teacher education curricula.

5.Thematic map of trainee teachers' experiences with e-waste and sustainable digital practices.



Thematic map illustrating a developmental pathway toward sustainable digital citizenship.

This diagram illustrates the journey toward sustainable digital citizenship among trainee teachers. Their awareness of digital risks, commitment to responsible digital practices, and engagement with e-waste management all shape their digital behavior. However, when knowledge is lacking or habits are inconsistent, these areas reflect gaps in sustainable literacy limiting their potential impact. Bridging these gaps is essential for preparing educators who model and teach responsible digital habits.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

Conclusion and Reflection:

Conclusion:

The present study set out to explore *students' experiences with e-waste and sustainable digital practices* through qualitative thematic analysis of open-ended responses from trainee teachers. Three areas were examined: (i) practices of disposing of old devices (Q1), (ii) perceptions about updating software and applications (Q2), and (iii) precautions while installing new apps or extensions (Q3).

The findings revealed that students demonstrated diverse levels of awareness and practice. Many participants described eco-friendly disposal methods, such as recycling, donating, or returning devices through company programs. These responses suggest an emerging sense of responsibility toward sustainable e-waste management. However, unsafe practices such as discarding devices with household waste or storing them indefinitely at home also surfaced, indicating persistent gaps in knowledge.

In relation to software updates, participants recognized their importance primarily for cybersecurity and device performance. Updates were perceived as essential to protect personal data, fix bugs, and prolong device life thus indirectly reducing e-waste. Similarly, in app installation practices, most students expressed caution, reporting checks of reviews, permissions, and trusted sources, though a few admitted neglecting precautions altogether.

In all, the study identified three major themes: *Sustainable E-Waste Management, Awareness of Digital Risks, and Responsible Digital Practices* alongside a fourth cross-cutting theme of *Gaps in Sustainable Literacy*. These gaps demonstrate that while teacher trainees are beginning to adopt responsible digital behaviors, systematic and structured interventions remain necessary to make these practices consistent and effective.

Overall, this research underscores the interconnectedness of sustainability, digital safety, and responsible citizenship. It highlights the critical role of teacher education in embedding not only technical skills but also ethical and environmental awareness into future digital citizens.

Final Reflection:

The study concludes that while awareness and positive intentions exist, they are not yet translated into consistent sustainable digital practices among students. The findings contribute to an emerging but crucial discourse in the Indian context, where digital expansion and sustainability must go hand in hand. By equipping teacher trainees with knowledge and responsibility today, institutions can help build a future generation of educators who will model and promote eco-friendly digital citizenship in schools and beyond.

References:

1. *Aithal, A., & Aithal, P. S. (2016). Impact of digital technology on education system: A study of digital citizenship in higher education. International Journal of Management, IT & Engineering, 6(1), 102–113*
2. *Borthakur, A., & Govind, M. (2017). Public understandings of e-waste and its disposal in urban India: From a review towards a conceptual framework. Journal of Cleaner Production, 113, 509–520. https://doi.org/10.1016/j.jclepro.2015.11.076*
3. *Chatterjee, S., & Kumar, K. (2020). Sustainable e-waste management in developing countries: A study of Indian e-waste recycling systems. Waste Management & Research, 38(5), 499–508. https://doi.org/10.1177/0734242X20904643*
4. *Chaturvedi, R., & Gupta, R. (2021). Digital citizenship and sustainable development: An Indian perspective. Journal of Education and Human Development, 10(2), 43–52. https://doi.org/10.15640/jehd.v10n2a5*

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Issues– IV July – August, 2025

OPEN ACCESS Original Research Article

5. *Kumar, A., & Holuszko, M. (2016). Electronic waste management in India: A review. Science of the Total Environment, 566–567, 1443–1452. https://doi.org/10.1016/j.scitotenv.2016.05.069*
6. *Livingstone, S., & Third, A. (2017). Children and young people's rights in the digital age: An emerging agenda. New Media & Society, 19(5), 657–670. https://doi.org/10.1177/1461444816686318*
7. *Mishra, R., & Singh, S. (2019). Awareness and practices of digital citizenship among teacher trainees in India. International Journal of Education and Development, 7(3), 81–90.*
8. *Nair, S., & Menon, S. (2018). Sustainable digital literacy: A pathway for environmental responsibility. Asian Journal of Sustainability and Social Responsibility, 3(12), 1–13. https://doi.org/10.1186/s41180-018-0028-9*
9. *Ravi, V., & Shankar, R. (2015). E-waste management in India: Issues and challenges. International Journal of Environment and Waste Management, 16(2), 105–120. https://doi.org/10.1504/IJEWM.2015.069624*
10. *UNESCO. (2019). Digital citizenship education: Overview and trends. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000370638*
11. *Wath, S. B., Vaidya, A. N., Dutt, P. S., & Chakrabarti, T. (2016). A roadmap for development of sustainable e-waste management system in India. Science of the Total Environment, 568, 22–33. https://doi.org/10.1016/j.scitotenv.2016.05.048*

Cite This Article:

Matele T. & Prof. Magre S. (2025). *Students' Experiences with E-Waste and Sustainable Digital Practices: A Thematic Analysis.* **In Aarhat Multidisciplinary International Education Research Journal**: Vol. XIV (Number III, pp. 50–59). ***Doi:*** ***https://doi.org/10.5281/zenodo.17193136***