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# Social Media as a Platform for Collaborative Innovation: Enhancing Human Capital and Urban Sustainability in Tehran

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**Abstract**

This study aims to explore how social media platforms contribute to collaborative innovation, the development of human and social capital, and the promotion of urban sustainability practices in Tehran. Employing a qualitative research design based on Grounded Theory, this study collected data through in-depth, semi-structured interviews with 12 purposefully selected participants actively engaged in social media-based knowledge sharing, environmental activism, and innovation. Participants were diverse in terms of age, gender, education, and profession. Data collection continued until theoretical saturation was achieved. Thematic analysis was conducted using open, axial, and selective coding procedures. Credibility of the findings was ensured through member checking and triangulation of viewpoints. Analysis revealed four main categories through which social media enhances urban innovation and sustainability: (1) enhancing environmental literacy through awareness campaigns; (2) enabling collaborative innovation via citizen problem-solving; (3) fostering behavioral change through peer-generated content; and (4) facilitating social mobilization through hashtag activism and online coordination. Participants emphasized the role of social platforms in generating ecological awareness, sharing grassroots solutions, and fostering digital communities that promote sustainable behaviors. The findings highlight the interplay between human capital and social capital as central to the innovation potential of social media in Tehran's urban context. Social media functions as a participatory infrastructure for civic innovation and sustainability in Tehran, enabling decentralized learning, peer-to-peer influence, and digital coordination. These platforms empower citizens to share knowledge, co-create urban solutions, and engage in environmental advocacy, particularly in contexts where formal institutional pathways are limited. The integration of digital tools into urban governance and community development strategies is essential for fostering inclusive, sustainable urban futures.

**Keywords:** Social media; collaborative innovation; human capital; social capital; urban sustainability; Tehran; environmental literacy; digital participation.

## 1. Introduction

In recent years, the emergence of social media as a socio-technical infrastructure has radically transformed the dynamics of knowledge production, public engagement, and innovation ecosystems in urban contexts. These platforms, initially designed for communication and entertainment, have gradually evolved into arenas for collaborative innovation and social learning, enabling citizens to co-create solutions to pressing urban challenges. The conceptual foundation of this research is rooted in the interlinkages between human capital, social capital, and digital innovation systems, with a particular emphasis on how

interactive digital environments like social media can function as catalysts for behavioral change and co-creation. According to Barrena-Martínez et al., integrating intellectual capital with the open innovation paradigm offers a more holistic understanding of collaborative value creation, particularly in urban contexts where knowledge is widely distributed (Barrena-Martínez et al., 2020). Open innovation, when extended to social media platforms, enables bottom-up participation, particularly from citizens who are traditionally excluded from formal innovation processes (Cachay-Huamán & Ramírez-Hernández, 2019). This phenomenon, often labeled "digital co-innovation," relies on real-time exchanges, peer validation, and crowd-sourced problem-solving.

Urban sustainability, as both a policy goal and a social practice, requires citizen engagement beyond conventional participation. This includes the active generation and dissemination of ecological knowledge, digital activism, and collaborative urban planning. Sdoukopoulos et al. emphasize that social media can play a crucial role in assessing and promoting sustainable urban mobility through community feedback and crowd-sourced indicators (Sdoukopoulos et al., 2018). These platforms offer agile mechanisms for identifying context-specific needs, amplifying underrepresented voices, and enabling decentralized coordination around sustainability issues. In the case of Tehran, where traditional governance mechanisms often lag behind the pace of urban challenges, digital platforms offer new hope for bottom-up urban resilience.

At the center of this dynamic lies the concept of social capital, often described as the network of relationships, shared norms, and trust that facilitate cooperation within a society. Social media platforms enable the expansion and densification of social capital through digital interaction, collaborative discourse, and mutual support. As Parzefall and Kuppelwieser note, social capital not only mediates employee outcomes but also fosters a sense of shared identity and psychological safety that encourages innovation (Parzefall & Kuppelwieser, 2012). Similarly, in urban settings, networked social capital can manifest as online communities that advocate for environmental justice, share green innovations, and mobilize civic engagement. Li et al. demonstrate that social capital significantly mediates the relationship between information technology capabilities and organizational resilience, a relationship equally applicable to community-led resilience initiatives (Li et al., 2024).

Moreover, social capital intersects with human capital, especially in knowledge-based societies where the ability to absorb, create, and disseminate knowledge determines collective adaptability. The development of human capital—understood as the accumulation of skills, competencies, and learning capacity—is increasingly shaped by informal, peer-based, and digitally mediated environments. According to Jalali and Tajik, digital development methods such as e-learning and online communities have a direct impact on both human and social capital, especially when knowledge management is involved as a mediating factor (Jalali & Tajik, 2024). This synergy is particularly important in the context of Tehran's youth and professional populations, who often rely on digital platforms for skill enhancement, career development, and civic engagement.

The role of human capital in innovation has also been emphasized in studies like that of Krishna, who positions universities as central agents in national innovation systems, noting their shift from siloed knowledge generation to more collaborative and open frameworks that include societal actors (Krishna, 2019). Similarly, Nguyen et al. highlight that during crises—such as the COVID-19 pandemic—social media became a critical enabler for startups, allowing them to access both human capital and resources through digital transformation strategies (Nguyen et al., 2023). This underscores the capacity of social media to function not just as a communication tool, but as an innovation infrastructure—especially in complex, uncertain environments like contemporary urban Tehran.

The Iranian context adds further complexity. The confluence of demographic pressure, environmental degradation, and constrained formal avenues for public participation has created fertile ground for the emergence of social innovation via informal digital means. Research by Khoshmaram et al. emphasizes the role of environmental support and social capital in shaping entrepreneurial behaviors among rural Iranian communities—insights that readily translate into the urban digital sphere (Khoshmaram et al., 2020). Likewise, studies such as those by Hosseini et al. have shown how different dimensions of social media use can influence performance outcomes and social capital within Iranian organizational settings (Hosseini et al., 2020).

From an organizational perspective, the implications of digital engagement and participatory innovation extend into human resource systems and sustainability. Ahmadzadeh and Shokouh found that sustainable HRM practices mediated by social capital significantly influence both innovation and citizenship behaviors within organizations (Ahmadzadeh & Shokouh, 2020). This is supported by Khodaparast et al., who revealed that knowledge-based HRM systems enhance innovative

performance through the mediating function of social capital (Khodaparast et al., 2021). These findings suggest that digitally mediated innovation is not limited to individual behaviors, but is deeply embedded in institutional and relational dynamics.

The need for collaborative digital infrastructures that support urban transformation has also been addressed in global research. Hanley et al. emphasize that regional connectivity infrastructure, such as high-speed rail, influences patterns of collaborative innovation across spatial systems, reinforcing the idea that mobility and digitality are mutually reinforcing (Hanley et al., 2022). In this sense, Tehran's digital ecosystem—though under strain due to regulatory and infrastructural constraints—serves as a critical node for distributed innovation and urban experimentation.

Furthermore, cross-border initiatives and the role of digital innovation hubs (DIHs) have gained prominence as effective models for empowering small enterprises and communities through technology. Volpe et al. argue that experimentation in digital cooperation across borders contributes significantly to sustainable business practices and localized innovation in marginalized areas (Volpe et al., 2021). Tehran's startup ecosystem—despite limited formal support—mirrors some of these dynamics in its reliance on peer networks and digital communities for scaling impact and enhancing entrepreneurial learning.

In addition, studies like those by Masoumparast et al. indicate that social capital, through emotional intelligence and trust-building, plays a mediating role in enhancing psychological well-being, especially among education professionals—a sector heavily represented in Tehran's active social media users (Masoumparast et al., 2019). This is echoed in Faghiharam's research, which connects the use of social networks to improvements in social health outcomes, particularly among women in urban environments (Faghiharam, 2019). Given that many of Tehran's digital environmental activists are women, these findings hold critical relevance.

In understanding the enabling conditions for human capital development through digital ecosystems, the work of Teymoori provides insight into how motivational and social capital can mediate the maturity of human resources in academic and applied fields (Teymoori, 2018). Similarly, Amirkhani et al. underscore the foundational role of psychological and social capital in improving organizational performance, which is translatable to informal digital collectives aiming to influence urban sustainability outcomes (Amirkhani et al., 2014).

Finally, this study draws on the framework that positions social media as a transformative tool for distributed innovation, participatory sustainability, and human capital enrichment. The intersection of digital interaction, ecological literacy, and collaborative problem-solving forms the foundation of this inquiry into Tehran's evolving urban fabric. It is through the exploration of these layered dynamics—technological, social, institutional, and behavioral—that this research aims to contribute to both theory and practice in sustainable urban development and digital innovation.

## 2. Methods and Materials

This qualitative study adopted the Grounded Theory approach to explore how social media functions as an infrastructural platform for collaborative innovation and contributes to the enhancement of human capital and urban sustainability in Tehran. Grounded Theory was selected because of its capacity to generate conceptual frameworks from real-world data without being confined by pre-existing theoretical assumptions. This methodological choice allowed for the emergence of theory that is tightly interwoven with participants' lived experiences and contextual realities.

The target population for this research consisted of individuals who actively use social media for purposes such as acquiring knowledge, applying innovative ideas, sharing educational content, developing digital businesses, or engaging in social projects related to sustainable development. Participants included educators, cultural activists, social and environmental entrepreneurs, and community developers who demonstrated ongoing and meaningful engagement with social media platforms in relation to learning and innovation.

A purposeful sampling strategy was employed to ensure the selection of information-rich cases with deep and varied perspectives. The inclusion criterion was sustained and meaningful engagement in social media centered around socio-economic innovation or public awareness regarding sustainable urban development. Diversity in age, gender, educational background, and type of social activity was prioritized. Initially, ten participants were identified through targeted outreach and referral chains. After conducting and analyzing these first ten in-depth interviews, two additional interviews were conducted

to ensure the emergence of no new conceptual categories. Theoretical saturation was achieved after twelve interviews, as the key themes began to repeat and no novel dimensions emerged. Consequently, data collection was concluded at this point.

Data were collected through in-depth, semi-structured interviews, designed to elicit rich narrative data and facilitate exploratory insight into participants' experiences and interpretations. Each interview began with a brief explanation of the research purpose and ethical assurances regarding confidentiality. Verbal and written informed consent was obtained, including consent for audio recording. Interviews were conducted either in-person, in a quiet and mutually convenient location, or online through videoconferencing platforms, depending on the participant's preference and availability.

The average duration of interviews ranged from 40 to 60 minutes, although several extended up to 75 minutes based on the participant's engagement and depth of responses. All interviews were recorded, transcribed verbatim, and then reviewed by the researcher. Analytical memos and field notes were written immediately after each session to capture impressions, emotional cues, and emerging patterns that could inform the coding process.

The interview guide included open-ended questions that allowed flexibility in probing themes such as individual motivation for using social media, perceptions of social media's role in professional or social development, and experiences of digital engagement in community and knowledge-based initiatives. These guiding questions were adapted during interviews to follow the narrative flow and uncover unanticipated insights.

To enhance the validity of the collected data, member checking was used by sending key summaries of each interview to the corresponding participant for verification or correction. Triangulation was also applied by comparing viewpoints across diverse participants, helping to validate recurring themes across social, economic, and environmental sectors.

The analysis was carried out in accordance with the three-stage coding framework characteristic of Grounded Theory: open coding, axial coding, and selective coding. Each stage served as a layer of abstraction and synthesis that contributed to building the emergent theory.

In the open coding phase, the transcribed texts were reviewed line by line to extract initial codes reflecting the substantive content of participants' responses. These codes were mostly descriptive and grounded in the participants' own words (in vivo coding), thereby preserving the authenticity of meaning. Over 250 initial codes were generated from the twelve interviews.

During axial coding, these open codes were clustered into broader categories based on conceptual similarity and thematic overlap. Constant comparison was applied to identify relationships between codes, ensuring coherence and integrative development of categories. For instance, codes such as "access to educational content" and "professional upskilling" were grouped under the category of "specialized learning through social media." Eventually, about 20 subcategories emerged and were organized under six major thematic categories.

In the final stage of selective coding, a central or core category was identified that integrated the major themes and addressed the overarching research question.

## 3. Findings and Results

The participants in this study included 12 individuals—6 women and 6 men—representing a diverse range of educational backgrounds, professional domains, and levels of engagement with social media. The age of participants ranged from 25 to 45 years, with the majority distributed across the 25–30, 30–35, and 35–40 age brackets. In terms of academic qualifications, most held a master's degree (7 individuals), while others had completed undergraduate studies (4 individuals) or held doctoral degrees (2 individuals). Professionally, the participants were engaged in various fields such as sustainable development consulting, IT research, media and journalism, academic teaching, environmental campaigning, NGO work, business analysis, content creation, and social entrepreneurship. Their experience in purposeful social media activity—defined as using digital platforms for education, awareness, innovation, or civic participation—ranged from 2 to 7 years, with an average of approximately 4.5 years. This demographic variety contributed to a rich, multifaceted exploration of how social media supports collaborative innovation and urban sustainability.

**Table 1. Main Themes, Subthemes, and Concepts (Open Codes)**

| Category (Main Theme) | Subcategory | Concepts (Open Codes) |
|---|---|---|
| 1. Enhancing Environmental Literacy through Awareness Campaigns | Social Media as a Green Learning Space | Eco-educational content, Instagram infographics, short videos on recycling, live talks with environmentalists, awareness reels |

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| | Influencers' Role in Spreading Environmental Norms | Eco-influencers, storytelling techniques, role modeling sustainable habits, emotional persuasion, follower engagement |
| | Visual and Interactive Environmental Communication | Before-after images of pollution, gamified challenges, interactive quizzes, infographics on carbon footprint |
| | Viral Campaigns on Climate Change | Hashtag challenges, Earth Day campaigns, user-generated content, trend-based posts, community pledges |
| | Youth Participation in Digital Green Movements | Student-led initiatives, youth green clubs online, Gen Z climate activism, TikTok environmental videos, collaboration with NGOs |
| | Translation of Global Messages into Local Context | Local dialects in campaigns, Tehran-specific issues, adapting global challenges to Iranian realities, cultural symbols in messaging |
| | Countering Misinformation about Environmental Issues | Fact-checking posts, expert interviews, myth-busting stories, flagged misinformation, correcting common ecological myths |
| 2. Collaborative Innovation through Citizen Problem Solving | Digital Brainstorming and Idea Co-Creation | Open calls for ideas, crowdsourcing, online design thinking, feedback loops, creative co-authoring |
| | Community-Based Urban Design Feedback | Geo-tagged reports, participatory maps, comments on street design, collaborative planning apps, public surveys |
| | Peer-to-Peer Skill Sharing for Urban Solutions | DIY tutorials, mentoring via comments, citizen engineers, video-based solution exchange |
| | Innovation Labs and Hackathons via Social Platforms | Social media-hosted hackathons, Telegram idea groups, virtual innovation sprints, youth civic challenges |
| | Integration of Local Knowledge in Policy Dialogues | Livestream Q&As with officials, citizen storytelling, local data sharing, integrating lived experience into planning |
| | Resource Exchange through Digital Trust Networks | Lending tools online, local barter pages, peer resource maps, trust-based sharing, WhatsApp sustainability circles |
| 3. Behavioral Change through Peer-Generated Content | Modeling Everyday Eco-Friendly Actions | Peer videos of composting, bike-to-work vlogs, shopping sustainably, showing green home routines |
| | Influence of Micro-Communities on Habits | Group accountability posts, supportive comments, behavior-tracking challenges, motivation circles |
| | Emotional Resonance through Storytelling | Personal waste-reduction stories, overcoming resistance to change, narratives of transformation |
| | Value-Driven Content Engagement | Content aligned with Islamic environmental ethics, eco-values discussions, crowd validation of values |
| | Triggering Reflexivity through Online Dialogue | "Why I changed" discussions, debating convenience vs. ethics, dilemmas in sustainability posts |
| 4. Social Mobilization through Hashtag Activism and Online Coordination | Hashtag Movements for Urban Environmental Justice | #CleanAirForTehran, #SaveJamshidieh, trend coordination, tagging city officials |
| | Flash Campaigns for Policy Impact | Sudden spikes in posting, mobilization after crises, tagging ministries, policy change demands |
| | Online-Offline Synergy for Collective Action | Marches coordinated via Instagram, clean-up events through Telegram, turnout via WhatsApp broadcast |
| | Influencing Local Decision-Making | City council tagging, inviting officials to live chats, pushing petitions, coordinated comment storms |
| | Creating Shared Digital Identity | Common slogans, campaign logos, profile frame adoption, collective aesthetic for activism |
| | Sustained Participation through Digital Rituals | Weekly challenges, eco-Friday posts, monthly impact tracking, virtual commemorations |

**Category 1: Enhancing Environmental Literacy through Awareness Campaigns**

Participants frequently described social media as a green learning space, where environmental concepts were introduced through simple, visual, and accessible formats. Many pointed to platforms like Instagram and YouTube as their first exposure to recycling tips, climate change information, and sustainable habits. As one participant shared: "I never really thought about my water usage until I saw a short animation on my feed showing how much water goes to waste brushing teeth without turning off the tap."

The role of influencers in spreading environmental norms was prominent. Respondents indicated that when trusted influencers shared eco-friendly behaviors, followers were more likely to emulate them. One participant mentioned: "When a well-known lifestyle blogger switched to reusable bags, it felt normal to do the same—I didn't question it." Influencers' personal stories and emotional framing made abstract issues relatable.

The use of visual and interactive communication tools—like infographics, quizzes, and challenge-based content—was also cited as enhancing engagement. For example, several participants mentioned participating in a "plastic-free challenge" where they documented their daily progress. As one interviewee explained: "It was fun and easy to follow because they posted steps every day. You didn't have to be an expert."

Viral campaigns on climate change served to amplify awareness, especially when tied to international observances like Earth Day. Participants described feeling part of a larger global movement through hashtags and shared visuals. “It felt like I was marching with millions of people online,” said a participant who had engaged with #ClimateStrike posts.

Notably, youth participation in digital green movements emerged as a vibrant force. Young respondents, particularly students and Gen Z activists, reported creating and sharing their own content—videos, memes, and critiques—through platforms like TikTok. One interviewee said: “We may not be in parliament, but we have Instagram—and that’s powerful.”



Participants also highlighted the translation of global environmental messages into local context as essential for relevance. Posts referencing Tehran-specific challenges—like air pollution or water scarcity—were more impactful. As one respondent explained: “It’s one thing to talk about melting glaciers; it’s another to see smog over Milad Tower.”

Finally, many users described their efforts in countering misinformation about environmental issues by sharing fact-checked content or correcting myths in comment sections. “People still think separating trash is pointless. I often reply with data or expert videos to explain why it matters,” shared one participant.

**Category 2: Collaborative Innovation through Citizen Problem Solving**

A key finding was the prevalence of digital brainstorming and idea co-creation. Participants described using platforms like Telegram or Twitter to crowdsource urban improvement ideas. “We once redesigned a park bench digitally by sharing sketches in a WhatsApp group,” noted one interviewee. This collective ideation process helped generate context-aware, low-cost solutions.

Community-based urban design feedback emerged through features such as geo-tagged complaints or comment threads on poor infrastructure. Some respondents referenced tagging local officials in stories showing cracked sidewalks or broken public furniture. One participant remarked: “We turned every citizen into an urban inspector—with just a phone camera.”

The culture of peer-to-peer skill sharing enabled residents to exchange knowledge on waste sorting, upcycling, or water-saving practices. Through DIY tutorials and digital mentoring, people learned from one another. As one respondent put it: “I didn’t need a workshop—I just watched someone from my neighborhood fix their faucet on YouTube.”

The rise of innovation labs and hackathons via social media was also noted. Participants described joining themed events that encouraged creative thinking for sustainability, such as "48-hour green challenges" hosted on Instagram Lives or Clubhouse rooms. “It was intense but exciting—we built a prototype for a vertical garden system from our phones,” said one user.

Another layer involved the integration of local knowledge in policy dialogues. Interviewees discussed participating in livestream discussions with city officials or posting personal stories that resonated with broader planning issues. “I once talked about waste in our alley, and the council member reshared my story—people started paying attention,” one participant recalled.

Finally, resource exchange through digital trust networks (such as sharing gardening tools or books via Telegram groups) underscored the importance of social capital in innovation. “We trust each other online because we’ve worked on campaigns before—it’s not just anonymous,” said an activist involved in urban farming.

**Category 3: Behavioral Change through Peer-Generated Content**

Participants frequently described how modeling everyday eco-friendly actions by peers—such as composting or reducing plastic—encouraged them to adopt similar behaviors. For example, one participant shared: “When my colleague showed his rooftop garden on stories, I thought—if he can do it in Tehran, I can too.”

The influence of micro-communities (e.g., WhatsApp eco-groups or Instagram friend circles) was highlighted as crucial in sustaining change. These groups acted as informal accountability systems. “We have a Telegram group where we share our green goals each week. It’s like a gym buddy, but for the planet,” explained one respondent.

Emotional resonance through storytelling emerged as a powerful motivator. Narratives of personal transformation and vulnerability were frequently cited as catalysts for action. “I cried when a woman posted about how her child’s asthma got worse due to pollution. It hit home and made me change,” one participant admitted.

Respondents also emphasized the appeal of value-driven content engagement, where religious, ethical, or community-based motivations aligned with sustainability themes. For instance, content referencing Islamic views on cleanliness or balance with nature was well received. One interviewee stated: “When someone said wasting water goes against Islamic teachings, it just clicked.”

Lastly, triggering reflexivity through online dialogue played a significant role. Discussion posts and polls sparked introspection about daily habits. “Someone asked, ‘Do you really need three showers a day?’ and I actually stopped to think about it,” said one respondent.

**Category 4: Social Mobilization through Hashtag Activism and Online Coordination**

Participants provided rich examples of how hashtag movements for urban environmental justice mobilized digital publics. Tags like #CleanAirForTehran or #SaveJamshidieh were described as rallying cries that sparked collective momentum. One participant reflected: “When we all posted under the same hashtag, it felt like we were one voice.”

Flash campaigns for policy impact often arose following environmental incidents—like water shortages or tree removal. Participants reported rapid, large-scale engagement. “We flooded the ministry’s page with comments after that illegal construction in the park,” explained a user who participated in a campaign.

The online-offline synergy for collective action allowed organizers to translate digital momentum into real-world events, such as cleanup days or awareness walks. “We organized an event to clean the riverbanks, all via Instagram DMs,” one participant noted.

Influencing local decision-making through social media was another emergent strategy. Participants mentioned tagging city council members, initiating online petitions, or inviting officials to join live broadcasts. As one interviewee explained: “We cornered the mayor digitally—he couldn’t ignore 10,000 angry comments.”

A notable theme was the creation of a shared digital identity. Users adopted campaign slogans, visual frames, or coordinated display pictures to signify membership in a cause. “We changed our profile frames to green and it gave us a sense of belonging,” said a participant.

Lastly, sustained participation through digital rituals helped maintain long-term engagement. Participants described recurring posts like “Eco Fridays” or monthly waste audits as ways to keep motivation high. “Every first Sunday, we post our eco-goals. It’s become a habit now,” shared one user.

## 4. Discussion and Conclusion

The findings of this study reveal four primary mechanisms through which social media platforms contribute to collaborative innovation, human capital development, and sustainable urban transformation in Tehran: enhancing environmental literacy, enabling citizen-driven innovation, shaping behavioral change through peer content, and supporting social mobilization through digital coordination. These dimensions collectively portray social media not as passive communication channels but as dynamic infrastructures of civic participation and decentralized learning. Through in-depth interviews and grounded theory analysis, it becomes clear that these platforms offer unique affordances that can activate social and human capital in service of urban sustainability.

The first major finding—enhancing environmental literacy through awareness campaigns—highlights the pedagogical role of social media in urban contexts. Participants consistently emphasized how platforms like Instagram and Telegram served as entry points into environmental education, especially through infographics, short videos, and influencer-led content. These findings align with prior work by Sdoukopoulos et al., who argued that social media facilitates the diffusion of sustainability indicators and ecological knowledge at the community level (Sdoukopoulos et al., 2018). Similarly, Barrena-Martínez et al. suggested that open innovation frameworks flourish when citizens are equipped with basic knowledge and tools, reinforcing the role of informal education in innovation systems (Barrena-Martínez et al., 2020). The grassroots nature of these campaigns, often translated into culturally relevant narratives by local users, underscores the contextualization of global ecological discourse—a process crucial for environmental transformation in cities like Tehran.

The second key result centers on collaborative innovation through citizen problem-solving. Participants described various ways in which social media platforms functioned as open labs for ideation, co-design, and knowledge sharing. Digital brainstorming, participatory urban design feedback, and hackathons were identified as everyday practices within these environments. These results resonate with studies by Cachay-Huamán, who illustrated how MOOCs and other digital platforms enable collaborative and interdisciplinary educational innovation (Cachay-Huamán & Ramírez-Hernández, 2019). Likewise, Krishna’s study on universities in national innovation systems emphasized the shift toward collaborative models that

extend beyond institutional boundaries to include civil society actors (Krishna, 2019). In this sense, the findings in Tehran reflect broader global trends in the democratization of innovation and the importance of civic tech in urban governance.

A related mechanism was found in the behavioral change triggered by peer-generated content. Participants frequently referred to how observing sustainable behaviors among peers—such as composting, biking, or water conservation—motivated personal change. These behaviors were often reinforced through digital micro-communities that provided accountability and emotional support. This dynamic is supported by Masoumparast et al., who highlighted the importance of social capital and emotional intelligence in shaping the psychological well-being of educational staff, suggesting that emotional resonance is a critical factor in behavior adoption (Masoumparast et al., 2019). Similarly, Hosseini et al. demonstrated how social media use impacts employee performance by mediating through social capital dimensions such as mutual trust and shared norms (Hosseini et al., 2020). These findings collectively reinforce the idea that social media facilitates behavioral change not through one-way messaging but via interaction, resonance, and community validation.



The final major theme—social mobilization through hashtag activism and digital coordination—points to the strategic use of social media for civic influence and grassroots organizing. Participants recounted using platforms to organize clean-up drives, comment storms on municipal pages, and coordinated campaigns targeting local policymakers. This aligns with Nguyen et al.'s findings on the role of digital transformation in enabling access to resources and human capital for startups, especially during moments of crisis (Nguyen et al., 2023). In Tehran's constrained civic space, digital platforms offer a workaround to physical limitations, allowing citizens to scale collective action and influence policy outcomes. This is also echoed in Volpe et al.'s study on cross-border digital innovation hubs (DIHs), which found that experimentation through digital networks enhances service capacity and resilience, especially among under-resourced communities (Volpe et al., 2021).

Underpinning all four of these mechanisms is the interplay between human capital and social capital. Participants in this study were not passive users but knowledge producers, mentors, campaigners, and co-creators—demonstrating high levels of digital literacy, self-efficacy, and trust-based collaboration. These qualities reflect the foundational insights of Nazari Ebrah Bakoh et al., who examined how the interplay of human and social capital at the board level impacts financial performance—translating in this study to social performance and community resilience (Nazari Ebrah Bakoh & Azizi, 2022). Similarly, Li et al. underscored the role of social capital as a mediating variable in the relationship between technological capability and organizational resilience, a finding that resonates with how Tehran's digital communities create adaptive responses to environmental and governance challenges (Li et al., 2024).

Additionally, the emphasis on peer learning, civic innovation, and ecological accountability mirrors Jalali and Tajik's findings on how employee development methods (e.g., participatory training and digital learning) enhance both human and social capital, particularly when knowledge management is central (Jalali & Tajik, 2024). These synergies are crucial in urban innovation ecosystems, where decentralized actors co-produce value and drive sustainable transitions. As Khoshmaram et al. demonstrated in the agricultural sector, environmental support mediated through social capital and entrepreneurial behavior creates pathways to change—a finding that this study confirms in the urban-digital context of Tehran (Khoshmaram et al., 2020).

The findings also validate Khodaparast et al.'s model in which knowledge-based human resource management positively affects innovation outcomes via the mediating role of social capital (Khodaparast et al., 2021). These parallels suggest that digital engagement, when designed and supported effectively, serves as a form of informal HRM—particularly for citizen innovators and digital activists. The result is a bottom-up mechanism for building innovative capacity in environments where top-down interventions are insufficient.

In terms of broader institutional implications, the data affirm Ahmadzadeh and Shokouh's proposition that sustainable HRM practices, when combined with strong social networks, foster innovation and organizational citizenship behavior (Ahmadzadeh & Shokouh, 2020). Although this study focuses on informal digital communities rather than formal organizations, the mechanisms of trust-building, mutual learning, and civic responsibility remain consistent. This speaks to the utility of applying HRM and organizational behavior frameworks to the study of digital urban communities.

Finally, the narratives gathered in this study reflect the deeper sociocultural and motivational currents outlined by Teymoori and Amirkhani, both of whom emphasized the role of motivational and psychological capital in sustaining long-term human

development outcomes (Amirkhani et al., 2014; Teymoori, 2018). Participants in this study were not simply acting on environmental knowledge; they were emotionally and ethically invested in collective futures—highlighting the critical role of digital spaces in cultivating meaning, identity, and civic hope in urban life.

While this study offers rich insight into the intersection of social media, collaborative innovation, and urban sustainability, it is not without limitations. First, the sample size, though methodologically justified through theoretical saturation, remains relatively small and context-bound. All participants were based in Tehran and had pre-existing familiarity with digital platforms, which may limit generalizability to more marginalized or offline populations. Second, the reliance on self-reported data from interviews may be influenced by participants' desire to present their engagement in socially favorable terms. Third, the evolving nature of digital platforms means that affordances and usage patterns are constantly shifting—posing challenges for longitudinal reliability. Finally, regulatory and political constraints on social media in Iran could have impacted the depth and openness of participants' disclosures, potentially underrepresenting more contentious or critical narratives.



Future studies could expand this research in several directions. First, comparative research across different Iranian cities—or even transnational comparisons in similar urban settings in the Global South—could shed light on how sociotechnical infrastructures vary across political and cultural contexts. Second, longitudinal studies would be useful to track how patterns of engagement evolve over time, particularly as digital platforms change their algorithms or governance structures. Third, more targeted investigations into the role of gender, class, or education in shaping digital participation would help unpack the internal dynamics of online environmental communities. Additionally, future research could explore the role of specific platform affordances (e.g., hashtags, live streaming, comment sections) in enabling or constraining innovation, coordination, and learning. Finally, integrating digital trace data or social network analysis could complement interview-based insights and provide quantitative validation for the emergent conceptual model.

To leverage the transformative potential of social media in urban sustainability, policymakers and civic actors must embrace these platforms as legitimate arenas of participation and innovation. Municipal institutions should actively collaborate with digital communities, environmental influencers, and youth networks to co-design awareness campaigns and support community-led interventions. Educational institutions and NGOs can integrate digital literacy, social innovation, and ecological ethics into their training programs to nurture the next generation of civic innovators. Technology developers and platform managers should prioritize affordances that encourage constructive dialogue, peer learning, and transparency. Finally, regulatory frameworks should be revised to safeguard freedom of digital expression while supporting ethical norms of participation, ensuring that social media remains a space for inclusive, collaborative urban transformation.

## Ethical Considerations

All procedures performed in this study were under the ethical standards.

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## Conflict of Interest

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