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Immersive Media and Digital Storytelling for Eco-Literacy in the Circular Economy: A Case Study Perspective

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Abstract

The transition to a restorative circular economy is a global imperative, yet its success is fundamentally limited by a lack of societal eco-literacy. While immersive media shows potential, a significant mechanistic gap exists in understanding how these tools move users from mere presence to actionable circular behaviour. This paper investigates immersive media and digital storytelling as transformative educational tools to bridge this gap. Using a qualitative design and purposive sampling, this study analyzes global case studies within a Blended Learning (BL) framework. The findings indicate that narrative-driven digital experiences effectively motivate awareness and reflection. The study synthesizes these results into a conceptual model linking immersive media directly to circular behavioural adoption. Effectively integrated immersive media enables continuous learning for a sustainable transition. Strategic scaling and localization are recommended to equip future generations with a circular mindset.

Keywords: Immersive media, digital storytelling, eco-literacy, circular economy, environmental communication.

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Introduction

Eco-literacy As the Foundation for A Circular Economy Transition

The transition from a linear "take-make-dispose" economic model to a restorative circular economy represents a critical global imperative. While technological and policy innovations are essential drivers of this transition, their long-term efficacy is fundamentally contingent upon a parallel societal shift in understanding and behavior. This shift is cultivated through eco-literacy, a key term defined here as a competency extending beyond basic environmental awareness to encompass a comprehensive, systemic understanding of ecological principles and sustainability. It is this systemic mindset that is necessary to align human activity with the circular economy's core goals of minimizing waste, maximizing resource efficiency, and redefining consumption patterns. The role of formal and informal education in promoting this mindset is pivotal. Research indicates that environmental awareness is a significant precursor to positive attitudes toward circular economy products, particularly among higher education students, highlighting educational institutions as key arenas for shaping future consumers (Yang et al., 2024). Furthermore, the concept of eco-innovation, which includes shifts in business models and consumer behaviors, is inherently supported by educational efforts that prioritize sustainability (Vence & Pereira, 2018). Technical and Vocational Education and Training (TVET) systems are also identified as critical for bridging this gap, providing the practical skills fundamental to circular practices (Ab Hamid et al., 2024). However, a significant challenge persists. Despite its recognized importance, there is a noted need for a more profound integration of circular economy principles within existing educational frameworks (Ab Hamid et al., 2024). A synthesis of the literature reveals that while the goal of fostering eco-literacy is widely acknowledged, the methodologies require significant innovation. Studies demonstrate that participatory strategies like eco-clubs (Cincera et al., 2023), interdisciplinary approaches like STEAM (Syahmani et al., 2021) and experiential outdoor learning (Lugg, 2007) are effective, yet they often struggle to translate complex, systemic circular principles into personally meaningful experiences. The overarching consensus is that effective eco-literacy requires pedagogical approaches that successfully connect awareness with actionable behaviors (Del Vecchio et al., 2021). The primary obstacle is the difficulty in making abstract systems like global supply chains or product lifecycles feel emotionally resonant and personally relevant to learners, a task at which conventional methods often fall short.

The Pedagogical Potential of Immersive Media

To address these limitations, immersive media encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR) emerges as a transformative tool with unique pedagogical strengths well-suited to building deep, actionable eco-literacy. A principal strength is its capacity for experiential learning; by simulating real-world environments and complex systems, learners can actively participate in virtual scenarios, fostering critical thinking and practical skill development within a dynamic setting (Crogman et al., 2025; Fromm et al., 2021).

Furthermore, immersive media significantly enhances affective engagement by generating a powerful sense of presence and realism that evokes strong emotional responses, making the learning experience more memorable and impactful than traditional media (Eskiadi & Panagiotou, 2024; Jones, 2017). Finally, spatial storytelling a narrative technique where stories unfold within three-dimensional spaces allows learners to explore and interact with a narrative directly, leading to a more intuitive and profound understanding of interconnected systems (Nakevska et al., 2017). These capabilities make immersive media a powerful tool for translating abstract sustainability concepts into tangible experiences. For instance, VR can simulate the journey of plastic waste to create a visceral understanding of consumption's consequences (Sekhar et al., 2024). AR can overlay a product's environmental footprint onto a real-world context, making invisible impacts visible and guiding sustainable choices (AlGerafi et al., 2023). Similarly, gamified simulations allow users to experiment with circular economy models in an engaging, consequence-free environment (Gronowski et al., 2024).

Digital Storytelling: Bridging Industrial Digitalisation and Pedagogical Practice

Digital storytelling serves as the crucial narrative engine that can bring these immersive experiences to life. As a strategy, it leverages communication techniques to raise awareness, educate stakeholders, and catalyze behavior change towards sustainable consumption. While the industrial application of digital tools is well-documented for instance, using digital twins to optimize resource management (Albrecht & Hofer, 2025) or blockchain to ensure supply chain transparency (Hamedani et al., 2025). their power is not limited to industry. When integrated into an educational digital storytelling framework, these same technologies can be used to create powerful learning narratives. A digital twin of a product's lifecycle, for example, is not just an industrial optimization tool; it can become the centerpiece

of an educational story, allowing a learner to explore the environmental impact of a smartphone from mine to landfill. Platforms that facilitate circular business models, like Oddbox's food rescue mission (Akarsu, 2024), provide compelling real-world narratives that can be adapted into pedagogical content, demonstrating social impact and circular values in action. In this context, immersive media provides the technological canvas for experience, while digital storytelling provides the narrative architecture that guides the learner, transforming raw data and complex systems into relatable, human-centered journeys that make circular principles accessible and actionable.

Defining the Research Aim

Despite the recognized potential of these tools, a significant mechanistic gap persists in the literature. While existing research acknowledges the "communication gap" hindering public adoption of circular principles (Almulhim & Abubakar, 2021), it often fails to explain how specific immersive and narrative triggers translate into sustained behavioural shifts. Currently, the inherent complexity of systemic circular concepts remains a barrier to entry for the public (Salimi & Taherkhani, 2024), and institutional strategies often lack the pedagogical framework to move users from mere "presence" in a virtual environment to actionable "eco-literacy" in the physical world (Del Vecchio et al., 2021). This paper suggests that immersive storytelling through its unique blend of experiential learning, affective engagement, and narrative structure provides the necessary bridge between abstract knowledge and concrete action. Therefore, the primary aim of this research is to synthesize evidence from existing case studies to develop a conceptual framework. This framework will model the cognitive and affective pathways through which immersive storytelling fosters eco-literacy and motivates the adoption of circular behaviours. By doing so, this review seeks to move beyond exploring the "potential" of technology to outlining a tangible trajectory for behavioural change, offering a structured understanding of how to cultivate the knowledge, attitudes, and intentions required for a global circular transition.

Method

This study employs a qualitative research design based on a purposive sampling of case studies to investigate the efficacy of immersive media in promoting eco-literacy. The case study selection was guided by specific qualitative criteria, prioritizing initiatives that demonstrate relevance to circular economy principles and

significant engagement via media immersion. To assess "measurable educational or behavioural outcomes," the selection process focused on identifying initiatives with documented evidence of impact. For this review, "impact" was defined using a set of qualitative indicators derived from the case study literature: a) Scalability & Reach (e.g., audience size, campaign participation numbers); b) Policy or Curricular Influence (e.g., adoption of a program in schools, mentions in policy briefs); c) Stated Behavioural Intent or Change (e.g., survey results showing increased willingness to act, reported shifts in public discourse); and d) Educational Validation (e.g., implementation within a formal pedagogical framework). These indicators allowed for a consistent, albeit qualitative, evaluation of "High," "Medium," or "Emerging" engagement across diverse cases, as summarized in the comparative tables.

To ensure a robust and comprehensive analysis, the study encompasses a diverse range of geographical contexts, featuring examples from India, the UK, Cambodia, the Philippines, the USA, and indigenous communities. This global perspective is critical for understanding how digital storytelling functions across different cultural and ecological settings. The data sources were drawn from a heterogeneous mix of sectors, including academic projects, NGO initiatives, and museum or digital campaigns, to capture the full breadth of current sustainability communication strategies. The deliberate inclusion of such varied initiatives from a high-budget natural history documentary (Blue Planet II) to a grassroots NGO workshop (WOM, Cambodia) is methodologically justified by the study's aim to build a conceptual framework. The goal is not to directly compare their quantitative efficacy, but to abstract the underlying mechanisms of engagement. By examining how distinct approaches (mass media, interactive platforms, formal pedagogy) each leverage narrative and immersion to foster a connection with sustainability, we can identify the universal pathways that inform the final conceptual model.

To facilitate this structured thematic analysis, the case studies were grouped into three analytical categories under the umbrella of 'Media as a Catalyst for Sustainability':

A. Digital storytelling for environmental awareness: This category examines narrative-driven initiatives focused on raising mass awareness and shifting public discourse, such as the Mission Paani water conservation campaign (Indiantelevision Team, 2019) and the Wetlands for LiFE initiative.

B. Immersive platforms: This group analyses high-engagement platforms that utilize visual and emotional dominance to create powerful affective connections

with environmental issues. Examples include Cambodia's WOM project, the Exploring the Plastic Sea immersive experience, the global Fridays for Future movement, and the BBC documentary Blue Planet II.

C. Media integration for education: This section focuses on the pedagogical application of virtual reality (VR) and simulation tools within structured learning environments. It specifically analyses JellyBean VR: Marine Ecology and Pollutant Impact, Eco-Ego VR, and climate impact simulations developed at the University of Indonesia.

Case Study Review and Thematic Analysis

The objective of the case study selection was to review the media strategy used, engagement and reach, and the subsequent impact on the target population. The selected case studies vividly illustrate how traditional, digital, and participatory media can effectively promote environmental issues and conservation. Some are directly relevant to eco-literacy on water sustainability and the circular bioeconomy, while others are from allied fields, serving as examples of digital media as a powerful advocacy tool via film and storytelling. The varied approaches include filmmaking, mobile journalism (MoJo), campaigning, community engagement, workshops, and policy dialogue. Campaigners shared personal "nature stories" via different traditional, digital, and social media platforms, providing resources for educators to integrate into their curriculum. The case study analysis was focused on 'Media as a catalyst for sustainability'. Media formats integrate television, social media, live events, web apps, and educational toolkits to amplify eco-literacy. Targeting diverse audiences from schoolchildren to policymakers, they blend narrative-driven awareness (personal stories, dramatic ocean visuals), immersive experiential elements (protests, virtual habitats, festival forums), and structured education (classroom packs, teach-ins, youth training), highlighting scalable models for circular economy advocacy in contexts like India, the UK, and beyond (B-Reel UK, 2019). Table 1 presents a comparative synthesis of the case study analysis, describing their alignment across digital storytelling, immersive platforms, and media integration in education. Wetlands for LiFE Film Festival, India; Our Planet Interactive Experience, Netflix + WWF; Fridays for Future, Global; and BBC Blue Planet II, UK best fit across all three categories. They used narrative techniques in digital storytelling for product life awareness and material cycles, included interactive or experiential elements for immersion, and were integrated into blended learning platforms (LMS) and educational curricula via tools like AR/VR platforms.

Table 1

Inferences of case study and thematic analysis. A- Digital Storytelling, B-. Immersive Platforms, C- Educational integration

Group	Name, Location, Initiator, reference	Strategy	Eco-literacy	Circular economy	Engagement & Reach	Sustainable consumption, & Impact
A	Mission Paani_ India. Reckitt Benckiser, News18, Harpic & NGOs. (Indiantelevision Team, 2019)	Citizen MoJo & filmmaking; celebrity ambassadors, community pledges, and school competitions.	Water conservation and public awareness	Reuse, efficient water management	690M+ reach, 20M+ Indians for behaviour change by 2022, 2L+ sanitation workers trained;	Increased public awareness, shifted attitudes - millions pledged to save water. Best media campaign, national water awards 2020
A C	UNEP #BeatPlasticPollution (Global) (UNEP, 2025; United Nations in India, 2025)	Global campaign against plastic pollution	Plastic lifecycle education & resources	Central focus is circular economy (reuse/recycle)	Global events, World Environment Day	Encourages reduced plastic consumption & reuse. Advocates systemic change across life cycle
A B C	Wetlands for LiFE Film Festival_India, CMS India, MoEFCC, GIZ, WWF, Ramsar. (12th CMS vatavaran, 2024)	Film & forum tour to connect wetlands with lifestyles	Screenings/ workshops on wetlands	Highlights stewardship and conservation	Multi-city, thousands engaged	Encouraged mindful resource use, built 'Wetland Mitras (friends)', raised public awareness.
A B C	Our Planet Interactive Experience (Netflix + WWF) (Clay et al., 2019)	Documentary + interactive digital content	Global biodiversity & climate science education	Encourages understanding of interconnected systems	Global streaming + education resources	Inspired eco choices and actions. Highlighted pressing challenges, broad global audience.
A B C	Fridays for Future (Global), Greta Tintin Eleonora Ernman Thunberg (Fridays For Future, Accessed 2025)	Climate strikes & advocacy	Teaches climate justice & science	Calls for systemic change reducing fossil dependency	Millions of young people globally. 7,500 Cities, 14M	Promotes low-carbon lifestyles. Influenced global climate dialogue.

A B C	BBC Blue Planet II (UK). (Thompson, 2019)	Nature documentary series	Ocean ecosystems & human impact awareness	Sparked conversations about pollution design	Broadcast in dozens of countries	Highlighted need to reduce single-use plastics. Increased public/plastic pollution awareness for 'Blue Planet effect'
B C	Cambodia's WOM Campaign. (UNESCO, 2025)	Community events & outreach. Climate smart education systems initiative	Local awareness of environment/ ecotourism.	Promotes local sustainable practices	568 posts, 3.2M reach, 150k+ engagements	Encouraged reduced waste & tourism impact. Included in education as part of Cambodia's Nationally Determined Contributions (NDC) 3.0.
B	Jelly Bean VR: Marine Ecology & Pollutant Impact	Google Cardboard VR experience. (Roy et al., 2025)	Immersive learning about marine ecology & pollutants	Suggests behavior changes to reduce pollution	Engages students in VR environment	Encouraged reducing everyday pollutant impacts. Increased interest and awareness in environment conservation.
C	Eco-Ego VR & Climate Simulations (Univ. of Indonesia). (Carmona-Galindo et al., 2025)	VR & simulation for climate education	Interactive climate/eco simulations	Teaches systems thinking on resources	Used in academic courses & outreach	Encouraged sustainable lifestyle changes. VR raised ecological understanding (general research)
C	University of Sharjah, Sustainability Programs) (University of Sharjah, Accessed 2025)	Campus sustainability education/ research	Coursework & workshops on sustainability	Campus waste/ recycling initiatives	Students and community involvement	Built sustainability literacy and research. Promoted sustainable campus consumption.

Note. Compiled by the authors from the case-study sources cited in the second column of the table.

Discussion and Analysis

Digital Storytelling

Digital storytelling is used extensively for environmental, material cycles, and product life awareness in the circular economy. Through experiential learning (Kolb's theory), learners reflect on real-world environmental challenges and internalize key concepts (Robin, 2016). Story-driven experiences foster attitude shifts toward sustainability by highlighting personal and collective impacts, while calls-to-action embedded within narratives encourage behavioural adoption, such as participating in local climate initiatives (Modi et al., 2024). Challenges include limited technology access and maintaining engagement for diverse audiences. Integrating localized storytelling into academic curricula and policy communication platforms can strengthen community engagement and environmental action (Lambert, 2013). Digital storytelling initiatives guide learners through visual, textual, and interactive narratives that build knowledge and raise awareness (Siu, 2025). These parameters were compared and evaluated (Table 2) to systematically identify pedagogical trade-offs in educational approaches (Siddique & Khan, 2024; Modi et al., 2024).

Table 2

Comparative evaluation of core capabilities

Parameter	Storytelling for cycles	Immersive emotional connection	AR/VR eco-literacy
Environmental Awareness	High (narratives on water/materials)	Very High (visual/ emotional triggers)	High (knowledge building)
Engagement Level	Medium (passive viewing)	High (immersive response)	Very High (interactive simulations)
Behaviour Change	Resource-focused (reuse)	Attitude shift (concern)	Consumption habits (circular)
Scalability	Festivals/ campaigns	Media broadcasts	Classroom/tech access needed

Note. Compiled by the authors from the case studies in Table 1 and the sources cited in Section 3.1.1.

Immersive Platforms

Integration of immersive technologies such as Augmented Reality (AR), Virtual Reality (VR), and Extended Reality (AR+VR+MR) creates interactive, experiential

learning environments that drive behavioural shifts. As Table 3 illustrates, the power of these platforms lies in the very feature that limits their scalability: the high sense of presence and interactivity. Unlike the passive viewing of Group A, which can be broadcast to millions, the deeply embodied, real-time interaction in Group B requires specialized hardware. This creates a critical trade-off: lower scalability for a significantly higher potential for affective engagement and attitude shift. Immersive media interventions like JellyBean VR and Cambodia's WOM campaign leverage these environments for behavioural adoption, such as reducing plastic consumption or supporting conservation campaigns. Key limitations involve high costs, technology accessibility, and the need for inclusive design (Dalgarno & Lee, 2010). Future directions include developing scalable immersive experiences for public policy workshops and school-based environmental education programs (Merchant et al, 2014).

Table 3.

Assessment of media features

Parameter	Storytelling for cycles	Immersive emotional connection	AR/VR eco-literacy
Sense of presence	Low-medium (screen-based, observer role)	High (user feels "inside" the narrative world)	Very high (fully embodied in simulated environments)
Interactivity level	Low (limited choices)	Medium (branching paths, simple user inputs)	Very High (real-time manipulation of objects/ systems)
Engagement type	Passive viewing	Emotional immersion	Hands-on simulation
Scalability	High (screen-based)	Medium (device needed)	Low (hardware required)

Note. Compiled by the authors from the case studies in Table 1 and the sources cited in Section 3.1.2.

Media Integration for Education

This section discusses the role of AR/VR-mediated eco-literacy to enhance responsible, circular consumption. Examples of project implementations for education in schools and universities globally are included as model examples (UNEP,

2025), apart from the six global case studies mentioned in Table 1. Educational integration initiatives by the University of Sharjah (University of Sharjah, 2024) and the University of Indonesia exemplify the embedding of environmental media across curricula and learning modules. By combining traditional instruction with media-rich content, these programs foster knowledge gain, raise environmental awareness, and influence attitudes, translating into behavioural adoption, such as campus-wide plastic reduction initiatives or student-led sustainability projects (Table 1).

The teaching and learning outcomes compared across these three groups (Table 4) are best understood through the lens of transformative learning theory (Mezirow, 1991). The process often begins with a "disorienting dilemma," a key stage in Mezirow's framework, which is exemplified by the visceral experience of Blue Planet II (Group B). The powerful imagery of an ocean choked with plastic served as a global-scale dilemma, disrupting viewers' existing, passive understanding of pollution and forcing a reconsideration of their own consumption habits. Following this is "critical reflection," a stage powerfully facilitated by the structured learning environments of Group C. For instance, the simulations at the University of Indonesia do not just show pollution; they allow learners to manipulate variables and witness the systemic consequences of their choices. This active experimentation moves learners from emotional shock to a critical analysis of the systems that create waste, fostering a deeper, more structured understanding necessary for lasting change.

Each pedagogical approach discussed above contributes distinct yet complementary strengths toward this transformative process. Digital Storytelling (A) demonstrates high scalability and accessibility at a relatively low cost, making it effective for large-scale awareness generation and foundational knowledge dissemination. Immersive Media Platforms (B) deepen affective engagement and situational awareness. Through interactive documentaries, participatory storytelling, and simulations, learners move into actual experience and active experimentation (Duchatelet et al, 2023), strengthening emotional connection and moral positioning. Media integration for education (C) facilitates systemic understanding and critical reflection, the fundamental mechanism in transformative learning theory (Tolba & Youssef, 2024). AR/VR-mediated Eco-literacy excels in knowledge gain, attitude shift, and behavioural adoption, fostering deep learning. The case study comparative analysis advances circularity by systematically identifying pedagogical trade-offs across scalability, engagement depth, accessibility, technological

demand, retention capacity, and cost efficiency. In digital storytelling, reusability and adaptability reduce digital redundancy and extend the lifecycle of educational content, mirroring material efficiency in circular systems. Immersive platforms frequently trigger perspective transformation towards pro-environmental intent, such as visualizing plastic pollution or ecosystem degradation, thereby catalysing attitudinal shifts (Tolba & Youssef, 2024). This structured comparison enables educators to optimize knowledge circulation within environmental learning ecosystems, aligning educational design with circular economy principles.

Table 4

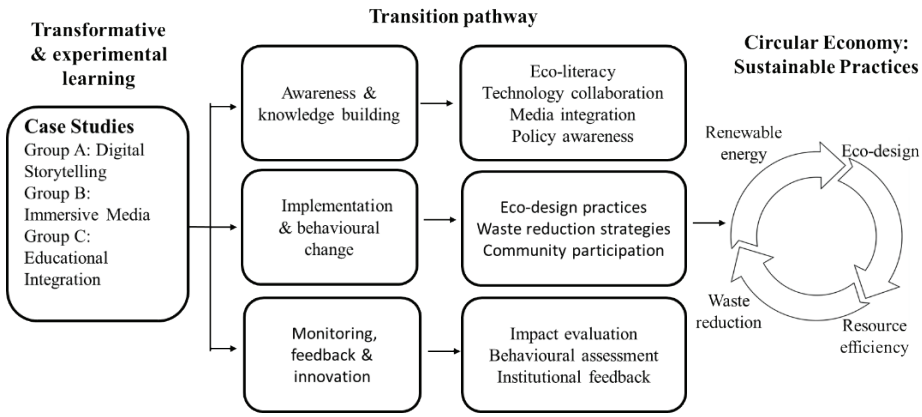
Pedagogical Effectiveness

Parameter	Storytelling for cycles	Immersive emotional connection	AR/VR eco-literacy
Content delivery format	Narrative videos, infographics	Interactive videos, emotion-driven animations	360° simulations, interactive 3D models
Learner engagement	Medium (passive viewing with reflection)	High (emotional triggers and empathy building)	Very high (hands-on exploration and choices)
Knowledge retention	Medium (Good, story recall aids memory)	High (Strong, emotions reinforce long-term recall)	Very high (Excellent, experiential learning- deepen understanding)
Feedback Mechanisms	Basic analytics (views, completion)	Sentiment tracking (reactions, comments)	Advanced (interaction data, progress tracking)
Innovation Potential	Medium (story remixing)	High (personalized emotional paths)	Very high (AI-driven adaptive scenarios)
Assessment integration	Basic quizzes	Reflection journals	Performance metrics

Note. Compiled by the authors from the case studies in Table 1 and the sources cited in Sections 3.1.1-3.1.3.

Figure 1

Eco-Literacy: transition to circular economy



Note. Developed by the authors, based on the synthesis presented in Tables 1-4.

Mapping these differentiated strengths supports hybrid pedagogical strategies that combine A's wide distribution (Table 2), B's affective engagement (Table 3), and C's transformative depth (Table 4). The conceptual pathway diagram (Figure 1) illustrates how these approaches move from isolated educational interventions to a circular sustainability framework through structured educational intervention. The diagram's final stage, "Monitoring, feedback & innovation," is crucial for creating a truly circular learning system. This is not a passive endpoint but an active mechanism for continuous improvement. For example, the institutional feedback from a formal educational integration of Eco-Ego VR (Group C) such as assessment data showing which sustainability concepts students struggle with, or survey feedback indicating which immersive scenarios were most effective should flow back to the designers and educators. This data can then be used to refine the digital storytelling narratives (Group A), making them more pedagogically precise, or to update the immersive platform's (Group B) scenarios to address newly identified knowledge gaps. This creates a virtuous cycle where real-world educational outcomes directly inform the next generation of immersive learning tools, ensuring they are not only engaging but also demonstrably effective in fostering the deep, actionable eco-literacy required for a circular economy.

Conclusion and Implications

This case study research set out to address the mechanistic gap identified in the literature, specifically the lack of a clear pedagogical framework explaining how immersive tools move users from passive presence to actionable eco-literacy. By synthesizing global case studies from India to the UK through the lens of the introduction's core concepts of experiential learning, affective engagement, and spatial storytelling, this paper confirms that digital storytelling and immersive media are not merely communication tools but transformative pedagogical methods capable of bridging the divide between abstract knowledge and concrete circular behavior. The findings validate the conceptual pathway proposed in the introduction, demonstrating that immersive engagement when powered by narrative architecture can successfully lead to the development of eco-literacy, which in turn drives circular behaviour and collective action.

The analysis validates the suitability of distinct media platforms for specific educational objectives within the circular economy transition. Digital storytelling demonstrates high scalability and effectiveness in generating mass awareness and shifting public discourse on material cycles and product life awareness, making it ideal for reaching broad audiences from schoolchildren to policymakers. Immersive platforms excel at creating the affective engagement necessary to foster deep-seated empathy through a powerful sense of presence and realism, triggering the disorienting dilemmas that catalyze perspective transformation as described by Mezirow's transformative learning theory. Media integration for education, particularly AR and VR mediated eco-literacy, provides the structured environment for critical reflection and systemic understanding, leading to the deepest levels of knowledge retention and measurable behavioural adoption despite higher costs and lower scalability.

A critical finding of this study is the empirical validation of the conceptual linear to circular learning pathway proposed in the introduction. The findings confirm that the unique blend of experiential learning, affective engagement, and narrative structure inherent in immersive storytelling provides the necessary bridge between abstract knowledge and concrete action, moving the field beyond exploring the mere potential of technology toward outlining a tangible trajectory for behavioural change. This directly addresses the primary obstacle identified in the introduction, namely the difficulty in making abstract systems like global supply chains or product lifecycles feel emotionally resonant and personally relevant to learners, a task at which conventional methods often fall short.

Furthermore, the analysis redefines the relationship between the introduction's core concepts by establishing that digital storytelling provides the narrative architecture that guides the learner while immersive media provides the technological canvas for experience. Together they transform raw data and complex systems into relatable human centered journeys that make circular economy principles accessible and actionable. This synergy is essential for translating complex systemic circular principles into personally meaningful experiences, directly addressing the overarching consensus from the literature that effective eco-literacy requires pedagogical approaches successfully connecting awareness with actionable behaviours.

The study offers significant implications for educators, designers, and sustainability communicators seeking to enhance public participation through narrative immersion. To effectively empower diverse learners with the knowledge and motivation needed for environmental stewardship, three strategic recommendations emerge from the analysis directly responding to the challenges outlined in the introduction. First to address the communication gap hindering public adoption of circular principles it is crucial to scale successful methods from isolated pilot projects into wider applications reaching broader audiences worldwide through the high scalability of digital storytelling. Second to overcome the barrier that systemic circular concepts pose to the general public localization is essential requiring stories that reflect specific cultural and ecological contexts as seen in initiatives from India and indigenous communities ensuring that global sustainability goals resonate on a local level and making abstract principles personally meaningful. Third to move users from mere presence in virtual environments to actionable eco-literacy in the physical world the integration of these tools into formal educational systems is paramount embedding eco-literacy modules powered by immersive media into standard curricula ensures that sustainability becomes a foundational element of learning rather than an extracurricular add on providing the pedagogical framework necessary for critical reflection and lasting behavioural change.

Finally, the monitoring feedback and innovation loop identified in the conceptual model creates a virtuous cycle that directly addresses the need for continuous improvement in educational methodologies. Institutional feedback from formal educational integrations such as assessment data showing which sustainability concepts students struggle with or survey feedback indicating which immersive scenarios were most effective flows back to refine digital storytelling narratives and update immersive platform scenarios. This ensures that the next generation

of tools is not only engaging but also demonstrably effective in fostering the deep actionable eco-literacy required for a circular economy.

By prioritizing the scaling of VR and AR experiences, fostering localized campaigns, and integrating digital storytelling into educational frameworks, stakeholders can successfully bridge the gap between knowledge and behaviour. These strategic directions promise to support lasting behavioural change for future generations. This will help to develop systemic mindset to align human activity with the circular economy's core goals and redefining consumption patterns for a truly restorative economic model.

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