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Designing a Paradigmatic Model of Social Media in Addressing Environmental Issues of Electronic Waste in Iran

ABSTRACT

The present study was conducted with the aim of designing a paradigmatic model of social media—specifically Instagram and X (formerly Twitter)—in addressing the environmental issues of electronic waste in Iran. From the perspective of its purpose, this research falls within the category of applied-developmental studies. The participants consisted of two groups of experts: theoretical experts (professors and researchers in the fields of media, communication, and environmental management with expertise in media marketing) and practical experts (managers and specialists working in waste management organizations and social media activists involved in the environmental issues of electronic waste). Using theoretical sampling and continuing the interview process until reaching theoretical saturation, a total of 12 participants were selected. Data analysis was conducted using the grounded theory method with the assistance of MaxQDA. The findings indicated that causal conditions (including political and legal awareness, socio-cultural, economic and commercial, and technological and innovative factors) provided the foundation for the emergence of the core phenomenon (i.e., the role of social media in representing environmental issues related to electronic waste). This phenomenon developed within the context of contextual conditions (such as the institutional structure of information dissemination and governmental policymaking) and under the influence of intervening conditions (such as the limitations and challenges of social media) in Iran. Under these circumstances, a set of strategies emerged—particularly the production and redistribution of environmental content on social media—which led to outcomes in three domains: improving the management and recycling of electronic waste, developing economic aspects related to recycling, and influencing policymaking and audience behavior change through the media. The findings of this study can provide an appropriate basis for media policymaking and environmental planning in the country.

Keywords: electronic waste, media model, environmental issues, social media

Introduction

The rapid proliferation of electronic products in the digital era has profoundly transformed production and consumption patterns worldwide, but it has also generated a growing stream of electronic waste (e-waste) that poses serious environmental, social, and economic challenges. E-waste contains a complex mixture of hazardous and valuable materials, and its mismanagement contributes to soil contamination, water pollution, and public health risks (1-3). Globally, millions of tons of e-waste are produced annually, and the trend is accelerating as innovation cycles shorten and device obsolescence increases (4,

5). This surge in discarded electronics demands sustainable strategies for collection, recycling, and safe disposal to prevent long-term ecological damage and resource depletion (6, 7).

In Iran, the challenges of e-waste management are especially acute due to rapid urbanization, technological diffusion, and insufficient infrastructure for collection and recycling systems (8, 9). Studies indicate that a substantial portion of e-waste generated by households and government offices is not properly collected or treated, increasing the risk of illegal dumping and informal recycling activities that exacerbate environmental hazards (5, 10). Informal processing often involves unsafe methods such as open burning or acid leaching, which release toxic substances including lead, mercury, and cadmium into ecosystems and human food chains (1, 11). Such practices not only degrade environmental quality but also jeopardize workers' health and public safety (12, 13).

Against this backdrop, scholars have emphasized the necessity of adopting circular economy approaches and integrating e-waste management with broader sustainability strategies (14, 15). Circular economy principles advocate for closing material loops through reuse, repair, remanufacturing, and recycling to reduce resource extraction and waste generation (2, 7). Applying these principles to e-waste can recover valuable materials, reduce environmental burdens, and create green economic opportunities (6, 16). However, effective implementation requires not only technological capacity and regulatory frameworks but also widespread public participation and behavioral change in disposal practices (17, 18). This underscores the importance of developing communication strategies that can shape public attitudes and mobilize collective action.

In this context, social media platforms have emerged as powerful tools for influencing environmental behavior and fostering citizen engagement in sustainable practices (19, 20). With their high levels of interactivity, real-time reach, and participatory affordances, platforms like Instagram and X (formerly Twitter) can significantly shape public discourse on environmental issues, including e-waste management (21, 22). Social media enables users to create and disseminate content, engage in discussions, and build communities around shared environmental values (23, 24). These features position social media as a key arena for raising awareness, promoting responsible behaviors, and advocating policy reforms in the domain of e-waste governance (25, 26).

Despite its potential, leveraging social media for e-waste management presents several challenges. Studies show that public engagement in recycling initiatives remains limited, often due to low perceived personal responsibility, lack of knowledge about collection systems, and mistrust in institutional capacities (17, 27). In Iran, additional barriers include fragmented institutional structures, policy incoherence, and regulatory gaps that hinder coordinated media campaigns and citizen participation (10, 28). Furthermore, content related to e-waste often fails to attract user attention amid competing digital stimuli, underscoring the need for innovative content production strategies tailored to platform-specific dynamics (23, 29). Addressing these barriers requires integrating behavioral insights, persuasive communication techniques, and participatory design into social media strategies for e-waste campaigns (15, 30).

Another critical factor is the rapid evolution of digital technologies, which both drives e-waste generation and provides new avenues for its management. The proliferation of short-lived digital devices, including those driven by emerging technologies such as Artificial Intelligence (AI), accelerates the pace of e-waste accumulation (31). However, digital tools can also facilitate smart collection, tracking, and recycling systems, enhancing transparency and efficiency in e-waste management (7, 14). In this regard, aligning technological innovation with environmental governance frameworks is essential to mitigate the environmental footprint of the digital economy (13, 32). Countries that have successfully developed producer responsibility schemes and formalized recycling infrastructures demonstrate the importance of regulatory enforcement and cross-sector collaboration (4, 11). For Iran, adopting similar integrated strategies is crucial to move beyond ad hoc approaches and towards systemic, sustainable solutions (8, 9).

To design effective interventions, it is essential to understand the socio-cultural and psychological determinants of e-waste disposal behaviors. Research highlights the influence of personal norms, perceived behavioral control, and social influence on individuals' willingness to recycle electronic products (17, 18). Social media can amplify these determinants by leveraging peer influence, social norms, and emotional appeals to shift attitudes and encourage pro-environmental behaviors (19, 20). Campaigns that use storytelling, visual narratives, and gamification techniques have shown promise in increasing user engagement and recycling intentions (22, 29). Moreover, integrating ethical considerations into social media strategies can enhance public trust and legitimacy, which are critical for sustained participation (21, 26). This aligns with calls for ethical frameworks to guide communication practices in the age of pervasive digital media (24, 25).

The grounded theory approach offers a robust methodological framework for developing context-specific models of social media engagement in e-waste governance (30, 33). By systematically deriving theoretical categories from empirical data, grounded theory allows researchers to capture the complex, multi-level dynamics among media structures, user behaviors, and institutional contexts. This approach has been effectively used in previous studies to design sustainable e-waste management models that integrate technological, behavioral, and policy dimensions (12, 14). Applying grounded theory can reveal the causal, contextual, intervening, and strategic factors that shape the role of social media in e-waste management, leading to the development of paradigmatic models suited to the Iranian socio-cultural environment (5, 27).

In summary, the escalating e-waste crisis necessitates innovative, multi-dimensional responses that combine technological solutions, regulatory measures, and behavioral change strategies. Social media platforms provide an underutilized yet powerful channel to raise public awareness, mobilize citizen participation, and advocate policy reforms in e-waste governance (15, 19). However, realizing this potential requires addressing institutional, behavioral, and technological barriers through evidence-based, ethically informed strategies tailored to local contexts (22, 25). This study aims to design a paradigmatic model of social media—focusing on Instagram and X—for addressing the environmental challenges of e-waste in Iran, thereby contributing to both theoretical advancement and practical policymaking in sustainable waste management.

Findings and Results

In the qualitative section, 12 individuals participated, including 4 university professors (33.3%) and 8 experts in the fields of waste management and social media related to environmental issues of electronic waste (66.7%). In terms of gender, 10 were men (83.3%) and 2 were women (16.7%). Regarding age, 2 participants (16.7%) were under 45 years old, 5 (41.7%) were between 46 and 55 years old, and 5 (41.7%) were over 56 years old. In terms of education, 3 participants (25%) held master's degrees, and 9 (75%) held doctoral degrees. Regarding work experience, 3 participants (25%) had 10–15 years of experience, and 9 participants (75%) had more than 16 years of experience.

To design the paradigmatic media model of environmental issues of electronic waste in Iran, with emphasis on Instagram and X (formerly Twitter), the qualitative data obtained from semi-structured interviews with experts were analyzed using the grounded theory method and the systematic approach of Strauss and Corbin (1997) in three stages: open coding, axial coding, and selective coding. The analysis tool was MaxQDA, which served as a specialized platform for organizing, coding, and interpreting textual data.

Step One: Open Coding

In the first step, open coding, all interviews were examined line by line and initial conceptual units were carefully extracted. Synonymous, similar, or semantically overlapping concepts were grouped into preliminary categories. This process was carried out using a comparative and reflective approach, simultaneously with analysis and gradual conceptual development. Repeated data reviews and constant comparison of codes enhanced coherence in forming the initial concepts.

At this stage, 497 initial codes were identified, which, after conceptual refinement and the elimination of duplicates, and through merging synonymous and overlapping codes, were reduced to 69 final open codes. These foundational concepts were used in subsequent stages to develop axial categories and build the conceptual model. Emphasizing concepts derived from field data rather than relying solely on theoretical assumptions gave authenticity and novelty to the analysis and provided the foundation for developing a localized model suitable for managing media-related environmental issues of electronic waste in Iran.

Step Two: Axial Coding

In the axial coding stage, the aim was to reorganize and integrate the open codes into higher-level conceptual categories and constructs. This analysis focused on identifying causal, contextual, intervening, strategic, and consequential relationships among the concepts. The core phenomenon of the study, “social media and environmental issues of electronic waste,” was considered the axis of meaning-making, and the open codes were systematically classified into intermediate categories. The main extracted strategy was “content production strategy on Instagram and X,” which was identified as the organizational response to causal, contextual, and intervening conditions. The resulting outcomes were categorized into three main areas: strategic impacts on the management and recycling of electronic waste, economic aspects of recycling, and policy and media influences on public audience behavior. Finally, the conceptual structure of the initial model was developed by focusing on the logic of inter-category relationships and creating networked linkages.

Step Three: Selective Coding

In the final step, selective coding, the identified core categories were systematically organized within the paradigmatic model framework of grounded theory. Accordingly, the final categories were placed into six main dimensions:

1. Causal conditions
2. Core phenomenon
3. Contextual conditions
4. Intervening conditions
5. Strategies and actions
6. Consequences

The selective coding process aimed to integrate the findings and outline the final structure of the conceptual model. In this stage, 6 selective codes as the main dimensions of the model, 12 axial codes as mid-level conceptual categories, and 69 open codes as foundational field-derived concepts were identified and finalized. The final structure of these codes was organized and presented in tables, providing a theoretical basis for developing a localized model for the mediatization of environmental issues of electronic waste in Iran, with emphasis on social media platforms Instagram and X. The results of the selective coding are presented separately in the following six main dimensions.

Categories of Causal Conditions

Causal conditions refer to a set of fundamental, enabling factors that play an initiating or accelerating role in the emergence and development of the core phenomenon. As structural or functional drivers, these conditions provide the prerequisites for the occurrence of the phenomenon and highlight causal interactions among key variables. Analyzing causal conditions not only makes it possible to recognize the internal logic of the phenomenon’s transformative process, but also allows the researcher to model causal relationships systematically and to gain a deeper understanding of why and how the phenomenon takes shape. This analysis plays an essential role in developing grounded theories and provides a basis for a precise, localized explanation of the dynamics of the phenomenon under study.

Table 1. Categories of Causal Conditions

Dimension	Main Category	Subcategories
Causal Conditions	Political and Legal Awareness	Analytical and critical coverage in the media of laws and policies related to e-waste management; leveraging media capabilities for advocacy and compelling companies to observe environmental responsibility; media support for government-driven policies aimed at reducing excessive electronic production and consumption; exerting public pressure through the media to expand formal and transparent recycling infrastructures; public reporting on violations and illegal practices in the collection, disposal, and export of e-waste
	Social and Cultural Awareness	Institutionalizing a culture of reuse and recycling of electronic equipment; public education on proper e-waste disposal; strengthening public perceptions regarding the environmental and health consequences of e-waste; increasing social sensitivity to harms caused by improper management of digital waste; promoting social responsibility discourse among producers and consumers of electronic equipment
	Economic and Commercial Awareness	Explaining the economic value of e-waste and its capacity to recover valuable resources; introducing innovative business models based on recycling, repair, and remanufacturing of electronic devices; disseminating information about domestic and global markets related to e-waste management; raising awareness of financial benefits of green/circular economy participation; encouraging environmental entrepreneurship by introducing business opportunities in recycling technologies; showcasing competitive advantages of environmentally responsible brands on social media
	Technological Awareness and Innovation	Introducing emerging technologies for the reduction, separation, and smart recycling of e-waste; monitoring and disseminating industrial and academic innovations in green e-waste management; proposing technological solutions for optimal recovery of raw materials from end-of-life electronics; analyzing international trends in using bio-sustainable materials in electronic product supply chains

Categories of Contextual Conditions

Contextual conditions refer to a set of structural, cultural, institutional, and environmental factors that shape the setting in which the core phenomenon occurs and influence the manner, intensity, and pattern of its manifestation. These conditions function as contextual frameworks within which the phenomenon acquires meaning and is directed along a specific path. Analyzing these factors enables a deeper understanding of the social, cultural, and organizational contexts affecting the phenomenon and allows the researcher to interpret the emergence of the phenomenon not in isolation, but in connection with its real-world setting. By highlighting intra-textual interactions between environment and phenomenon, this analysis lays the groundwork for developing a systematic, localization-oriented model with greater theoretical coherence and analytical validity.

Table 2. Categories of Contextual Conditions

Dimension	Main Category	Subcategories
Contextual Conditions	Institutional Structure of Information Dissemination and Environmental Participation in the Media	Level of public participation in environmental media campaigns; citizens' awareness of e-waste consequences through the media; role of users in producing and redistributing environmental content (UGC); public engagement with media challenges, drives, and calls related to recycling; audience capacities for critique, feedback, and participation; media literacy level in confronting environmental messages; public access to practical information on digital media
	Government Policymaking	Analyzing effectiveness of national e-waste management policies and laws; identifying institutional challenges and implementation barriers in recycling policies; examining roles and functions of governmental, public, and private institutions in implementing e-waste policies; assessing influence of international standards and commitments on domestic legal frameworks; analyzing media–policymaker interaction in promoting environmental laws

Categories of the Core Phenomenon

As the central nucleus of analysis in grounded theory, the core phenomenon is the concept with the highest semantic frequency in the data around which other categories and theoretical dimensions are organized. It represents the main topic and the dominant current in the research field and acts as a nexus in explaining the internal and external mechanisms of the data's semantic system. During selective coding, the core phenomenon is identified from among the set of axial categories and chosen as the integrating axis of the theoretical model. Anchored in this central concept, causal, contextual, intervening, strategic, and consequential relationships among categories are explicated in a structured manner. This conceptual organization enables the

researcher to formulate a coherent, theory-driven model grounded in empirical realities, thereby deepening the analysis and enhancing the study's theoretical credibility.

Table 3. Categories of the Core Phenomenon

Dimension	Main Category	Subcategories
Core Phenomenon	Social Media and Environmental Issues of Electronic Waste	Conceptual explanation of e-waste for digital audiences using simple, visual language; presenting classified data on types of e-waste in interactive formats; targeted dissemination of information on environmental and health effects of e-waste through multimedia narratives; digital training on safe and proper e-waste disposal for households and urban users; promoting smart recycling skills through experiential, practice-based content; introducing technological innovations in e-waste reduction, recycling, and processing with futures-oriented focus; enhancing digital environmental literacy through mainstreaming scientific information flows on social networks

Categories of Strategies and Actions

Strategies refer to a set of goal-oriented actions, implementation-focused decisions, and operational patterns adopted by actors to manage, address, moderate, or steer the core phenomenon. These strategies can take shape at individual, institutional, or organizational levels and reflect the interactive mechanisms and practical rationality of actors in response to causal, contextual, and intervening conditions. Analyzing strategies makes it possible to identify decision logics, reactive pathways, and the degree of flexibility or resistance exhibited by the system in the face of change. This analysis also helps map the role of actors in reproducing, stabilizing, or transforming the status quo and provides a theoretical basis for understanding power dynamics, strategic rationality, and institutional mechanisms in the formation of the phenomenon. From this perspective, strategies are not merely scattered actions but constitute an essential component of the grounded-theory architecture that renders the structure–agency linkage explainable.

Table 4. Categories of Strategies and Actions

Dimension	Main Category	Subcategories
Strategies and Actions	Content Production Strategy on Instagram and X (formerly Twitter)	Designing interactive, user-friendly content to attract and retain digital audiences; employing multimedia tools (video, infographics, interactive stories) to increase the appeal of environmental content; establishing response channels and strengthening two-way communication with users; using clickable links to direct users to credible resources; launching targeted e-waste and smart recycling campaigns; leveraging user feedback to optimize content strategies; organizing creative challenges and competitions to promote green behaviors

Categories of Intervening Conditions

Intervening conditions denote a set of background or environmental variables and factors that influence the strength, direction, and pattern of the effects of causal and contextual conditions on the core phenomenon. These conditions may play moderating, reinforcing, or inhibiting roles and, in some cases, alter the transformational pathways of the phenomenon. Analyzing these conditions helps the researcher move beyond linear, simple relationships to attain a deeper understanding of the complex, multi-factor, and nonlinear dynamics governing the phenomenon's formation and evolution. Intervening conditions often surface at decision points or in the face of systemic frictions, and their role in facilitating or obstructing strategy implementation is pivotal to explaining the why and how of changes in social, organizational, and cultural processes. Accordingly, the systematic identification and analysis of these conditions constitute one of the cornerstones of developing flexible, realistic theoretical models in qualitative research.

Table 5. Categories of Intervening Conditions

Dimension	Main Category	Subcategories
Intervening Conditions	Challenges of Instagram and X in Iran	Legal restrictions and filtering that limit open access to international social platforms; lack of transparent, coherent policies on media use of social networks; insufficient institutional experience and strategic record in using social media for e-waste education; lack of specialized human resources in digital-waste management for content production; deficiencies in producing and disseminating localized knowledge on e-waste; international sanctions and disruption of engagement with global platforms; private-sector demotivation and investor reluctance to enter the field

Categories of Consequences

Consequences are the final results and effects arising from the implementation of strategies in interaction with the core phenomenon; they may encompass various structural, behavioral, cultural, economic, or social dimensions and may be observable in the short or long term. Consequences not only constitute a direct reflection of the efficiency and effectiveness of the adopted strategies but also indicate the direction of changes stemming from the systematic engagement of actors with the subject under study. Analyzing consequences enables the researcher to realistically assess the impact of strategies, identify their continuity or discontinuity with contextual and intervening conditions, and delineate holistic patterns of transformational processes. Consequences also serve as the linkage between grounded theorizing and its practical applications, playing a key role in the formation, adjustment, or development of theoretical frameworks and explanatory models.

Table 6. Categories of Consequences

Dimension	Main Category	Subcategories
Consequences	Strategic Effects on the Management and Recycling of Electronic Waste	Sustainable reduction of environmental impacts from improper disposal of electronics; strengthening public participation and social activism in recycling/remanufacturing; creating synergistic networks among governmental, private, and NGOs in digital-waste management; improving lifecycle management efficiency of electronics; increasing reutilization of usable e-waste components; standardizing safe and legal e-waste disposal processes
	Economic Aspects of E-Waste Recycling and Policy Impacts	Comparative analysis of upfront investment costs vs. long-term benefits of recycling; examining the role of recycling in reducing macro-level waste management costs; assessing media effectiveness in explaining economic benefits of recycling to industrial/tech firms; evaluating government incentives and policies in boosting private-sector participation; analyzing e-recycling's impact on raw-materials market regulation and reducing import dependence
	Media Influence on Public Audience Behavior	Shifting environmental attitudes and beliefs through targeted media messaging; facilitating comprehension of complex concepts using simple, narrative, visual language; changing daily consumption and disposal behaviors via social media influence; analyzing user responses to media campaigns; consolidating social norms of responsible consumption and recycling, focusing on non-expert audiences

Synthesis of the Qualitative Section and Presentation of the Paradigmatic Model

In grounded-theory development, data integration is one of the essential and decisive stages in the theory-building process, during which raw, disparate data are transformed—through systematic analyses—into a coherent, explanatory, and intelligible structure. This process involves identifying patterns, concepts, and conceptual relationships within the data that lead to the formation of core categories and, ultimately, the construction of a conceptual model. Models resulting from data integration are systematically formulated to advance theoretical knowledge and are often validated both theoretically and empirically. Such models may extend or revise existing theories and, ultimately, culminate in a localized theory grounded in social reality. Thus, data integration is not merely a technical phase but a philosophical dimension of theorization that constitutes the foundation of the study's conceptual development. The paradigmatic model of the research is presented below.

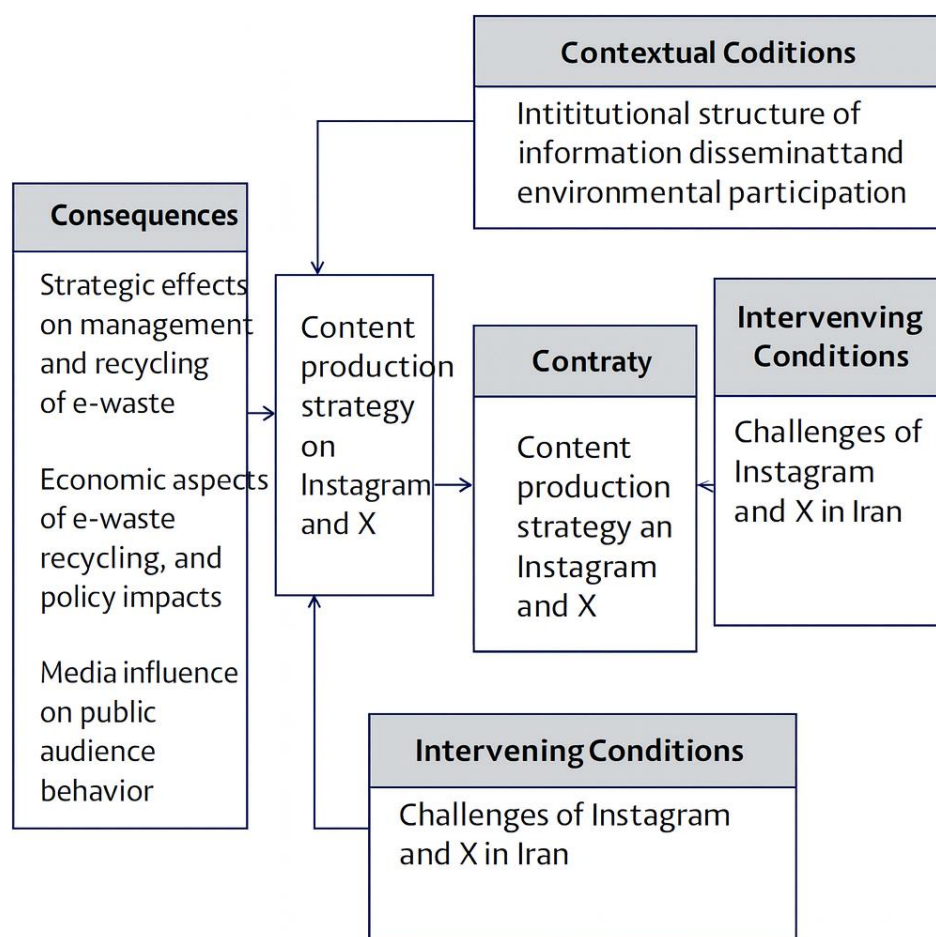


Figure 1. The Study's Paradigmatic Model

The narrative of this study, based on the analysis of field data and the systematic coding process, reflects the complex interaction between Instagram, X (formerly Twitter), and the management of environmental issues of electronic waste in Iran. The findings indicate that the designed paradigmatic model was developed through the identification and analysis of causal, contextual, intervening, strategic, and consequential relationships among the components and provides a theoretical framework for explaining the role of social media in this field.

The causal conditions include four main dimensions:

Political and legal awareness, which focuses on the development and dissemination of laws, regulations, and policies related to e-waste management and strengthens the institutional foundation necessary for media actions.

Social and cultural awareness, which emphasizes improving citizens' attitudes, beliefs, and behaviors toward environmental protection and participation in recycling processes.

Economic and commercial awareness, which highlights the role of the media in showcasing the economic benefits of recycling and developing related markets, thereby reinforcing economic motivations.

Technological awareness and innovation, which underscores the capacity of the media to promote new technologies and green innovations in e-waste management.

These causal conditions directly shape the core phenomenon of the study, namely "social media and environmental issues of electronic waste." As the central nucleus of the model, the core phenomenon represents the role of social networks (Instagram and X) in shaping environmental discourse, raising public awareness, and changing behaviors related to the production and disposal of e-waste.

The contextual conditions include two key dimensions: “the institutional structure of information dissemination and environmental participation in the media” and “government policymaking”, which together create the enabling and supportive environment for media strategies. The institutional structure refers to the degree of cohesion and capacity of related organizations to manage and direct media messages, while government policymaking determines the coordination and overall orientation of media-related actions.

In response to these conditions, the main strategy of the study—titled “content production strategy on Instagram and X”—was extracted. This strategy emphasizes the production and dissemination of targeted, interactive, and evidence-based content that can enhance public knowledge, raise environmental sensitivity, and encourage citizen participation in recycling and e-waste management processes.

The implementation of these strategies faces intervening conditions, identified as “the challenges of Instagram and X in Iran.” Access restrictions, filtering, distrust among certain user groups, and weaknesses in digital content management are among the factors that affect the effectiveness of media actions. These intervening conditions can determine the strength or weakness of the outcomes of media strategies.

Ultimately, the consequences of the model were organized into three main areas:

Strategic effects on the management and recycling of electronic waste, including improved efficiency of recycling systems, increased public participation, and enhanced sustainable waste management.

Economic aspects of e-waste recycling and policy impacts, indicating increased economic value of recycling, reduced environmental costs, and influence on macro-level policymaking.

Media influence on public audience behavior, referring to the role of social media in changing attitudes, reinforcing responsible behaviors, and fostering a sustainable environmental culture.

This conceptual model not only explains the relationship between social media and e-waste management but also shows how the intelligent use of the capacities of modern media can become an effective tool for environmental policymaking and the promotion of pro-environmental social behaviors in Iran.

Discussion and Conclusion

The findings of this study provide a nuanced understanding of how Instagram and X (formerly Twitter) can be mobilized as strategic platforms for addressing the environmental challenges of electronic waste (e-waste) in Iran. Through the grounded theory approach, the analysis revealed that four main causal conditions—political and legal awareness, social and cultural awareness, economic and commercial awareness, and technological awareness and innovation—directly drive the emergence of the core phenomenon, namely the utilization of social media to influence public awareness, attitudes, and behaviors regarding e-waste management. This aligns with prior research showing that structural determinants such as legal frameworks and policy infrastructures significantly shape media-driven environmental behaviors (10, 25). By strengthening institutional capacities and creating a coherent policy environment, governments can enhance the effectiveness of media-based campaigns in steering public participation toward sustainable e-waste practices (5, 13).

The identification of political and legal awareness as a core driver reinforces earlier evidence suggesting that the absence of clear regulations and enforcement mechanisms is one of the main obstacles to effective e-waste management (8, 11). In contexts where regulatory infrastructures are fragmented, informal recycling often dominates, resulting in hazardous processing and environmental degradation (1, 2). By contrast, the present study indicates that when media campaigns emphasize legal responsibilities and advocate for stricter enforcement of producer responsibility schemes, they can help bridge the regulatory gap and foster accountability among both corporations and consumers. This echoes findings from global case studies showing

that media engagement amplifies the impact of extended producer responsibility regulations by shaping public discourse and mobilizing citizen support (7, 14).

Similarly, the emergence of social and cultural awareness as a critical causal condition is consistent with behavioral models positing that pro-environmental behavior is largely shaped by social norms, cultural values, and perceived collective responsibility (17, 18). The study found that content designed to normalize responsible e-waste disposal, celebrate recycling champions, and integrate environmental messages into everyday cultural narratives can shift public attitudes and increase participation. Prior research has highlighted that social media's participatory features—such as commenting, sharing, and user-generated content—create powerful social proof that accelerates behavior diffusion (19, 20). In this respect, the study's results underscore that media campaigns must be culturally embedded and framed in ways that resonate with the values and identities of target audiences to achieve behavioral change (21, 24).

Economic and commercial awareness also emerged as a strong determinant of media engagement with e-waste issues. This finding reflects evidence that public participation in recycling initiatives is often constrained by the perceived lack of tangible economic incentives (12, 27). By highlighting the economic value of recyclable materials, showcasing green entrepreneurship opportunities, and framing recycling as part of a broader circular economy, social media can enhance public motivation to participate. Previous studies have shown that emphasizing financial benefits, such as cost savings and potential income from selling used electronics, can significantly improve recycling intentions (14, 16). The present study's evidence that media campaigns highlighting market opportunities and brand competitiveness foster greater engagement aligns with the broader literature on eco-innovation and circular business models (15, 32).

Technological awareness and innovation were also identified as important drivers, reflecting the role of social media in disseminating knowledge about cutting-edge recycling technologies, smart collection systems, and green design practices. This supports previous findings that media visibility accelerates the diffusion of environmental technologies by bridging knowledge gaps and reducing perceived complexity (2, 6). The study revealed that campaigns showcasing technological innovations, such as AI-assisted sorting or automated collection kiosks, can inspire public confidence and increase trust in formal recycling systems. This finding is consistent with research highlighting that technological optimism can increase willingness to engage in pro-environmental behaviors by portraying solutions as feasible and effective (4, 31). Thus, the integration of innovation-oriented narratives into media content can enhance both cognitive engagement and behavioral intentions.

The study also emphasized the significance of contextual conditions—specifically, the institutional structure of information dissemination and environmental participation in the media, and government policymaking—which shape the broader environment in which social media strategies operate. Where institutional structures are fragmented and poorly coordinated, media campaigns tend to be sporadic and lack coherence, limiting their impact (10, 28). The present findings show that cohesive institutional support, such as inter-agency collaboration and centralized messaging, can amplify the reach and consistency of media initiatives. This is congruent with evidence that coordinated institutional ecosystems are essential for scaling up environmental communication and ensuring continuity of engagement (22, 25). Moreover, government policymaking emerged as a crucial contextual factor, as policy alignment and public endorsement provide legitimacy and resources for sustained media campaigns. Studies have demonstrated that policy-driven media efforts, when combined with community participation mechanisms, produce more durable changes in environmental behavior (13, 15).

Intervening conditions were represented by the challenges of leveraging Instagram and X in Iran, including access restrictions, platform filtering, and weak content management infrastructures. These barriers have been cited in prior studies as key impediments to harnessing social media for environmental governance (20, 24). The findings confirm that limited access and user distrust reduce the effectiveness of campaigns, while low content diversity and production capacity diminish

engagement. Similar concerns have been reported in analyses of informal e-waste flows, where weak institutional trust and fragmented media landscapes hinder public participation (8, 11). Addressing these barriers requires improving regulatory clarity, building local content production capabilities, and ensuring secure, reliable access to platforms (23, 26).

The core strategy derived from this study—content production strategy on Instagram and X—provides critical insights into how targeted, evidence-based, and interactive media content can mobilize behavioral change. The evidence suggests that content using visual storytelling, interactive formats, and localized messaging can increase engagement and promote pro-environmental behaviors. This is supported by studies showing that emotionally resonant, culturally tailored content is more likely to be shared and acted upon (17, 19). Additionally, the use of gamification elements such as challenges and competitions was found to enhance participation, consistent with findings that reward-based strategies foster habit formation and sustained engagement (22, 29). Importantly, the strategy also emphasized two-way communication, which builds trust and collective identity—factors shown to be essential for long-term community-based environmental action (12, 21).

The outcomes associated with the model were grouped into three main domains: strategic effects on the management and recycling of e-waste, economic aspects of recycling and policy impacts, and media influence on public audience behavior. The finding that social media can strengthen recycling systems and improve operational efficiency aligns with evidence that media-based coordination reduces transaction costs and streamlines supply chains in waste management systems (14, 15). The observed enhancement of public participation mirrors global patterns where social media engagement has significantly increased recycling rates through community mobilization and peer influence (19, 20). Similarly, the results showed that media can shape policy agendas and accelerate the adoption of supportive regulatory frameworks, consistent with prior studies documenting the agenda-setting role of digital platforms in environmental policymaking (24, 25).

Finally, the study confirmed that social media can alter environmental attitudes, strengthen responsible consumption norms, and embed sustainability values into public consciousness. These effects echo theoretical frameworks that conceptualize social media as not only information channels but also cultural infrastructures that shape meaning systems and collective identities (22, 26). By leveraging these socio-cultural mechanisms, media strategies can transform individual behaviors and catalyze societal transitions toward sustainable e-waste management. Overall, the findings validate the central premise that Instagram and X, when strategically utilized, can serve as powerful levers for environmental behavior change and policy innovation in Iran.

Despite its contributions, this study has several limitations. First, the sample size was relatively small, consisting of twelve experts, which limits the generalizability of the findings. Although the study reached theoretical saturation, the perspectives captured may not fully represent the diversity of stakeholders involved in e-waste management and social media engagement. Second, the study focused exclusively on two platforms—Instagram and X—which may not encompass the full spectrum of social media ecosystems relevant to environmental communication in Iran. Other platforms such as messaging apps, video-sharing networks, or local platforms may operate under different dynamics and could influence public behavior in distinct ways. Third, the reliance on self-reported data from interviews introduces the risk of response bias, as participants may have portrayed their organizations or practices in a more favorable light. Finally, the grounded theory approach, while appropriate for exploring complex social phenomena, is inherently interpretive and context-bound, which may limit the transferability of the findings to other national or cultural contexts.

Future research could build on this study by employing larger and more diverse samples that include not only experts but also ordinary users, policymakers, and industry stakeholders. This would allow for a more comprehensive understanding of the multi-level dynamics shaping social media engagement with e-waste issues. Additionally, longitudinal designs could track changes in public attitudes and behaviors over time in response to specific media campaigns, providing stronger causal evidence

of media effects. Comparative studies across different social media platforms and cultural contexts could also clarify how platform affordances and cultural values interact to influence environmental behavior. Furthermore, incorporating quantitative methods such as surveys, experiments, or big-data analytics could complement qualitative insights and enhance the robustness of findings. Finally, exploring the role of emerging technologies—such as AI-driven recommendation systems or blockchain-based traceability tools—in shaping e-waste communication could provide novel insights for future interventions.

Practitioners designing social media campaigns on e-waste should prioritize localized, culturally resonant content that connects environmental issues to the everyday lives and values of target audiences. They should invest in interactive, visually engaging formats that capture user attention and encourage participation, such as gamified challenges, user-generated content, and storytelling videos. Collaboration between government agencies, NGOs, and private sector actors is crucial to ensure consistent messaging, shared resources, and institutional legitimacy. Practitioners should also build two-way communication channels to foster trust, feedback, and collective ownership among users. Finally, developing metrics to evaluate the effectiveness of campaigns in terms of engagement, behavior change, and policy influence can help refine strategies and ensure sustained impact over time.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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