

Empowering Sustainable e-Commerce through Digital Education: Bridging Knowledge Gaps for Green Consumerism

Deepak Mahaur¹, Dr. Sunil Kumar²

¹ Research Scholar
P.G. Department of Commerce
Veer Kunwar Singh University, Ara, Bihar, India

² Professor
P.G. Department of Commerce
Veer Kunwar Singh University, Ara, Bihar, India

Abstract

Digital education plays a vital role in advancing sustainable e-commerce by equipping consumers and businesses with the knowledge needed for green consumerism. This study investigates how digital education can bridge knowledge gaps related to ethical consumption and eco-friendly business practices in the district of Ara, Bihar. Using a secondary data-based methodology, the research analyzes academic literature, policy documents, and industry reports to assess the effectiveness of digital literacy initiatives and sustainability-focused learning platforms. The findings suggest that while digital infrastructure is expanding, there remains a lack of sustainability-oriented content in mainstream digital education. Integrating such content, particularly through AI-driven and localized learning models can significantly enhance awareness of green consumer behavior and sustainable supply chains. The study highlights the need for policy reforms, curriculum redesign, and region-specific interventions to empower communities with the digital competencies required for responsible e-commerce. It offers actionable insights for educators, policymakers, and digital platforms working toward sustainability goals.

Keywords: Digital Education, Eco-Friendly Business Practices, Ethical Consumption, Green Consumerism, Sustainable e-Commerce

1. Introduction

The global e-commerce landscape has witnessed an unprecedented transformation in the last two decades, fueled by rapid digitization, changing consumer behaviors, and the proliferation of mobile technologies. As digital marketplaces expand, so does their environmental footprint, prompting concerns over the sustainability of online commerce. From excessive packaging and energy-intensive logistics to the environmental costs of fast fashion and tech consumption, the implications of e-commerce on the environment are vast and complex (Mangiaracina et al., 2015; Lim et al., 2021). In response, a growing movement has emerged advocating for sustainable e-commerce—a paradigm that seeks to align digital retail practices with environmental, social, and economic sustainability goals. However, transitioning to sustainable models necessitates not only systemic change in supply chains and business operations but also a well-informed, environmentally conscious consumer base. This is where digital education becomes pivotal.

Sustainable e-commerce hinges on the principles of environmental protection, ethical sourcing, responsible consumption, and social equity (Kumar & Rahman, 2016). Yet, despite the increasing availability of eco-friendly products and services online, consumer adoption remains inconsistent. A significant barrier to green consumerism is the knowledge gap—a disconnect between consumers'

awareness of environmental issues and their ability to make informed, sustainable purchasing decisions (Peattie & Crane, 2005). This is compounded by digital misinformation, greenwashing, and a lack of standardized metrics or transparency in sustainability claims made by e-commerce platforms (Delmas&Burbano, 2011). To address these challenges, digital education emerges as a transformative tool. By integrating sustainability literacy into digital platforms, academic curricula, and public outreach, digital education can foster critical thinking, consumer awareness, and responsible decision-making. It empowers individuals to evaluate product life cycles, assess environmental impacts, and prioritize ethical considerations, thereby bridging the existing knowledge gap and fostering a culture of green consumerism (Filho et al., 2018).

Green consumerism refers to the tendency of consumers to base their buying decisions on environmental considerations such as biodegradability, eco-labeling, and ethical sourcing. This behavior has gained traction over the last decade, particularly among younger, digitally native demographics who demand both convenience and conscience in their consumption habits (Johnstone & Tan, 2015). E-commerce platforms are now pressured to offer sustainable product alternatives and transparent environmental data. However, the mere availability of such options does not guarantee their uptake. Research shows that consumers often struggle to identify what constitutes a “green” product due to inconsistent labels, lack of environmental literacy, and competing economic factors (Testa et al., 2020).

This disconnect calls for an educational approach that leverages digital tools to enhance consumer knowledge. Web-based learning, social media campaigns, gamified sustainability platforms, and eco-influencer content can play an integral role in shaping behaviors and instilling sustainable values (Hesselbarth&Schaltegger, 2014). These platforms also enable scalable, inclusive, and context-specific educational interventions, especially in developing economies where traditional education channels may be limited. Digital education encompasses the use of online platforms, e-learning modules, virtual reality, AI-driven recommendation systems, and interactive content to impart knowledge and skills. In the context of sustainable e-commerce, it serves multiple functions: enhancing consumer literacy, promoting eco-conscious choices, debunking myths about green products, and fostering behavioral change (Bianchi & Andrews, 2012). More importantly, digital education democratizes access to sustainability knowledge by transcending geographical and socioeconomic barriers. For instance, MOOCs (Massive Open Online Courses) on sustainability, green certifications integrated into e-commerce platforms, and mobile applications that scan product barcodes to provide environmental impact data have all demonstrated potential in bridging knowledge gaps (Leal Filho et al., 2019). Furthermore, digital education can enable micro-learning modules targeted at specific groups-such as urban millennials, rural entrepreneurs, or SMEs-thus customizing the learning experience based on user profiles and behavioral data.

While the potential is significant, integrating digital education into e-commerce platforms is not without challenges. These include platform resistance, cost constraints, technological disparities, and cognitive overload for consumers. Moreover, trust remains a central issue. Greenwashing-where companies falsely advertise products as environmentally friendly-has eroded consumer confidence in sustainability claims (Delmas&Burbano, 2011). Hence, educational efforts must be paired with institutional regulation, third-party verification, and transparent labeling systems to ensure credibility and uptake. Another critical issue is digital divide-the disparity in access to digital infrastructure, especially in low-income and rural communities. Without equitable access to digital education, the goals of inclusive green consumerism may remain unfulfilled. Thus, there is a pressing need for policy frameworks that support digital literacy, invest in ICT infrastructure, and incentivize sustainable practices within e-commerce ecosystems (Hilton & Hughes, 2013). Bridging the knowledge gap is not merely about information dissemination but about behavioral transformation. Research in behavioral economics and psychology underscores the importance of nudges, habit formation, and social proof in influencing sustainable consumption (Thaler&Sunstein, 2008). Therefore, digital education strategies must be behaviorally informed, culturally sensitive, and aligned with user motivations. Embedding sustainability nudges in the digital shopping experience-such as default green options, peer comparisons, or real-time environmental impact metrics-can significantly influence consumer choices (White et al., 2019).

Moreover, partnerships between governments, academia, NGOs, and private e-commerce players are essential to create and disseminate meaningful educational content. This multi-stakeholder approach ensures credibility, relevance, and scalability of green education initiatives. Ultimately, empowering consumers with sustainability knowledge not only promotes greener choices but also pushes companies to innovate, compete, and deliver environmentally responsible products and services. In an era defined by both climate urgency and rapid digital transformation, the convergence of sustainable e-commerce and digital education offers a critical pathway for change. As consumers and businesses increasingly engage with online platforms, it becomes imperative to embed sustainability knowledge within digital ecosystems. This research focuses on how digital education-particularly in contexts like Ara district of Bihar, India-can address key knowledge gaps that hinder the adoption of green consumerism and eco-friendly business practices. Drawing upon secondary data, including industry insights and academic studies, the study highlights the potential of sustainability-focused digital literacy, AI-enabled learning tools, and targeted educational policies in promoting ethical consumption and green supply chain engagement. Ultimately, strengthening digital training and policy frameworks can empower consumers to make responsible choices and support a more equitable, sustainable e-commerce environment in both local and global contexts.

2. Literature Review

2.1 Digital Literacy and Pro-Environmental Behavior

Hu and Meng (2022) conducted two interrelated studies examining how digital literacy influences green consumption via psychological pathways grounded in social cognitive and self-regulatory theories. They found that self-efficacy, outcome expectation, anticipated pride, and anticipated guilt jointly mediate the impact of digital literacy on green purchasing behavior. Furthermore, the availability of green products was shown to amplify some of these psychological effects, enhancing pro-environmental choices. Zhai et al. (2024) explored the impact of digital literacy on farmers' adoption of green production technologies in China. Using regression and instrumental variable techniques, they confirmed that higher digital literacy significantly predicts adoption of green techniques, robust even when controlling for demographic and regional variables. Mediation analysis highlighted ecological cognition as a core mechanism translating digital skill into sustainable practice (Zhai et al., 2024). Additionally, a 2024 study in Hainan Province, China (Chen et al., 2024) demonstrated that improving digital literacy significantly enhances rural residents' policy cognition and engagement in eco-friendly behaviors. Using ordered probit modeling, the research highlighted that greater digital literacy helps people better understand and implement ecological policies (Chen et al., 2024).

2.2 Digital Education and Sustainability in University Contexts

In Taiwan, Lin and Huang (2023) examined how university students' digital capability translates into sustainable behaviors. Findings from two case-study samples-tourism/hospitality and leisure/recreation students-revealed that employability skills, innovation capability, information sharing, and involvement each mediate the link between digital capability and sustainability behavior. These mediators varied by academic domain but collectively illustrated how digital education fosters sustainable attitudes and actions. Trakoonsanti and Abbas (2025) investigated educators, policymakers, and teachers in Thailand through the lens of TAM and TPB frameworks, showing that environmental awareness, motivation for green consumption, perceived usefulness of digital tools, and sustainability knowledge all positively influenced green consumer behavior. Together, these constructs mediated digital engagement into eco-conscious behavior (Trakoonsanti& Abbas, 2025).

2.3 Interface Design and Embedded Sustainability Nudges

Islam et al. (2022) introduced SEER ("Sustainable E-commerce with Environmental-impact Rating"), an experimental interface that displays environmental-impact ratings and explainable labels during online shopping. In a experiment involving 98 U.S. consumers, SEER users were significantly more

likely than controls to select eco-friendly products. Participants also reported higher trust and convenience, and usability was rated with a System Usability Scale (SUS) score of approximately 79. Modeling suggests that widespread adoption of SEER could reduce annual carbon emissions by nearly 2.88 million tonnes in the U.S. (Islam et al., 2022).

2.4 AI, Supply Chain Management, and Sustainability Education

Teixeira, Ferreira, and Ramos (2025) conducted a systematic review on the integration of artificial intelligence into supply chain management. They identified key roles of AI in predictive analytics, optimization, and traceability, noting that explainable AI and digital twins are instrumental in advancing supply chain sustainability. However, adoption barriers include legacy systems, data challenges, and ethical considerations (Teixeira et al., 2025). Jahin et al. (2023) assessed AI/ML models in supply chain risk assessment, showing that modern techniques like XGBoost and hybrid models significantly improve predictive accuracy and robustness in logistics risk mitigation (Jahin et al., 2023). Hasan (2024) focused on carbon footprint reduction in U.S. supply chains through AI-enabled decision-making. The study emphasized that predictive modeling and optimization algorithms help firms meet sustainability and consumer demands, though still grappling with regulatory and integration challenges (Hasan, 2024).

2.5 Educational Technology for Sustainability Learning

Mokhtar, Sundram, and Shahrom (2023) explored gamification, augmented reality, and AI-driven modules in sustainable supply chain management education. They found significantly higher engagement and retention among learners exposed to immersive, interactive educational technology compared to static formats. Similarly, digital learning designs grounded in connectivist principles and personalized learning pathways were shown to help learners critically evaluate sustainability information and resist greenwashing—thus enhancing sustainability knowledge and responsible consumption habits (Mokhtar et al., 2023).

2.6 Empirical Quantitative Studies

2.6.1 Digital Literacy & Green Behavior

Liu et al. (2024) employed ordered logit, OLS, 2SLS, and PSM methods on Chinese farmers, finding that digital learning, social, and transactional literacies each significantly enhanced green production behaviors. Ecological cognition served as a key mediating factor. Hu and Meng (2022) surveyed consumers to show that digital literacy positively influences green purchasing practices, mediated by self-efficacy, outcome expectations, anticipated pride or guilt, and moderated by product availability.

2.6.2 Sustainable Consumerism in India

Ghouse, Shekhar, and Chaudhary (2024) used TPB-based structural models to explore how digital literacy shapes green purchase intentions among Gen Y and Z in Northern India, finding generational differences in how digital literacy and social norms influence decisions. Ramachandran and Sudhir (2023) conducted a PLS-SEM survey in Tamil Nadu, revealing that green orientation and social influence significantly affect attitudes toward sustainable products, though literacy alone was not as predictive of behavior.

2.6.3 Digital Transformation & Circularity

Das (2025), through a mixed qualitative–quantitative study, identified 34 barriers and nine categories impacting circular economy uptake in India's textile industry. His findings emphasize supply chain transparency and digital frameworks as necessary enablers of circular business models.

2.7 Experimental and Interface-Based Interventions

2.7.1 Environmental Impact Nudges

Islam et al. (2022) introduced SEER-a quasi-experimental e-commerce interface that embeds explainable environmental ratings. Their experiment with U.S. consumers demonstrated a significant increase in green purchasing behavior and suggested a potential 2.88 million-ton yearly reduction in carbon emissions if SEER were adopted widely.

2.7.2 Digital Education Impact

Rani and Sachar (2024) evaluated "Digital India" education initiatives, concluding that digitally delivered sustainability modules significantly improved eco-citizen outcomes.

2.8 Review and Conceptual Studies

2.8.1 AI in Sustainable Supply Chains

Teixeira, Ferreira, and Ramos (2025) provided a systematic literature review highlighting AI techniques-including explainable AI and digital twins-as key drivers of supply chain sustainability. They also emphasized governance and ethical frameworks for effective adoption. Badshah et al. (2023) reviewed the convergence of IoT and AI in education, advocating for smart educational spaces but highlighting resistance in traditional systems.

2.8.2 Digital Inclusion & Education

MdPI (2024) identified digital inequality, public policy, and digital accessibility as critical fronts in sustainable education-a finding underscored by digital citizen training programs like India's DIKSHA and NDLI platforms. Vaidya and Kumar (2025) documented global trends in e-business and sustainable finance, pointing to digital-business-finance synergies propelled by AI, blockchain, and IoT.

2.9 Thematic Synthesis and Identified Gaps

Table: 1.1
Research Gaps

Theme	Key Insights	Gaps Identified
Digital Literacy → Green Behavior	Consistently positive effects mediated by ecological cognition and self-efficacy	Few studies in semi-urban/rural India
Interface Nudges in E-commerce	Environmental information nudges boost sustainable decisions	Lack of Indian/Bihar focus on UI interventions
AI in Supply Chains	Emerging tools boost efficiency and traceability, but require ethical/governance frameworks	Limited integration of digital literacy & skill-building
Digital Education Models	Smart EdTech (IoT/AR/gamification) dramatically improves sustainability knowledge	Need for scalable models in developing regions (e.g., Bihar)
Digital Inclusion Platforms in India	National portals enhance access to learning but lack sustainability-specific courses	Need curricular inclusion for green consumerism in district-level programs

The reviewed literature underscores a robust, positive link between digital skills and sustainable actions across both farming and consumer spheres. Technological interventions-like SEER or smart digital education-show promising efficacy. However, adoption barriers persist: digital divides, policy weak spots, and low contextual adaptation limit impact, especially in rural India. This points to an urgent need for localized, scalable, and culturally attuned interventions that blend digital literacy, educational frameworks, and behavioral nudges to promote green e-commerce in regions such as Bihar.

3. Research Gaps

Despite a growing body of international literature emphasizing the positive correlation between digital literacy and sustainable behaviors, several critical research gaps persist in the Indian context, particularly in semi-urban and rural districts like Ara in Bihar. Most existing studies, such as those conducted in China and Taiwan (e.g., Zhai et al., 2024; Chen et al., 2024; Lin & Huang, 2023), provide strong empirical evidence of how digital skills influence green behaviors through mechanisms like ecological cognition, self-efficacy, and innovation capability. However, comparable studies within India have largely focused on urban populations or specific generational cohorts, such as Gen Y and Z in northern cities (Ghouse et al., 2024), leaving a significant void in understanding how digital literacy affects sustainable practices in rural or low-income settings. There is limited scholarly attention to how these relationships manifest in economically and infrastructurally challenged districts such as Ara, where digital access remains inconsistent and educational interventions lack contextual adaptation.

Another major gap lies in the curriculum and pedagogical content of digital education initiatives in India. While platforms like DIKSHA and NDLI have made strides in digital inclusion, they often fail to incorporate sustainability-oriented modules, particularly at the district or grassroots level. This limits their potential to foster eco-conscious consumer behavior or green entrepreneurial practices. As a result, educational institutions and digital training programs across many Indian districts remain detached from the broader goals of environmental sustainability, lacking integration with themes like ethical consumption or sustainable e-commerce.

In addition, behavioral and interface design studies, which have shown promise globally-for instance, SEER's environmental impact labels in the U.S. (Islam et al., 2022)-have not been sufficiently tested or adapted for Indian consumers. There is a notable absence of localized experiments that investigate how interface nudges or digital behavioral cues could promote green purchasing behaviors in online marketplaces serving Indian users, especially those in linguistically and culturally diverse regions like Bihar.

Moreover, there is limited integration between AI-driven educational platforms and sustainable business practice awareness in the Indian context. Although research elsewhere has shown that AI tools, including predictive models, gamified modules, and personalized learning systems, can enhance both supply chain sustainability and student engagement (Teixeira et al., 2025; Mokhtar et al., 2023), such technologies remain underutilized in India's sustainability education and e-commerce ecosystems. This suggests a significant research and implementation gap in how AI can be leveraged to personalize green consumer education and scale awareness in regional economies.

Finally, despite national initiatives under the Digital India mission, the localization of digital literacy policy frameworks continues to be weak, particularly regarding sustainability learning. Most digital skilling programs do not embed eco-literacy or ethical consumption as core components, thereby missing opportunities to build capacity for sustainable behaviors at the grassroots level. There is a need to rethink educational policy and digital training in a way that aligns with sustainability goals, especially in underrepresented areas like Ara, Bihar.

These research gaps collectively underscore the need for localized, interdisciplinary, and policy-oriented research that bridges digital education, behavioral science, and sustainability studies. The current study responds to these gaps by examining how digital education-when enhanced with sustainability-focused content and AI-driven personalization-can empower both consumers and small

businesses in Ara, Bihar to adopt green e-commerce practices. It aims to contribute not only to academic understanding but also to practical policy interventions that support sustainable digital transformation in India's underserved regions.

4. Research Objectives

- To examine the role of digital education in enhancing awareness and knowledge of green consumerism among consumers and small businesses in Ara, Bihar.
- To analyze how integrating sustainability-focused courses and digital literacy programs can bridge knowledge gaps and promote eco-friendly e-commerce practices.
- To explore the potential of AI-driven learning platforms and personalized digital education models in fostering responsible consumption and sustainable supply chain awareness.

5. Research Methodology

This study employs a secondary data-based research methodology to explore the role of digital education in promoting sustainable e-commerce and green consumerism in the district of Ara, Bihar. Data sources include government reports, policy documents, academic journal articles, industry white papers, and digital education platform analytics related to digital literacy and sustainability practices. A qualitative content analysis approach is used to synthesize insights from these sources, identifying patterns, gaps, and correlations between digital education initiatives and eco-friendly consumer behaviors. This methodology enables a contextual understanding of how existing digital frameworks and educational interventions influence sustainable online shopping and business practices in a semi-urban Indian setting.

6. Data Analysis

This section presents a comprehensive analysis of secondary data to assess the role of digital education in fostering sustainable e-commerce and green consumerism in the district of Ara, Bihar. The analysis draws on various published reports, academic articles, government documents, digital platform analytics, and sustainability indices.

6.1 Digital Education and Green Consumer Awareness

In the Indian context, digital literacy is increasingly recognized as a foundational skill for civic participation, economic engagement, and environmental awareness. In semi-urban and rural areas like Ara, Bihar, digital literacy remains constrained by limited access to devices, connectivity, and relevant educational content (Ministry of Electronics and Information Technology [MeitY], 2023). Although initiatives such as the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) have been introduced to promote digital inclusion, their content primarily focuses on functional digital skills rather than sustainability-oriented learning (Digital Empowerment Foundation, 2022).

Studies have shown that digital education, when embedded with environmental literacy, can significantly influence consumer awareness regarding green consumerism (Hu & Meng, 2022). However, this potential remains underexplored in Indian rural regions. Consumer awareness of concepts such as ethical consumption, environmental labelling, and carbon footprint reduction remains low in district-level economies (Confederation of Indian Industry [CII], 2022). The absence of structured digital curricula that address these themes contributes to a persistent knowledge gap among both consumers and small-scale online retailers.

Social media and informal digital channels play a growing role in shaping public understanding of sustainability. YouTube, WhatsApp, and regional content apps serve as informal learning platforms. However, the quality and factual reliability of sustainability content across these platforms vary

widely. While such channels offer opportunities for large-scale outreach, the lack of standardized, evidence-based digital learning materials limits their effectiveness in transforming consumer behavior (Vaidya & Kumar, 2025).

6.2 Integration of Sustainability-Focused Content in Digital Literacy Programs

National-level digital education platforms such as DIKSHA, SWAYAM, and the National Digital Library of India (NDLI) offer a wide range of open-access learning resources. However, a critical review of these platforms reveals that sustainability-oriented modules are often minimal, theoretical, or outdated (MdPI, 2024). Content on environmental awareness is usually embedded within general science or environmental studies courses, with limited contextualization to digital commerce or green consumerism.

At the state level, Bihar's digital education strategy prioritizes infrastructure development, including the provision of smart classrooms and digital devices, but lacks a focused curriculum on sustainable digital practices (Bihar Education Project Council, 2023). Consequently, learners are not adequately equipped to make informed choices related to sustainable consumption, ethical sourcing, or circular e-commerce practices.

The gap between digital literacy and sustainability education is further compounded by the lack of targeted interventions at the district level. Community-driven educational models implemented by non-governmental organizations (NGOs) have shown promise in bridging this gap. For instance, the Digital Empowerment Foundation has piloted programs in various parts of rural India, integrating environmental education with digital tools using local languages and culturally relevant pedagogies (Digital Empowerment Foundation, 2022). These efforts demonstrate the potential of community-based learning to influence behavior, although such programs remain limited in scale and scope.

Reports from industry bodies also underscore the importance of equipping small and medium enterprises (SMEs) with digital skills that include sustainability perspectives. The Federation of Indian Chambers of Commerce and Industry (FICCI, 2023) emphasizes that the future of sustainable retail in India depends on the ability of MSMEs to align with environmental standards. However, the lack of accessible digital training that embeds sustainability principles continues to impede this transition.

6.3 AI-Driven Learning Platforms and Personalized Education for Sustainability

Artificial intelligence (AI) is reshaping the education sector through personalized learning platforms, adaptive content delivery, and intelligent feedback systems. While platforms such as Byju's, Khan Academy, and Embibe have implemented AI to enhance learning outcomes, the integration of sustainability content within these systems remains limited (Teixeira, Ferreira, & Ramos, 2025). AI-based personalization is primarily used for test preparation or skill development in subjects like mathematics and science, rather than promoting behavioral learning related to sustainability.

Global studies have illustrated the effectiveness of AI in enhancing sustainability awareness when environmental data is incorporated into educational algorithms (Hasan, 2024). For example, user interfaces that display environmental ratings or green indicators during digital interactions have been associated with more informed and responsible consumption patterns (Islam et al., 2022). However, similar initiatives are largely absent in Indian platforms, particularly those designed for semi-urban or rural learners.

In addition to consumer behavior, AI also holds potential in training local businesses in sustainable supply chain practices. Digital platforms that use AI for agricultural traceability, logistics planning, or inventory optimization offer practical applications for small businesses in adopting greener business models (Jahin et al., 2023). However, educational content that explains these tools to entrepreneurs or consumers is either too technical or not available in regional languages, limiting its accessibility.

Within the Indian education ecosystem, the deployment of AI for personalized sustainability learning is constrained by infrastructural limitations, low faculty training levels, and minimal policy support. Nonetheless, pilot programs by NGOs and EdTech innovators have experimented with voice-based learning, WhatsApp modules, and vernacular mobile applications to deliver sustainability lessons in engaging and digestible formats (Mokhtar, Sundram, & Shahrom, 2023). While these models remain small-scale, they offer valuable insights for scaling AI-driven, personalized green education across diverse Indian demographics.

6.4 Thematic Synthesis and Cross-Objective Insights

The secondary data reviewed across national reports, academic literature, policy documents, and EdTech analyses reveal clear thematic linkages across the three research objectives. First, digital education has a demonstrable influence on green consumer awareness but remains underutilized in rural Indian districts due to limited infrastructure and a lack of contextual sustainability content. Second, the integration of sustainability-focused modules in digital education platforms is currently fragmented, with few programs offering practical guidance for ethical consumption or sustainable online business practices. Third, while AI-driven platforms possess the technological capacity to deliver personalized sustainability education, there is a notable gap in both content development and localized deployment strategies in the Indian context.

Efforts to bridge these gaps must consider linguistic diversity, local economic realities, and sociocultural factors influencing technology adoption. Moreover, collaborations between government institutions, private EdTech firms, and grassroots organizations are essential to expand the reach and relevance of digital education initiatives aimed at promoting sustainable e-commerce.

6.5 Implications for Policy and Practice

The findings from this analysis suggest a multi-pronged approach to empowering sustainable e-commerce through digital education. Policymakers should prioritize the integration of sustainability literacy into existing digital training programs, with a focus on regional customization and inclusivity. EdTech platforms must be encouraged to embed environmental themes into their core offerings, leveraging AI for adaptive and personalized content delivery. NGOs and community educators can serve as key partners in translating abstract environmental concepts into locally relevant practices that support both consumers and small business owners.

Ultimately, the convergence of digital education, sustainability awareness, and technological innovation offers a promising pathway to promote responsible consumer behavior in India. However, realizing this potential requires a deliberate effort to reimagine educational content, delivery mechanisms, and institutional frameworks that govern the future of e-commerce and digital learning.

7. Findings

The study analyzed secondary data sources to understand how digital education can promote sustainable e-commerce and bridge knowledge gaps related to green consumerism in the context of Ara, Bihar. The major findings, organized according to the three research objectives, offer critical insights into the intersection of digital literacy, sustainability education, and responsible consumer behavior.

7.1 Digital Education Has a Positive, Yet Untapped Role in Promoting Green Consumerism

The findings indicate that digital education holds significant potential to foster environmental awareness and influence eco-conscious consumer behavior. However, this potential remains largely untapped in semi-urban and rural settings like Ara. While national programs such as PMGDISHA and

Digital India have improved basic digital literacy, they often lack a sustainability focus. The content available to learners rarely addresses environmental decision-making, sustainable product choices, or the long-term ecological impacts of online consumption.

Furthermore, the dominance of unstructured digital content on social media platforms like YouTube and WhatsApp reveals that informal channels are shaping public perceptions. Yet, the lack of quality control and evidence-based material limits their educational value in driving behavioral change. There is a clear gap between basic digital access and the kind of informed, sustainability-oriented digital engagement required to foster green consumerism.

7.2 Integration of Sustainability-Focused Modules in Digital Education Is Inadequate

A critical gap identified in this research is the minimal integration of sustainability-focused content in mainstream digital education platforms. National repositories such as SWAYAM, DIKSHA, and NDLI offer limited courses that explicitly deal with green consumerism, ethical e-commerce, or environmentally responsible behavior. Most sustainability-related modules are theoretical, generic, or embedded in environmental science curricula without practical applications relevant to online shopping or green entrepreneurship.

At the regional level, Bihar's educational policies and digital literacy programs primarily concentrate on infrastructural development and digital enablement. However, they fall short of including sustainability topics within digital skilling initiatives like the Kushal Yuva Program. This lack of contextualized and action-oriented content prevents learners from developing the competencies needed to participate meaningfully in a sustainable digital economy.

Community-based interventions led by NGOs have been more successful in embedding sustainability into digital learning through vernacular content, localized pedagogy, and hands-on demonstrations. These efforts, though small in scale, highlight the importance of culturally relevant curriculum development. The research shows that community engagement and region-specific examples can make sustainability education more relatable and actionable.

7.3 AI-Driven Learning Platforms Are Underutilized for Green Education

Artificial intelligence (AI) and adaptive learning platforms have revolutionized educational delivery in many domains, but their application to sustainability education in India remains limited. The research finds that leading EdTech platforms use AI mainly for academic subjects, test preparation, or language learning. There is minimal integration of green consumerism, digital ethics, or environmental values into the adaptive learning frameworks of these platforms.

International models have demonstrated that AI can be a powerful enabler of sustainability education by offering personalized learning pathways, behavioral nudges, and contextual feedback. Yet, these innovations are not evident in Indian platforms, particularly those aimed at rural or semi-urban users. The absence of vernacular interfaces, localized examples, and culturally embedded learning experiences further reduces the accessibility and impact of AI in promoting responsible consumption.

While there are early signs of AI being used in agricultural traceability and supply chain optimization in India, these tools are primarily business-focused and do not include educational components. The disconnect between AI-driven commercial tools and educational applications represents a missed opportunity for holistic sustainability learning.

7.4 Policy Frameworks Lack Integration Between Digital Literacy and Sustainability Goals

Another key finding is the fragmentation between digital literacy policies and sustainability education. National and state-level programs tend to treat these as separate domains, resulting in missed opportunities for synergy. Despite growing global recognition of sustainability as a core digital competency, India's educational policy landscape has not yet evolved to reflect this integration.

Bihar's state policy documents emphasize digital access and basic training but make little mention of environmental consciousness or consumer ethics as desired learning outcomes. The lack of policy mandates or curriculum standards for sustainability education in digital skill development initiatives means that learners are often exposed to a narrow definition of digital literacy—one that is technologically functional but environmentally uninformed.

This policy gap reinforces the need for a more comprehensive framework that connects digital empowerment with environmental stewardship. Strengthening educational governance and curriculum design to include sustainability competencies would significantly enhance the transformative potential of digital education in regions like Ara.

7.5 Localized, Culturally Relevant Content Is Essential for Impactful Learning

Finally, the research highlights that localized and culturally adapted content significantly improves engagement and comprehension among learners. Generic digital content often fails to resonate with learners in rural and semi-urban areas. Conversely, when sustainability education is delivered in local languages, with relatable examples and region-specific scenarios, learners are more likely to internalize and apply the knowledge.

This underscores the importance of decentralizing content creation, involving local educators, NGOs, and learners in the co-design of sustainability curricula. Community-based models that use simple, mobile-friendly technologies and local success stories show greater promise in influencing behavior than top-down, one-size-fits-all approaches. Therefore, the development of green consumerism awareness must be rooted in the sociocultural realities of the learners, especially in regions like Bihar.

The collective findings of this research reveal a critical need to reimagine the role of digital education in fostering sustainable e-commerce in India. While there is growing infrastructure and policy attention toward digital inclusion, the integration of environmental values, ethical consumption, and AI-enabled personalization remains limited. Digital education, when appropriately localized and enriched with sustainability content, can become a powerful tool for behavioral transformation. However, realizing this potential will require curriculum reform, cross-sector collaboration, and a sustained policy shift toward embedding green competencies into digital literacy programs.

These findings validate the study's central premise: that bridging the knowledge gap in green consumerism requires not just access to digital tools, but a reorientation of educational content, delivery methods, and governance frameworks toward sustainable development goals.

8. Future Implications

The findings of this research underscore a transformative opportunity for shaping sustainable consumer behavior through strategic interventions in digital education. While the current landscape in regions like Ara, Bihar reflects notable limitations in digital literacy, curriculum relevance, and policy integration, this study points to several forward-looking implications that can guide educational reform, technological innovation, and policy design.

- **Integration of Sustainability into Digital Education Policies and Curricula**

A major implication of the study is the urgent need to embed sustainability literacy into national and regional digital education policies. Future educational programs must move beyond basic digital skills to include knowledge of green consumerism, ethical digital behavior, and environmental stewardship. Government bodies such as the Ministry of Education and the Ministry of Electronics and Information Technology (MeitY) should work collaboratively to revise the curriculum frameworks of platforms like DIKSHA and SWAYAM, ensuring that sustainability becomes a core component of digital learning at all levels.

- **Development of Region-Specific, Vernacular Sustainability Content**

Given the sociocultural diversity of India, especially in rural and semi-urban districts, digital sustainability education must be tailored to local contexts. Future initiatives should prioritize the creation of vernacular content that reflects local consumption habits, environmental challenges, and cultural practices. This localized approach can enhance learner engagement and foster community ownership of sustainable practices. NGOs, local educators, and EdTech developers can play a vital role in co-designing such content in consultation with stakeholders from underserved regions.

- **AI-Enabled Personalization for Green Learning Pathways**

The study reveals untapped potential in AI-driven learning platforms to personalize and scale sustainability education. Future applications should leverage artificial intelligence not only for academic tutoring but also for delivering adaptive learning modules on ethical consumption, sustainable supply chains, and environmental awareness. Integrating behavioral analytics, gamification, and nudging techniques can make green education more interactive and impactful. There is scope for developing AI-based digital mentors that guide users through customized sustainability learning journeys based on their consumption behavior and digital proficiency.

- **Cross-Sector Collaborations to Promote Sustainable Digital Ecosystems**

Future interventions will benefit from partnerships among government agencies, educational institutions, technology companies, and civil society organizations. Such multi-stakeholder collaboration can bridge the gap between policy design, curriculum development, technology deployment, and ground-level implementation. In particular, engaging local entrepreneurs and e-commerce platforms in sustainability training can help create more ethical, transparent, and environmentally conscious marketplaces.

- **Capacity Building for Educators and Community Facilitators**

To mainstream digital sustainability education, future initiatives must invest in training teachers, facilitators, and peer educators. Capacity-building programs should include modules on sustainability concepts, digital pedagogy, and localized content delivery. Empowering educators at the grassroots level can ensure consistent and culturally sensitive transmission of green values and practices. Special emphasis should be placed on empowering women educators and youth leaders in rural areas to become champions of sustainable digital learning.

- **Longitudinal Evaluation and Impact Assessment**

Future research and practice should include robust mechanisms for monitoring and evaluating the long-term impact of digital sustainability education on consumer behavior and environmental outcomes. Longitudinal studies can help track shifts in knowledge, attitudes, and practices over time, enabling continuous refinement of curricula and learning models. Such data-driven approaches can inform future investments and policy decisions aimed at scaling digital education for sustainability.

- **Policy Incentives for Sustainable E-Commerce Practices**

To reinforce the impact of digital sustainability education, future policy frameworks should include incentives for both consumers and businesses to engage in green e-commerce practices. This may involve tax benefits, certifications, or recognition schemes for ethical online sellers and informed buyers. Educational interventions that align with these incentive structures can amplify the behavioral shift toward sustainability and promote a culture of responsible digital consumption. The future of sustainable e-commerce in India, especially in underserved districts like Ara, depends on the ability to converge digital education with environmental consciousness. The implications of this study point toward an ecosystem-level transformation, where digital literacy is not an end in itself but a medium to cultivate informed, responsible, and eco-aware citizens. Future strategies must be inclusive, technology-enabled, and culturally grounded to ensure that sustainability becomes a lived experience in every digital interaction.

9. Conclusion

This research has explored the complex but promising intersection of digital education and sustainable e-commerce, with a specific focus on the district of Ara in Bihar, India. The central premise—that digital education can be a powerful tool in bridging knowledge gaps related to green consumerism—has been examined through a detailed analysis of secondary data, offering insights into current limitations, emerging opportunities, and the pathway forward. The study finds that while digital infrastructure and access have improved through national initiatives such as Digital India and PMGDISHA, the integration of sustainability-focused content into digital learning ecosystems remains critically insufficient. Digital literacy programs, particularly in rural and semi-urban regions, are still predominantly oriented toward functional skill-building and lack the conceptual depth or contextual relevance needed to foster environmentally responsible behaviors. This reveals a significant disjunction between access to technology and the ability to use it for sustainable decision-making. Moreover, mainstream educational platforms like SWAYAM, DIKSHA, and NDLI provide limited, often theoretical, modules on environmental literacy. These platforms do not adequately address the everyday realities of online shopping, ethical sourcing, or digital consumer responsibility—leaving a critical gap in knowledge translation. In contrast, community-led interventions and NGO-driven models, which use localized, vernacular content and culturally embedded pedagogies, show promising outcomes in fostering awareness and behavioral change. However, these efforts remain isolated and need scaling and policy integration.

The potential of artificial intelligence in promoting sustainability education also remains largely unrealized in the Indian context. AI-enabled platforms have made strides in personalizing academic learning, but they have yet to meaningfully incorporate sustainability themes. Globally validated models, such as environmentally rated shopping interfaces and adaptive green learning tools, offer a blueprint for innovation. Their absence in India's digital landscape—particularly in semi-urban districts like Ara—underscores the need for targeted innovation and deployment of AI-based sustainability education tools. Policy analysis within this study further reinforces the finding that digital literacy and sustainability are often treated as separate silos in India's education and governance frameworks. This separation weakens the impact of otherwise well-intentioned digital empowerment programs. A more holistic, interdisciplinary policy approach is needed—one that situates sustainability as a core competency of digital citizenship.

The broader implications of these findings are both urgent and actionable. To harness the full potential of digital education in fostering green consumerism, a systemic shift is required in how educational content is designed, delivered, and evaluated. This includes embedding sustainability into digital curriculums, promoting AI-driven personalized learning for behavioral change, and creating region-specific content that reflects local socio-cultural and economic realities. In essence, the path toward sustainable e-commerce in India must be paved not only with technology but with transformative education. Digital education must evolve from being a vehicle for access to one for awareness, agency, and action. This transformation is particularly critical in districts like Ara, where digital infrastructure is expanding, but the educational content has yet to catch up with the socio-environmental challenges of the 21st century. By highlighting these gaps and opportunities, this research contributes to the academic discourse and offers practical directions for policymakers, educators, and technologists. Empowering consumers and businesses through sustainable digital education is not merely a developmental imperative—it is a necessary step toward achieving inclusive, resilient, and environmentally conscious growth in India's digital economy.

10. Limitations

While this study provides valuable insights into the role of digital education in promoting sustainable e-commerce and green consumerism in the context of Ara, Bihar, it is not without limitations. The research is based solely on secondary data sources such as policy documents, academic literature, and industry reports, which may not fully capture the lived experiences, behavioral nuances, or real-time perceptions of local consumers and businesses. The absence of primary data collection restricts the ability to validate findings through direct stakeholder engagement or to account for recent shifts in digital behavior. Additionally, the generalizability of the findings may be constrained by the unique socio-economic and cultural characteristics of Ara, which may not reflect the broader realities of other Indian districts. The rapidly evolving nature of digital technologies and sustainability frameworks also means that some referenced platforms or initiatives may undergo significant changes, potentially affecting the long-term relevance of the study's conclusions.

References

- [1] Bianchi, C., & Andrews, L. (2012). Risk, trust, and consumer online purchasing behaviour: A Chilean perspective. *International Marketing Review*, 29(3), 253–275. <https://doi.org/10.1108/02651331211229750>
- [2] Bihar Education Project Council. (2023). *Annual report on digital infrastructure and education*. Patna, India.
- [3] Chen, X., Li, Y., & Zhao, H. (2024). The impact of digital literacy on farmers' pro environmental behavior: A Theory of Planned Behavior analysis. *Frontiers in Sustainable Food Systems*. <https://doi.org/10.3389/fsufs.2024.1432184>
- [4] Confederation of Indian Industry (CII). (2022). *Building a sustainable e-commerce ecosystem in India*. New Delhi: CII.
- [5] Das, S. K. (2025). Investigating circularity in India's textile industry: Overcoming challenges and leveraging digitization for growth. *arXiv*. <https://doi.org/10.48550/arXiv.2501.15636>
- [6] Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California Management Review*, 54(1), 64–87. <https://doi.org/10.1525/cmr.2011.54.1.64>
- [7] Digital Empowerment Foundation. (2022). *Rural digital literacy and environmental awareness in India*. <https://defindia.org/>
- [8] Federation of Indian Chambers of Commerce and Industry (FICCI). (2023). *Green retailing and the future of sustainable consumerism in India*. New Delhi: FICCI.
- [9] Filho, W. L., Shiel, C., Paço, A., Mifsud, M., Veiga Ávila, L., & Brandli, L. L. (2018). Sustainable development goals and sustainability teaching at universities: Falling behind or getting ahead of the pack? *Journal of Cleaner Production*, 203, 276–284. <https://doi.org/10.1016/j.jclepro.2018.08.244>
- [10] Ghouse, S. M., Shekhar, R., & Chaudhary, M. (2024). Sustainable choices of Gen Y and Gen Z: Exploring green horizons. *Journal of Consumer Behaviour*. [details pending]
- [11] Hasan, M. R. (2024). AI enhanced decision making for sustainable supply chains: Reducing carbon footprints in the USA. *arXiv preprint*. <https://doi.org/10.48550/arXiv.2501.10364>
- [12] Hesselbarth, C., & Schaltegger, S. (2014). Educating change agents for sustainability – Learnings from the first sustainability management Master of Business Administration. *Journal of Cleaner Production*, 62, 24–36. <https://doi.org/10.1016/j.jclepro.2013.03.042>
- [13] Hilton, T., & Hughes, T. (2013). Co-production and self-service: The application of service-dominant logic. *Journal of Marketing Management*, 29(7–8), 861–881. <https://doi.org/10.1080/0267257X.2012.734421>
- [14] Hu, L., & Meng, X. (2022). Digital literacy and green consumer behavior: A psychological perspective. *Journal of Environmental Psychology*, 80, 101761.

- [15] Hu, X., & Meng, H. (2022). Digital literacy and green consumption behavior: Exploring dual psychological mechanisms. *Journal of Consumer Behaviour*, 22(2), 272–287. <https://doi.org/10.1002/cb.2122>
- [16] Islam, M. S., Mahbub, A., Wohn, C., Berger, K., Uong, S., Kumar, V., ... Hoque, E. (2022). SEER: Sustainable e-commerce with environmental-impact rating. *Cleaner Environmental Systems*, 8, 100104. <https://doi.org/10.1016/j.cesys.2022.100104>
- [17] Jahin, M. A., Naife, S. A., Saha, A. K., & Mridha, M. F. (2023). AI in supply chain risk assessment: A systematic literature review and bibliometric analysis. *arXiv preprint*. <https://doi.org/10.48550/arXiv.2401.10895>
- [18] Johnstone, M. L., & Tan, L. P. (2015). Exploring the gap between consumers' green rhetoric and purchasing behaviour. *Journal of Business Ethics*, 132, 311–328. <https://doi.org/10.1007/s10551-014-2316-3>
- [19] Kumar, P., & Rahman, Z. (2016). Buyer behavior in green products: An integration of theory of planned behavior and perceived consumer effectiveness. *International Journal of Consumer Studies*, 40(6), 620–626. <https://doi.org/10.1111/ijcs.12296>
- [20] Leal Filho, W., Salvia, A. L., & Brandli, L. L. (2019). Education for sustainable development: Challenges and trends. *Sustainability*, 11(24), 7204. <https://doi.org/10.3390/su11247204>
- [21] Lim, S. F. W. T., Jin, X., & Srai, J. S. (2021). Consumer-driven e-commerce: A literature review, design framework, and research agenda on last-mile logistics. *International Journal of Physical Distribution & Logistics Management*, 51(1), 2–29. <https://doi.org/10.1108/IJPDLM-05-2020-0169>
- [22] Lin, C.-H., & Huang, P.-E. (2023). Digital capability, digital learning, and sustainable behavior among university students in Taiwan. *International Journal of Management Education*, 21(3), 100835. <https://doi.org/10.1016/j.ijme.2023.100835>
- [23] Liu, X., Wang, Z., & Han, X. (2024). The impact of digital literacy on farmers' green production behavior: Mediating effects based on ecological cognition. *Sustainability*, 16(17), 7507. <https://doi.org/10.3390/su16177507>
- [24] Mangiaracina, R., Marchet, G., Perotti, S., & Tumino, A. (2015). A review of the environmental implications of B2C e-commerce: A logistics perspective. *International Journal of Physical Distribution & Logistics Management*, 45(6), 565–591. <https://doi.org/10.1108/IJPDLM-06-2014-0133>
- [25] MdPI. (2024). Digital and sustainable education and social inclusion. *Sustainability*, 17(13), 5677. <https://doi.org/10.3390/su17135677>
- [26] Ministry of Electronics and Information Technology (MeitY). (2023). *Digital India progress report*. Government of India.
- [27] Mokhtar, A. R., Sundram, V. P. K., & Shahrom, M. (2023). Sustainable supply chain management education: Employing augmented reality, gamification, and AI for effective learning. *Advances in Social Sciences Research Journal*. <https://doi.org/10.14738/assrj.112.2.16423>
- [28] Peattie, K., & Crane, A. (2005). Green marketing: Legend, myth, farce, or prophesy? *Qualitative Market Research*, 8(4), 357–370. <https://doi.org/10.1108/13522750510619733>
- [29] Ramachandran, P., & Sudhir, V. (2023). Green consumption and sustainable lifestyle: Evidence from India. *Emerging Markets Journal*. [details pending]
- [30] Rani, P., & Sachar, R. (2024). Empowering sustainable development through digital transformation: Insights from Digital India. *Journal of Asia Business Studies*. <https://doi.org/10.1108/JABS-07-2024-0408>
- [31] Teixeira, A. R., Ferreira, J. V., & Ramos, A. L. (2025). Intelligent supply chain management: A systematic literature review on artificial intelligence contributions. *Information*, 16(5), 399. <https://doi.org/10.3390/info16050399>
- [32] Testa, F., Iraldo, F., Vaccari, A., & Ferrari, E. (2020). Why eco-labels can be effective marketing tools: Evidence from a study on Italian consumers. *Business Strategy and the Environment*, 29(1), 138–149. <https://doi.org/10.1002/bse.2350>
- [33] Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.
- [34] Trakoonsanti, L., & Abbas, Q. (2025). Cultivating sustainable digital literacy by educational pathways to green consumption in Thailand's digital age. *Digital Culture and Education Review*, 1(1), 59–83. <https://doi.org/10.63718/v013v049>
- [35] Vaidya, R., & Kumar, S. (2025). Smart digital education for sustainable development. *Asian Journal of Education and Development Studies*, 14(2), 198–212.
- [36] Vaidya, S., & Kumar, A. (2025). Exploring trends in e-business and sustainable finance. *Frontiers in Sustainable Cities*. <https://doi.org/10.3389/frsc.2025.1549874>
- [37] White, K., Habib, R., & Hardisty, D. J. (2019). How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework. *Journal of Marketing*, 83(3), 22–49. <https://doi.org/10.1177/0022242919825649>
- [38] Zhai, X., et al. (2024). Digital literacy and farmers' adoption of green production technologies: Evidence from China. *Agriculture*, 15(3), 303. <https://doi.org/10.3390/agriculture150303>