Article No. 6

BENCHMARKING E-WASTE MANAGEMENT FOR QUALITY ACCREDITATION OF EDUCATIONAL INSTITUTION IN INDIA: A PROSPECTION

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Abstract:

Purpose. *Opportunities for higher education institutions, especially post the coronavirus pandemic, explored to address the growing concerns about electrical and electronic waste (e-Waste) management.*

Objective*. Transformation with a circular vision considered e-Waste as a resource for adding value to the environment and economy against quality educational for sustainability goals.*

Method*. The term frequencies analysis gauged the scope of the higher educational institution for e-Waste management, followed by key indicators of circular vision mapped against a set of quality criteria of a national quality accreditation agency.*

Result*. The role of higher education institutions was prospected to be significant for the economic transformation from linear e-waste disposal to circular resource creation.*

Keywords: *e-Waste, Circular Economy, Higher Education, Sustainable Development, Quality Accreditation*

Introduction

The rapid aggregation of electrical and electronics equipment (EEE) in education, mainly post the Coronavirus pandemic (Covid), led the author to investigate the future of education for sustainable development (ESD). A future where theend-of-life EEE (EoL EEE) e-Waste or waste EEE (WEEE) is taken care of appropriately.Therefore, it was essential to understand the impacts of EEE, ESD, WEEE, and how any higher educational institution (HEI) can embrace circular economy (CE) principles? Aside, the positive provocation was HEI's Covid-led rapid transformation from physical to wholly online education and later to blended education. A testimony that human agencies have the innate capacity and capability for overcoming demanding challenges. This investigation, thus, delved on how HEIs can play an essential role in the valuable and gainful management of WEEE?

The driver hypotheses of the investigation were H0: to establishthe scope for HEIs with a ESD focus on WEEE management, and H1: to claim a prospect for quality ESD outcomes by HEIs from agencies like National Assessment and Accreditation Council (NAAC). NAAC accreditation is considered sacrosanct for a HEI;besides, it also links the International Network of Quality Assurance Agencies in Higher Education, comprising 120 different national agencies engaged in assessment, accreditation, and academic audit. In this regard, the primary goals considered under the circular vision were, a) to minimize the extraction of new resources, maximize the lifecycle of products in use, b) maximize the ESD learning credits in university degree education, c) maximize the re-options (reuse, repair,

remanufacture, recycle, and repurpose) under start-ups and do-it-yourself (DIY) projects, maximize the extended producer responsibility (EPR) and extended warranties, and d) rationally regulate consumer behaviours that are appropriate for the management of WEEE and for realizing the ESD goals.

WEEE In Context of HEI

WEEE includes any electrically powered appliances like white goods, consumer and business electronics, and information technology hardware in EoL and majorly goes to landfills (Khurrum 2011).It was known that there were at least 900 types of EoL EEE products disposed of after the first use. The most prominent in the context of HEIs were smartphones, laptops, personal computers (PC), and peripherals. There has been a resurgence in PCs with a market value of over $215 billion in 2020, assuming about 295 million PCs this year, with an average selling price of $733 (Deloitte 2020).The overall market for online education could reach $350 billion by 2025 with the rapid growth and adoption of education technology (EdTech), which by 2019 had already reached US$18.66 billion.There has been a significant surge in EdTech usage since Covid (Lalani 2020; Li 2020). The rate of growth of digital production and consumption in India by 2030 could involve 840 million users with the availability of affordable bandwidth for internet access to various types of information, educational and entertainment content in vernacular languages using mobile phones (Kandri 2020; KPMG 2019; Live Mint 2020; Pew Research Centre 2020).

Borrowing from the several cited studies here, the worldwide growth of the EdTech industry would significantly contribute to WEEE given the rapid obsolescence of EdTech and itsplanned obsolescence. Planned obsolescence is a business model for creating forced demand for new products. For instance, many proprietary software systems are designed to fail and planned for an early EoL of computer products.Besides, global agencies like the International Telecommunication Union (ITU), the International Labour Organization (ILO), the United Nations Environment Programme (UNEP), and other members like World Business Council for Sustainable Development (WEF 2020), have concluded that the demand for electronic devices would create the world's fastest-growing waste stream with 50 million tonnes of annual e-waste. If left unchecked, the estimated e-wastes could amount to 120 million tonnes by 2050. The United Nations calls this a tsunami of e-waste. However, such a massive problem can also offer a plethora of opportunities for emerging economies with improved WEEE management under a circular vision. With more than 1000 different substances, many of them hazardous, WEEE is one of the most environmentally unfriendly waste streams (Shevchenko et al. 2019; Perkins et al. 2014).

Circular Vision in the context of HEI

According to Ellen MacArthur Foundation, European Environmental Agency, and various insights from a systematic review of the literature (Kirchherr & Piscicelli 2019; Kopnina 2018; Arruda et al. 2021) on Circular Economy (CE)the need for CE was established. It was about rebuilding the natural and social capital in which resources are to be kept in more prolonged use as possible, improving the entire conditions for sustainable development. Therefore, a CE would necessitate the mitigation of unjustified demand for new resources with built-to-last business models, thereby handling the environmental pressures within the safe limits. That way, the linear economy mindsets like make-take-dispose and built-to-fail mindsets of producers and consumers shall change in favour of CE.

The reason why HEIs, especially in the post-Covid situation of blended learning,could start afresh with a new quality perspective that would integrate CE perspectives. Based on the study of other literature (Bhat & Patil 2021, Kopina 2017, Salas et al. 2021, Sharma & Madsen 2021), it was aptly clear that a Cradle (resource) to Cradle will be the need of the hour and not the prevalent Cradle to Grave (landfill) approach. In this regard, HEIs could educate on employing approaches like regenerative design (where the output of a system can be the input for another), biomimicry (mimicking the self-organizing solution systems of nature), performance economy (product-life extension and sharing economy), industrial ecology (resources use in closed-loop industrial systems for overall social wellbeing), and natural systems (shift to organic production with zero-waste). Those can be an integral part of ESD where HEI participants can involve themselves with higher-order thinking on WEEE problem solving and find practicalsolutions to strengthen the cause of CE.

Furthermore, in the realm of the National Education Policy 2020 (NEP) of India, HEIs and EdTech would have lot of common ground for meaningful partnerships. One compelling argument in favourwill bethe NEP mandate achieving a gross enrolment ratio (GER) of 50 percent by 2030 from the 2019-20 GER estimate of 27.1 percent (according to the All-India Survey on Higher Education report). Largely because of that, the EdTech industry is poised to become $30 billion by 2030 (Chandrasekaran 2021). In this situation, HEIs and the EdTech industry,expectedly, would co-create new types ofbusiness models supported under conducive government policies, including incentives forEdTech businessand HEIs with desired ESD outcomes on WEEE. Such business models, thereby, would support the dematerialization goals(employing technologies like cloud and internet of things) and counter theplanned obsolescence.

Method

A word cloud using a free text mining software (available at voyant-tools.org) broadly gauged the extent of circular activities in the realm of blended education (Table 1). For that purpose, the terms related to the EEE category of Information Technology and Telecommunication Equipment (CPCB 2016) were used. The visual output was obtained (Figure 1), which indicated that the re-options were not prominent. It led to deeper analysis using thesoftware mentioned above, which used Pearson's correlation coefficient or simple regression to find out how terms frequencies correlated. Scores approaching 1 meant that term frequencies varied in sync (rise and drop together), -1 meant term frequencies varied inversely, and 0 meant no meaningful correlation. At the same time, significance, measuredthe significance to correlation value, where =>0.5 indicated a strong correlation.

Table 1: EEE Terms (in the context of higher education)for word cloud and analysis

Information Technology and Telecommunication Equipment – EEE Terms and Codes	
Related EEE Codes (average life in years)	ITEW2 (6), ITEW3 (5), ITEW4 (5), ITEW6 (10), ITEW7 (8), ITEW15 (5)
Terms analysed using a text mining software	

Information Technology, Education Technology, Laptop, Desktop, Mobile, Smartphone, Zoom, Microsoft teams, Google Meet, WebEx, Router, Wireless, Repair, Reuse, Remanufacture, Recycle, Digital, Electronic waste, Landfill, CDROM, DVD, Pen drive, Hard disk, Earphone, Headset, Obsolescence, Printer, Pager, Scanner, Telephone, Cordless phone, Half-life, Semiconductors, Microchips, SIM cards, Memory cards, Cables, Charger, Battery, Connectors, Analog, Resale, Haves, Have-nots, Literacy, Poverty, Education, Digital literacy, Online education, Offline education, Blended education, Ubiquitous, Liberal education, Experiential, Creative, Holistic, Insightful, Personalized learning, Physical spaces, Digital spaces, Generation Z, Industry 4.0, 5G, OTT, IoT, Cyber, Data Security, Data Privacy, Data Skills, AI, E-Commerce, E-Governance, Financial Technology, School Dropouts, College Dropouts, Adult Education, Youth, Unemployment, Mental health

Source: EEE Terms, Codes, Average life in years (CPCB 2016)

Moreover, with the term frequencies analysis (Table 2), it'sa strong correlation between [education; literacy] and [digital; literacy] was found. The re-options were not even listed, which indicated its weak term frequencies in the realm of education. That was also evident from Figure 1.

Figure 1: Word Cloud with Table 1 terms

The H0 was prominently established a significant scope for HEIs to employ re-options for EEE under a circular vision. Complimenting that, H1 theoretically claimed how a quality accreditation instrument like NAAC could motivate HEIs for effectuating the H0 (Table 3).

Table 2:Term frequencies analysis

Term 1	Term 2	Correlation	Significance
education	literacy	0.9263671	0.0001175
digital	literacy	0.50917506	0.13280109
dropouts	technology	0.36440545	0.3005488
digital	education	0.34916797	0.32270265
digital	spaces	0.2182179	0.5447373
dropouts	education	0.084215194	0.81708026

data	technology	-0.2195122	0.5422937
spaces	technology	-0.23426065	0.51476294
data	education	-0.27619627	0.4398389
cards	education	-0.29475316	0.40838525
cards	digital	-0.32732683	0.35588378

Source: analysis supported by voyant-tools.org

Table 3: Key EEE Circularity Indicators and Relative Weightages under NAAC Criteria

NAAC Criterion	Key EEE Circularity Indicators	WT[A]	WO[B]
Curricular Aspects	ESD– at Under-Graduate and Post Graduate Levels mapped under Program's Outcome-Based Education	0.1	0.2
Teaching-Learning and Evaluation	Solving Resource Challenges – Reducing Waste Streams; Saving Resources; Avoiding Energy Production and Raw Material Extraction; Increasing the lifespan of Products, Reducing Need for New Resources, Value addition of old products, Circular Economy Literacy-Continuous flow of biological and technical materials, Systems Thinking Outcomes, Lifecycle Analysis, Eco-Design, Multidisciplinary knowledge and skills for re-options, Business Ethics, Social Entrepreneurship,	0.15	0.1
Research, Innovations& Extension	Design for durability for reuse, Easy to open EEE for repairs, Modular Design for remanufacturing, Fewer types of materials in EEE products for recycling, new product in compliance to regulations, Business models	0.2	NA
Infrastructure And Learning Resources	Open-source software development, Outsourcing, Leasing, EPR, EEE Codification ofExistingItems(Use and Not-in-Use) as per CPCB guidelines or any other statutory guidelines, Product labelling, Maintenance, Portability, Updates, Facilities for Repair, Remanufacture, Partnership for repurposing, Recycling	0.25	0.2
Student Support and Progression	Circular innovation (Product design, business models, etcetera), Progressive grading on circular activities, Choice-based ESD projects, internships with EPR EdTech companies	0.15	0.1
Governance, Leadership, and Management	Compliance with Regulations relating to Environment and WEEE, learning outcomes parity with that of Sustainable Development Goals, Funding, Incentives and Rewards for stated ESD learning outcomes of Programs	0.05	0.15

Institutional Values and Best Practices	Average Life of EEE Items in use, Repurposing of EoL EEE Items, Extended Warranties, Extended Producer Responsibility Partnerships, Donations, Environmentally Sound Management Practices, WEEE Regulation Policy	0.1	0.25

Source: Tabulated by the author from naac.gov.in and various another related research in the public domain. [A] criterion weightage applicable to Technical HEIs, [B] criterion weightage applicable to other HEIs

Discussion

Though theoretically, the hypotheses were maintained, thereby laying a premise for HEIs and accreditation agencies like NAAC to considering needful implementation. HEIs have proved post-Covid that they are agile enough to adapt to any change and transformation. The transformation from linear to circular should be in the paramount interest of HEIs in India, with the highest population in the age group of 18-25 years as potential agents for improving the environmental and economic development indices. Subsequently, under a blended circular education model, the physical learning spaces couldbe primarily utilized for innovative and practical circular activities, while digital spacesmajorly for theory. Accordingly, the Internal Quality Assurance Cells of NAACinrespective HEIs can also integrate other circular innovations under Institution Innovation Council, National Innovation and Start-up Policy, *Unnat Bharat Abhiyan*, Mahatma Gandhi National Council for Rural Education, National Institutional Ranking Framework, Atal Ranking of Institutions on Innovation Achievements, Make-in-India, Digital India, *Atmanirbhar Bharat*, and other similar initiatives of the government of India.

In the realm of circular global supply chains, HEIs mustconsider WEEE as a vital resource and not as a waste to educate on circular economy. They can collaborate for ESD academic bank of credits. That way, students can pursue their learningof chosen ESD credit modules from any HEI of their choice. Furthermore, HEIs would progressively upgrade to multidisciplinary education and research-based outcome-based education, emanating better WEEE management strategies and green standards to address resource challenges. Most importantly, the HEIsmust also enable the informal sectors in WEEE management with the requisite knowledge, skills, and abilities. For that, innovative circular business designs and reverse supply chain models, safety, and empowerment for e-waste handlers can be some of the expected outcomes under accreditation instruments like NAAC.

Conclusion

With radical thinking, businesses can profit from the wellbeing of people and the planet by avoiding mindless extraction of exhaustible resources and instead, mindfully maintaining the biological cycles. This article posits a huge opportunity for higher educational institutions to suitablycontribute on that count. Besides, India, with one of the largest pools of e-waste and growing, calls for such institutions to deliverpractical solutions for management of e-waste. The article rationally offers a compelling case for HEIs to trigger the minds with its circular vision that in the context of increasing digitalization, can extend the life of electrical and electronic products forenvironmental and economic benefit. Finally, it prepares anopen premise for innovative solutions, expertise, incentives, and policies that might be in the primary interest of HEIs and accreditation agencies like NAAC, apart from entrepreneurs,

investors, business, markets, consumers, policymakers, and all other stakeholders of the circular economy. Also, a premise for future of higher education to become more impactful.

Declaration
No potential conflict of interest.

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