

Interactive Media for Sustainability Awareness

Edited by

Dr. Pramiti Roy



Swami Vivekananda University

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Navigating Environmental Disasters: Strategies, Challenges, and Best Practices

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Abstract

Effective risk communication is very important in the management of environmental disasters, especially in India, with its variety of ecosystems and socio-economic factors that increase the impacts of such events. This paper reflects on strategies and challenges of risk communication, in the context of environmental disasters in India. Environmental disasters, such as floods, cyclones, and droughts, are some of the greatest threats to communities and infrastructure. These events must be coupled with effective communication in order to ensure timely dissemination of information, response coordination, and public awareness. In this paper, we would like to talk about strategies of risk communication, taking into account the use of traditional media, social media platforms, and various community engagement initiatives. The challenges in implementing these strategies include language barriers, misinformation, and need for culturally sensitive messaging. While bringing up case studies of recent environmental disasters in India, these provide an illustration of these challenges and the proposing of possible solutions to address the issues. This paper is going to try as well to come up with recommendations for improving risk communication practices in India. This implies putting into mainstream the community's know-how development, constituting targeted kinds of involvement from the concerned sectors,

community confidence in authorities, alongside adaptive approaches to communication that build people's resilience against environmental disasters. This paper maintains that a comprehensive risk communication approach should be adopted in anticipation of protecting those who are most vulnerable, with considerations run hand in hand with the environmental and socio-cultural settings within India.

Keywords: Public awareness, crisis management, adaptive communication, environmental disasters

Introductions

India, with its hugely variant geological and climatic conditions, is very vulnerable to a number of environmental disasters, such as floods, droughts, cyclones, landslides, and heat waves. Such disasters have social, economic, and environmental ramifications that get worse with fast-growing urbanization, increasing population, and climate change. The recurrence and increased intensity of these events add urgency for risk communication investment to reduce loss and grow ever resilient. This aspect of risk communication takes a prominent role in managing environmental disasters through its capability to communicate information to the at-risk populations in a timely manner, raising awareness, in preparing them for emergencies, and reducing long-term impacts with minimal damage. The apparent success of risk communication derives from the fact that it informs all its audiences, particularly marginalized communities, which are among the least likely to acquire access to technology, information, and inputs to comprehend what it has to say and act on it. The first is to provide a bird's-eye view of the leading environmental disasters in India, combined with their impacts on people as on the ecosystems. The second is risk communication, putting its case within the broader context of maximizing public protection and recovery from disasters. Third, it discusses risk communication strategies and challenges toward implementation, such as

misinformation, language barriers, and trust issues. The analysis, furthermore, will set the groundwork for providing ideas on communicating risks, therefore making India stronger and more resilient for disaster management. This paper drives home the message of how an improvement on the frameworks of risk communication will help to better counter this rising threat in India of environmental disasters.

Definition and scope of risk communication

The flow of information, advice or opinion from experts and authorities to the public regarding hazards and actual or potential menaces is understood by risk communication. In the context of environmental disasters, this means timely information release, which clarifies what happened and can help reduce harm and improve preparation. Thus, the main purpose of risk communication is to enhance awareness, direct emergency response efforts, promote preventive measures, and-most importantly-build trust among the general public before, during, and after disaster events. Effective risk communication enables people to understand the gravity level of risk, how to moderate it, and what measures should be taken to mitigate such risks, with the goal of lessening uncertainty and thereby enhancing decision-making capabilities.

For example, in a country like India, natural disasters such as floods, cyclones, and landslides are a routine occurrence. The difference between life and death is the ability to communicate risks. The effective risk communication strategy must involve clear, relevant, and actionable information which has taken into account the cultural, social, and linguistic diversity of the population.

Key Principles and Elements of Risk Communication

Whether or not risk communication is successful depends on the fulfillment of a set of key principles. These principles ensure the information shared is understood, trusted, and acted upon:

- **Accuracy and Timeliness:** The information served must rely on credible sources, so that people are given enough time to prepare or respond. Such delays or inaccuracies bring confusion, mistrust, and panic.
- **Clarity and Simple:** Information that is complex needs to be translated into language that is simple, clear, and free of technical jargon. In multilingual societies like India, translation in local languages is critical.
- **Transparency and Openness:** The openness about the nature of the risk, its possible impacts, as well as uncertainties, promotes trust. Covering up or playing it down makes it difficult to win cooperation from the public.
- **Two-way Communication:** Risk communication should not be one-way. It should allow the public to give it feedback, after which authorities can then tackle such concerns, answer questions to the best of their abilities, and even go a step higher by adjusting strategies according to community needs.
- **Targeted and Inclusive:** The communication needs to be targeted at various audiences, including vulnerable persons, particularly children, older people, and disabled, who may be more vulnerable in the face of a disaster. Such approaches need to be transmitted through all possible media.

Key Components of Risk Communication

Risk Identification and Evaluation: The beginning of developing an effective communications strategy is through identifying and assessing the nature and potential degree of the risk.

Message Development: Formulation of messages that are clear, simple to understand, and actionable. To these ends, the cultural environment of the target audiences the technological access available to the target audiences; and their literacy levels are crucial.

Channel Selection: The selection of communication channels, like television and radio, social media, and mobile messaging for higher coverage.

Contribution in Disaster Management

Risk communication is a very critical area that applies to all steps of disaster management: preparedness, response, and recovery.

- **Preparedness stage:** Risk communication builds up the awareness of potential threats and encourages preventive measures before a disaster. For example, providing people with notice of an incoming cyclone will enable them to evacuate or protect property in time. The aim at this stage is to motivate communities to begin involved actions of resilience building in advance, such as the practice of a disaster drill or the preparation of an emergency kit. In the course of the disaster, real-time information guides the immediate action taken during the event, which may include evacuation routes or the location of emergency shelters. This stage calls for great accuracy and promptness from information since misinformation leads to chaos and raises the number of casualties.

- **Recovery:** The process of risk communication after disaster supports the recovery efforts by making communities aware about the availability of medicines, rehabilitation facilities, and rebuilding programs. It also helps in rebuilding trust with the public, especially in case people have criticized the response effort to the disaster. The most recent cyclones in India that struck the country, Amphan and Tauktae, saw how effective communication during disaster response is worth. Among which early warnings through all media channels such as radio, television, and social media really helped save more lives. Nonetheless, circumstances such as misinformation, language barriers, and even lack of communication tools in remote areas do still exist and must be addressed. A sound risk communication framework will be of

paramount importance in mitigating the effects of environmental catastrophes. Ensuring that key principles and elements are followed, together with realizing the prominent role risk communication plays in the setup and implementation of disaster relief, makes the authorities in charge enhance public safety as well as resilience against rising environmental hazards.

Strategies for Effective Risk Communication

Effective risk communication in cases of environmental disasters depends on a number of strategies that ensure that information is given correctly, promptly, and appropriately. The use of traditional media, social media platforms, and community involvement provides a multi-pronged approach to hitting different populations. Each has its advantages and disadvantages, so the need arises to manage an all-rounded approach with different methods.

Traditional Media (Television, Radio, and Print Media)

Traditional media, consisting of television, radio, and print, has always been the backbone of risk communication in the event of natural disasters. Television and radio broadcasts enable immediate airing of information to many people. In India, the NDMA (National Disaster Management Authority) and the IMD (India Meteorological Department) normally make use of different means to communicate early warnings to people concerning cyclones, floods, and many other calamities.

Benefits

Wide Reach: Television and radio reach wide into the countryside where internet connectivity is minimal. This will ensure that even the most vulnerable populations receive timely disaster alerts and emergency instructions.

Trustworthiness: Traditional media outlets have traditionally been considered trusted sources of information, which helps garner public trust during a disaster.

Limitations

Minimal Interactivity: These media support one-way communication that do not allow for quick feedback or addressing issues by the community.

Access Barriers: In disaster situations, there is likely to be either a blackout or destruction of infrastructure that denies access to television and radio programmes. Furthermore, print media may not be able to provide information in real time to mitigate the situation.

Social Media Sites

Leveraging Twitter, Facebook, and WhatsApp

Recently, there has been a surge in the use of social media as an important tool for risk communication. These enable fast information dissemination and provide for interactive spaces whereby government agencies, media, and communities can share updates and emergency instructions.

Benefits

Speed and Reach: Social media channels can instantly disseminate information to millions of users. Twitter hashtags, Facebook posts, and WhatsApp group messages can quickly notify the public about evacuation routes, shelter locations, and other vital information.

Interactivity: These platforms offer two-way communication. Users may ask questions, share concerns, and gain access to official responses, which enhances the flow of accurate and timely information.

Problems

Misinformation: The high speed of information spread on social media could lead to spreading wrong or misleading content, creating confusion or even panic. Misinformation in the case of disasters can exacerbate the situation whereby people rely more on unverified sources.

The digital divide: Not everyone is able to access social media, especially in rural or low-income places where internet access might be limited. Again, here, a gap that exists is who has the ability to read news promptly and who does not.

Involvement of the Community Grass-root awareness campaigns

Community engagement is one of the essential risk communication approaches toward disaster preparedness and management. They generate programs which hope to make communities aware of dangers possible so as to involve them before as well as during the onset of a disaster. Some of these include organizing workshops on preparation for disasters, evacuation drills, and providing information about safety procedures.

Strengths

Localized Awareness: Local awareness programs can be streamlined according to the specific needs, cultural context, and risks of a community. This creates an information system that is effective in relation to action for the concerned community.

Empowerment: Such programs empower communities by preparing them for the same by provision of knowledge and toolkit-based response mechanisms. The motive behind this is local preparedness towards potential disasters.

Involving Community Leaders and Organizations: Engaging community leaders, NGOs, and local institutions who are well-known and respected by the public ensures that there will be trusted voices for communicating critical information. In the long run, these community leaders can help to bridge the gap between the public and the government agencies, therefore, reducing misinformation and improving trust about the official disaster response.

Challenges

Resource Limitations: Limited budget and other logistical challenges can affect the implementation of local awareness programs, particularly in scarce resource settings. Without sufficient resources and support, not all members of the community can be reached by such programs.

Reach: It becomes hard to reach everybody within the population in densely populated or high-transient populations.

Integrated Approaches to Communication Media and Community Campaigns

An integrated approach combines the features of traditional media, social media platforms, and community engagement toward achieving a more comprehensive and effective risk communication strategy. That way, information actually reaches all segments of the population that may not be as likely to access any one medium.

Benefits

Greater Reach: Using various means of communication will heighten the possibility that all the necessary information will reach different audiences-rural and urban, digital and non tech-savvy.

Strengthening Information: Utilizing various channels, key messages can be reinforced across the platforms of communication. An emergency broadcast on television can be further supported in real-time with social media while community leaders can verify the same information independently on the ground.

Challenges

Coordination: Control over a number of multiple communication sources and maintaining information consistency must be coordinated amongst the different

government agencies, media organizations and community bodies.

Misinformation: In a multi-platform approach, controlling misinformation becomes more difficult because the same false information, in this case, is allowed to spread across different channels.

This multi-dimensional approach entertained the use of traditional and social media combined with community engagement in imparting risk communication during environmental disasters. Understanding both the strengths and weaknesses of the strategy, by integrating these approaches, disaster management efforts can become more effective in reaching and protecting the vulnerable during these disasters.

Challenges in Risk Communication

Effective risk communication in environmental disasters means the difference between life and death or saving property damage. However, there are problems throughout the process by which correct and timely and actionable information reaches pertinent stakeholders. Here, challenges have ranged from language and literacy barriers to the spread of misinformation to concerns in culturally sensitive message delivery. It will take strategic solutions and best practices to bring these goals to fruition.

Language and Literacy Barriers Problem of Multilingual Communication

One of the biggest problems India faces is the linguistic diversity of the country. There are hundreds of languages and dialects, and so communicating risk information is a task that may not reach everybody in general. The local populations, for example, may speak only regional languages or local dialects, yet official warnings and alerts issued in Hindi or English are less possible in disaster-prone areas.

Challenges

Lack of Translation: Many government agencies and disaster management authorities forget that not everyone in the same community speaks the same language when it comes to risk communication materials, thus denying whole communities information.

Low Literacy Levels: Literacy levels vary from one region to the other, and in many rural settings, the literacy level might be rather low, hence an inability to read or understand a written warning. In this scenario, interpretation becomes confusing, misinterpreted, or else ignorance about very crucial safety instructions.

Solutions and Best Practices (Rumors and Misinformation)

Rumors and misinformation breed panic and confusion and lead to a lack of trust during a disaster. Social media sites that can be helpful in transmitting immediate information often devolve into false information. Unverified reports and wrong predictions give rise to overstatement, resulting in unhealthy choices. People might refuse to evacuate or take shelter in unsafe areas.

Sources of Misinformation

Social Media: In regards to unverified report news, social media information through WhatsApp, Facebook, and Twitter might be distributed, producing a lot more confusing messages.

Oral Tradition: In scenarios where official communication systems are missing or weak, distortion to the intended message may come about through hearsay.

Tactics for Countering False Information

Fact-checking and verification: The governments have to be closely coordinated with the social and traditional media sources to verify and debunk the false information

immediately. Facts-checking organizations, for instance, may become very active in dismantling and providing the public with correct data.

Official Channels: Government agencies should have active verified social media accounts and websites from where people get trusted facts. Periodically, they should update clear messages and keep a particular individual concerned about any miscommunication.

Community Mobilization: Partnering with respected leaders and local community groups could be instrumental in combating misinformation. The more local leaders are involved in the process, the more trusted or accepted the information; this affects less the spread of false reports.

Cultural Sensitivities

Craft Messages to Cultural Context

India has other cultural diversities that prove to be challenging for risk communication. Different regions have different social norms, religious beliefs, and cultural practices that affect the response of those people indirectly toward messages on disaster warnings and safety protocols. Inclusion of such contexts into the communication may lead to poor communication and resists the given safety guidelines.

Challenges

Religious Beliefs: In some areas, people might believe that the occurrence is due to the will of God; this could be the cause for antecedent unwillingness to heed evacuation orders or preventive measures.

Social Norms: Such cultures may also involve some kind of influence of traditional gender roles. For instance, in certain communities, some women are restricted from moving from one place to another; thus, their quick response to evacuation orders is not easy.

Examples of Culture-Sensitive Communication:

Localization of Messaging: Effective risk communication must be localized and framed in terms that can resonate with community values. For example, disaster preparedness messages may need to be interpreted in terms of saving homes or families in a cyclone-prone coastal region. Involving religious leaders in communication regarding the disaster can be highly effective because some of them were involved in promoting health protocols during the COVID-19 era in some of the regions. The same strategy can be used in disaster preparedness to convince people to adhere to safety measures

Community-Centered Approaches: In areas where there is a strong cultural or religious tradition, work through the local leaders, NGOs, and community group members to ensure the messages of disasters are heard and received. Messages can be devised to communicate with the values that are celebrated and cherished at the local level, thus making them more believable and effective.

Gender-sensitive messaging: Risk communication should be sensitive to gender issues as well, ensuring that information reaches women and marginalized groups. In certain risk communicative areas, prominent women's organizations or female leaders could be approached to ensure women receive appropriate, timely, and accurate information.

Effective risk communication during environmental disasters faces numerous challenges, including those of language, misinformation, and sensitivity to culture. Over and above strategies and best practices, a combination of these has to be employed in order to effectively deal with the challenges. Multilingual communication, fact-checking, collaboration with community leaders, and culturally sensitive messages are important for better disaster preparedness and response. Only after realizing and preventing these barriers will authorities have more resilient and well-informed communities to respond effectively towards environmental risks.

Recommendations for Improvement in Risk Communication

Risk communication after environmental disasters should be aimed at preventing loss and salvaging lives. However, there are other barriers to communication such as misinformation, language issues, and lack of mutual trust between authorities and members of the public on most occasions. Other recommendations for improving risk communication involve improvements in coordination between media and community, adaptable strategies, public trust, and local knowledge. With these recommendations, authorities are better placed with more efficient and inclusive disaster preparedness and response.

Strengthening Media and Community Coordination

- **Risk communication is multi-channel:** It sends traditional messages and digital ones, as well as engaging the community on a very grassroots level. Media coordination with community organizations can improve the scope of dissemination and the precision of information for disaster warnings and preparedness.
- **Enhance Partnership:** The government must engage with media houses, community-based organizations, and local influencers for uniform messaging. This includes creating a planned publicity ahead of a disaster event by coordinated communication. Provide regular briefings to the media and community leaders by government agencies to make sure that they are all 'speaking from the same page.'
- **Localized Messages:** Media houses should be localized to respond to and address various communities' needs and perceptions. The regional media will report in mother tongues, while community-based radio stations focus on the localized threats - the message thus becomes more relevant to different populations
- **Empower Community Leaders:** Community leaders, NGOs, and local influencers are of pivotal importance in order to

disseminate risk communication to the populations who may not reach and follow mainstream media or social media. Empowering these leaders with the necessary information through training and available resources can help these leaders become reliable sources of information for their communities within an emergency situation.

Develop Adaptive Communication Strategies

Adaptive communication strategies should therefore be developed within a dynamic disaster environment. This makes adaptive risk communication about real-time updates in message issues, a mix of platforms, and targeting specific groups based on the evolving nature of the disaster.

- **Multi-Channel Approach:** Authorities should use both the traditional and new media tools, including the mainstream media, like television, radio, as well as social media applications like Twitter, Facebook, mobile messaging Apps such as WhatsApp. This will ensure that all diverse demographic categories, from urban users of technology to rural communities, have access to the information. Flexibility in all these forms of communication allows authorities to easily modify the situation and make updates up to date.
- **Real-Time Update:** The situation might change with lightning speed during disasters. Updating communication is, therefore, viewed as critical to the situation. It should be achieved through real-time communication protocols in government agencies where the whole public receives changes in evacuation orders and weather forecasts promptly through various channels.
- **Tailored Messaging:** Different segments insist that different means be used. Delicate categories-the elderly, children, or disabled-would insist on communication channels distinct from the public. For example, specific evacuation procedures will be needed for a physically challenged individual, and perhaps a general straightforward message is needed by a child. Adaptive

strategies have to take these into account and improvise accordingly.

Building Trust between the Authorities and the Public

Public trust is a very important ingredient for communication in disaster-related risks. If there's no trust in the authorities or the information being delivered, then most people will shy away from evacuating the premises or taking any other precautions. Trust has to be built through transparency, consistency, and engagement.

- **Transparency:** The authorities have to be transparent about risks, uncertainties, and limitations of their information. The uncertainty mentioned could help to establish credibility rather than eroding it. When the public perceives that the authorities are transparent and honest, it is more likely that they will trust and act on the respective information provided.
- **Consistency and Accountability:** Consistency in communications coming from credible sources is essential. Mixed messages or previous errors in communications will alienate trust. All stakeholders, from government agencies down to local media, need to be on board to deliver consistent messages. Committing to follow through and rectifying mistakes can also enforce restoration of lost public trust.
- **Engagement and Dialogue:** Authority must adopt two- way communication with the public. In that channel, the authority can listen to the voice of the public, clarify their questions, and try to reduce the concerns of the people. Local forums, community meetings, and social media may help strengthen this point of interaction, thereby increasing public participation and trust

Conclusion

Effective risk communication is a crucial aspect of disaster preparedness, response, and recovery, especially in a diverse

country like India. In a vast country, another challenge in this regard comes from language, culture, and social dynamics concerning the dissemination of information. The paper mentions media and community coordination, adaptive communication strategies, trust-building with the public, and use of local knowledge to improve risk communication in the context of environmental disasters. This is interesting, as the results show that while both media streams received similar performance, the combination of community engagement with culturally relevant communication truly amplified outreach and message effectiveness. Effective risk communication invariably enables affected communities to be informed, make decisions, respect evacuation orders, and undertake preventive measures, saving many lives and properties. It further solidifies public trust and activates local experts in a manner apt for making communication meaningful and improved for a targeted audience, besides enhancing disaster resilience.

Future development studies propose that adaptive and inclusive frameworks of communication should be advocated more actively, considering the levels of technological advancement and changing social dynamics. Real-time misinformation management practices, the engagement of vulnerable groups, and integration of various emerging technologies into the communication design will surely become important tuning actions of risk communication. Continued effort in this regard will make such communities more resilient faces against future incoming environmental challenges.

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Virtual Reality and Augmented Reality: An Effective Tool for Sustainable Education in India

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Abstract

Environmental degradation has come to be accepted as one of the paramount global issues; hence, public awareness regarding environmental sustainability is crucial. While school curricula have long served as a medium for imparting environmental education to children in India, conventional techniques have sometimes shown inadequacy in elevating students and their communities to a more creative and exciting level. Immersive learning through the medium of interactive and immersive media, such as Virtual Reality and Augmented Reality, can create a really interesting environment for learning in the context of environmental education in India. The unique advantage of immersion media under an educational application will further enhance the in-depth understanding of environmental issues on the part of the learners. This paper discusses the current application of media-related immersive technologies in environmental education across the world, analyses their application in the Indian context, and opens up challenges and opportunities, especially focusing on such technologies and their application in environmental education in India. It examines media more as an interface tool for environmental education, the psychological influence of immersion of media on learners, and how interactive tools can trigger behaviour change.

Keywords: Immersive media, virtual reality, augmented reality, environment, sustainability, interactive media

Introduction

Environmental education inculcates an awareness of, understanding of, and action taken to protect the environment. With this, it can be said that effective environmental education was required more than ever to combat environmental degradation instances such as those in India and elsewhere due, in general, to rapid industrialization, urbanization, and population growth. Traditional pedagogical components of Lectures, Textbooks, and Field Trips, while valuable, fail to completely capture a student's would-be interest and long-lasting impact in terms of the measure of the environmental consciousness imbibed in them. In recent years, interactive and immersive media technologies like VR and AR have opened up new avenues to engage students in environmental education not possible with other mediums. Such experiences may ultimately transform what were traditionally felt to be intangible into touchable, real-world experiences. Students could be teleported into endangered ecosystems and witness environmental disasters unfolding; data could seamlessly unfold as powerful and emotionally engaging information. This paper presents a one-of-a-kind inquiry into the applicability of emerging immersive technologies in India for making environmental education work for learners. Addressing their unique environmental challenges while also creating a culture for sustainability.

Immersive learning

Immerse learning is a learning modality mirroring real-life scenarios with artificial, digital content and environments where one can learn and practice new things. Inside this safe environment, the learners can creatively determine outcomes to repeat learning and measure justly for success.

Thus, this form of learning is exactly what its name reads. It upholds learning goals because it encourages learners to

immerse themselves in learning or submerge fully in the learning environment. Immersive learning is an active process where learners learn by doing things themselves. They make use of their own hands, eyes, ears, and other sense organs to conceptualize anything, and then they participate in the learning process by doing what they have learned. Though this style of learning may find a rare application in literature or fine arts, it is mostly used in science, technology, engineering, and all applied learning subjects.

Immersive learning is full immersion into what you are learning. You'll see, hear, touch, smell, taste, and feel every detail pertinent to the subject matter. It's almost like the traditional classroom because you'll be in a room with other students (again, virtually!). But instead of interacting with your fellow classmates, you'll interact with the material and the environment within which the content is presented using technology.

This technological aspect of immersion is integral to immersive learning experiences. To that end, immersive learning creates far more profound learning than that which is created in a traditional classroom or in-person setting. For example, students in an in-class or non-immersive online architecture course might utilize CAD/CAM software to develop a 3D model of an architectural structure, such as a building, bridge, or dam. They can flip, rotate, and gyrate different views of the structure to feel a better closure around their proposed design.

However, an immersive approach could have the aspiring architects "step onto" the bridge using Augmented Reality (AR), walk upon it, and view it from different angles. They can stand on one end of the structure and watch how the columns react when heavy traffic goes across it. Such an interactive version of that very same class could have a student sit in the car and drive along the length of the bridge, while modifying and adjusting design parameters to observe effects of those modifications on the design.

Where the in-class architecture student may be able to make those same changes, he will only see them realized as a series of 3D drawings, the immersive learner gets to “live” those changes in as real life as the learning environment can make it feel.

Various types of immersive media

This immersive media is found in entertainment, Social VR, education, training, marketing, and healthcare, and provides experiences that are unique and engaging, unavailable to traditional media. Virtual Reality: VR headsets or HMDs create a simulated environment that one can explore interactively. Users might feel they are in a completely different world - users can view all around them with 360- degree views, and stroll around Augmented Reality: This is a technology which overlays the digital information on the real world. Using the devices such as a smartphone or, AR glasses, users can see images, information, or enhancements of the digital reality projected over what they see in the real world.

In this video, UX Design Consultant and Founder of Experience Dynamics, Frank Spillers, looks into the core aspects of spatial cognition in AR.

Mixed Reality (MR): MR is an environment that allows for the coexistence of both physical and digital objects in one space where users can interact with it in real time.

360-degree videos these videos take a view of every angle. They allow the consumer to look around in all directions, very often through a VR headset that gives the impression of being ‘inside’ the video. Google Arts and Culture have an assortment of videos that can let you explore art, architecture, sculpture, natural history and much more in 360 degrees. Here step inside the Orion Nebula

Meaning of Interactive Media

The collective term for a variety of media that are interactive in response to the user, such as video games, interactive

storytelling, or educational software. Examples include Oculus Story Studio that has created an interactive documentary, and the National Film Board of Canada, which, in collaboration with its partners, designed an interactive documentary that allowed the viewer to interact with the content in a non-linear fashion and very often influence the narrative based on their choices. All these actually fall under the term 'Extended Reality' encompassing Virtual Reality, Augmented Reality, Mixed Reality, 360-degree videos, and any interactive media. It is an all-encompassing term that generally represents the spectrum of media that modify our perception of reality, from fully immersive virtual environments to AR digital enhancements within the real-world environment and MR's combination of both.

Use of Immersive Media in Education

Immerse medium- digital space may share for a condition - mimesis of the real world and complement to use existing media technologies to develop multisensory experiences: being both visual, and auditory stimuli touching. Immersive technologies including VR and AR create a condition known as "presence"; in it, users believe they are inside a simulated environment, note the authors.

Virtual Reality embraces completely immersive experiences in which people are transported into a fully digital environment. It blocks off the physical world and replaces it with a virtual space where they will be interacting with the environment as if they were really there. For instance, imagine an experience that lets you visit a coral reef ecosystem without leaving the classroom.

Augmented reality combines the physical and digital world by superimposing virtual elements over real-world views. Augmented reality is accessible both through mobile devices and smart glasses, so teaching becomes more accessible to implement in the classroom. For instance, AR can be used to deploy 3D models of wildlife species, pollution data, or environmental changes in real time over a map of a local area.

With virtual reality, students can be immersed in realistic, simulated environments that provide for rich, interactive learning experiences. For environmental education, this allows for the generation of simulations of natural environments, ecosystems, and environmental processes.

Virtual Field Trips: One of the earliest uses of VR has been virtual field trips. They will enable students to explore places of the world far away or inaccessible, such as Arctic tundra, coral reefs, or dense rainforests. Much more immersive than video-based learning a VR field trip will let the student look around, touch or interact with objects and feel that they are actually there. **Simulation of Environmental Change:** The other use of VR is the simulation of change to environment over time. It allows them to experience the effect which global warming can cause on glaciers or even on coastal cities due to rise in sea level. A dynamic, real time learning process like this will help them more importantly understand the long-term effect of their activities on the environment.

Behaviour Change and Empathy Building: Several studies have shown that VR can improve empathy towards environmental issues because it enables users to be put in scenarios where they generate emotional responses. For example, students could be taken through the impacts of pollution through a simulation in a VR and may react to such a simulation by changing their normal behavior on earth. AR, on the other hand, provides a view of the environment through superimposing digital information over the real world. Using smart-phones, tablets, and even AR glasses is possible to achieve this. This also gives interactive learning in a layering fashion. For instance, a student may use a device to point at a tree to read information on carbon sequestration capacities or what type of animals the tree supports. AR apps add to the enriching of the field trips taken as they provide real-time data about what is currently surrounding a person. **Gamification and AR Apps:** AR fits very well with gamified learning experiences, oriented toward the environmental sustainability agenda. For instance, with AR apps, students

may be challenged to identify local plant species or map pollution areas, thereby making environmental education a game-like experience, and learning fun and memorable.

One of the most obvious uses of AR is in data visualization; that is, extracting complex data on environmental parameters such as air quality, pollution, and climate change into an easily understandable three-dimensional format.

Benefits of interactive and immersive media in education:

- **Increased Involvement:** Traditional ways of education can hardly attract the attention of the audience, especially when treating abstract topics. Virtual and augmented reality indeed provide more involvement and an interactive experience, making the subject matter more relatable. **Experiential Learning:** The simulated experience can provide the student a direct experience of various environments and scenarios that the students likely will never encounter in their real world. In this regard, a VR simulation could give the students an opportunity to see what deforestation in the Amazon rainforest means or experience seeing rising sea levels affecting coastal cities.
- **Interactivity:** Users of the environment can interact and this what most students experience as powerful for learning. They can, in VR, perform tasks or make decisions and get instant feedback on environmental consequences for their action. In AR, they can manipulate data, explore virtual ecosystems, or study species close up.
- **Immersive Storytelling:** One of the most important elements of successful environmental education is storytelling. Immersive media allows someone to tell a story in an extremely engaging way, placing the learner in the middle of environmental problems, thereby emphasizing their emotional involvement with an urge to solve these problems.

Virtual Reality and Environmental Education:

Since virtual reality was developed in the twentieth century, it has been applied in various sectors, such as engineering medicine, space exploration and communication. Education is among the domains that fall under VR technology influence. The very first experiment of applying VR in education was conducted in 1992 for VR as a learning aid. The assessment from the students was largely a positive comment. In the 1990s, Taylor and Disinger (1997) ^[9] explored the potential for using VR in environmental education by conducting a questionnaire of environmental education practitioners and developers of VR. The result of the questionnaire showed that VR is viewed as a useful learning tool for

Ecological education according to the interviewees (Taylor & Disinger, 1997) ^[9]. Additionally, a study indicated that VR may offer three key advantages for education (Martín- Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017) [4]:

- Increasing students' interest and participation. According to Salzman *et al.* (1999), VR systems may provide very attracting experiences and can make learners pay more attention to the topic of their study. As the virtual End Environmental setting which provides environment that can hardly reach in real life strengthens the relationship between learners and the environment hence environmental education benefitting. Later, in the twenty-first century, there were more studies showing that the use of VR technology would enhance the students' academic achievements and interest to learn by promoting students' involvement (Gutiérrez, Domínguez, & González, 2015; Harris & Reid, 2005) ^[2, 3].
- More interaction than with other learning materials. The VR technology can enhance the skills of learners such as deciding since learners are required to interact with the virtual environment (Martín-Gutiérrez *et al.*, 2017) ^[4]. The technology can also offer an immediate feedback mechanism for learners. Secondly, VR products with

interactive features improve learner's understanding and immersion level by engaging learners in active participation with a product.

- Offer virtual field trips, which are obviously cheaper than real field trips. Again, please consult section 2.4 for more information.

History of VR in environmental education

In 2014, Merchant *et al.* carried out a meta-analysis of the total of 69 studies, which incorporated VR in education, to analyze the effectiveness of desktop-based VR technology in education (Merchant, Goetz, Cifuentes, Keeney- Kennicutt, & Davis, 2014) ^[5]. As for test scores, this experiment indicated that the use of VR in instruction produces positive effects. The knowledge retention value of the game-based VR instruction technique can be higher than traditional short-term learning.

In 2018, Tudor *et al.* examined the students' experience of using a mobile VR application for a virtual geography field trip (Tudor, Minocha, Collins, & Tilling, 2018) ^[10]. The authors implemented the Google Expeditions smartphone- based virtual reality application. The study result indicated that after using this application in class, students were aware of the impacts of large-scale development and gained knowledge about the implication for the environment and proposed suggestions. In 2019, Fung *et al.* could successfully conduct a study using a VR platform in environmental chemistry education (Fung *et al.*, 2019). The authors resorted to a web-based online VR platform called edu2VR to create an overseas field trip simulation for undergraduate students. Two trials of this VR technique eventually led to most students ending up reporting a positive experience. The two major challenges of this study however were the limitation of the application and disorientation after a long period of using the VR head-mounted device.

Salient features of VR and Environmental Education

For an understanding of how VR can help in environmental education, a meshing with core principles of environmental education is necessary. This ranges from how VR can enhance these principles towards achieving high-level and - quality environmental education. The following are standards according to North American Association for Environmental Education ((NAAEE), 2021) by which the author refers to in this paper:

- **Valid and representative:** Environmental education materials should be valid and representative of the nature of the environment in all directions.
- **To skills acquisition:** Environmental education should help develop lifelong skills for learners
- **Conceptual understanding:** Instructional materials should build personal environmental literacy for learners.
- **Personal and civic responsibility:** Personal and civic responsibility offers an important base for environmental decision-making and action.
- **Effectiveness in instruction:** One great requirement for education materials is that they should create effective and all-inclusive learning environments for all learners.
- **Usability:** The materials should be designed to be easy and efficient to use by both educators and the learners

Virtual Field Trip

Field trips have been seen as crucial parts of environmental education because they link abstract textbook knowledge to real environmental situations and authentic experiences. In- situ experiences through field trips can make learners know the matter in depth and take responsibility for the environment.

However, sometimes, it is quite challenging to organize field trips due to the following reasons: (1) field excursions can be costly for institutes or students; (2) some research sites are not easily accessible (e.g. Antarctica, Mount Everest); (3) people with certain disabilities might not be able to travel easily.

- To overcome these challenges, a more practical replacement for conducting field trips is involvement in virtual field trips. Virtual field trips with VR tools can hold the following benefits (Tudor *et al.*, 2018):
- Just like an actual field trip, a virtual field trip offers a virtual landscape for students to make connections between book knowledge and pictures of the real world around them.
- Virtual field trip affords cheaper alternatives to a real field trip. The cost of VR equipment is cheaper than an actual field trip. Moreover, in addition to equipment such as HMD, even cheaper alternatives that do not involve headsets exist: 3D virtual environments on PCs and mobile devices.
- It also means less time than a real field trip: it saves, in both the traveling and preparing time.

Adaptation in India

In India, the integration of immersive technology with mass media and education has taken EE to a decent level. Organizations like Centre for Environment Education have been actively developing innovative programmes and educational material that exploit these technologies in promoting Education for Sustainable Development (ESD). The belief that EE leads to action for sustainable development in the Indian context is only possible if commitment is made to CEE's belief.

The environment education program had been approved for continuation up to 2025-26. It looks toward supplementing the knowledge acquired within the four walls of the classroom

with experiences from nature and hands-on activities. Eepmoefcc.nic.in initiatives like education and incentivization play a crucial role in psychological interventions that bring about a behavioural change towards the environment.

The interactive and immersive media like 360-degree videos, VR, and AR have been recognized to be effective change agents in learning. The immersion feature of the technologies creates an opportunity for learners to engage with environmental scenarios that may not otherwise be possible. This increases learner engagement and the retention of information (Tandonline.com). Finally, it could enhance the pedagogical rethinking process based on self-determined mobile learning, keeping in view the haptic, sensorial, and embodied experiences; however, this holds particularly true while involving India because its environmental issues are diverse and complex.

It has been proven through research that the individuals are more likely to accept immersive technologies in the educational environment as well, such as 360-degree video (Springeropen.com). There is also an option to explore educational use for platforms like Second Life and immersive online social platforms because they provide more social cues and interactive options (Tandonline.com).

Impact on Awareness and Sustainable Practices

The use of interactive and immersive media in EE has a deep impact on awareness and sustainable practices. Ahmad found in 2015 that videos are more influential than pamphlets among Indian youth concerning issues of the environment (Sifisherliessciences.com). However, according to Chung (2020), though young adults access most information through social media about the environment, they do not interact and share it. According to Sifisherliessciences.com, there is a need for the interactive and participatory content so that engagement can be encouraged.

Conclusion:

Interactive and immersive media holds great promise for transforming environmental education in India. These technologies can offer new learning methods that make one better understand the environment and makes it more interesting and, consequently, lead to a more profound commitment to environmental stewardship. The available evidence suggests that, indeed, with these media-assuming proper use-appropriate improved engagement could be fostered and sustainability-practice adoption promoted among learners. Despite the challenges, especially in terms of engagement with the content, there is a clear opportunity here for these technologies to have a central role in the future of environmental education in India.

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Eco-Communication in the Digital Age: Leveraging AI and Social Media for Environmental Advocacy

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Abstract:

This research paper analyses the role of artificial intelligence (AI) and social media in promoting environmental activism. In the face of growing communication digitization, AI technologies and social media sites have become transformational forces for the delivery of environmental messages and the addressing of environmental concerns. This paper analyses diverse digital strategies that raise environmental awareness, mobilize action, and drive policy changes. Using empirical evidence and case studies, it suggests best practices on how to make use of AI-powered analytics, chatbots, and tailored social media engagement for furthering the objectives of sustainability. Moreover, it investigates issues, moral factors, and possible future scopes of digital eco-communication.

Keywords: AI, social media, green campaigns, digital communication, sustainability, public mobilization.

Introduction:

The digital age has transformed environmental campaigning, providing new channels and instruments to reach the public. Social media has emerged as a powerful means of mobilizing people, spreading information, and putting pressure on policymakers. At the same time, AI-powered analytics enable us to better understand environmental

trends, making our communication more effective and targeted. This paper discusses how these technologies are transforming the landscape of eco-communication and how they can be maximized for maximum impact.

AI and Environmental Communication:

AI-Powered Data Analysis: AI allows organizations to monitor environmental trends via big data analysis, generating insights that inform effective communication strategies.

Chatbots and Virtual Assistants: AI chatbots facilitate higher engagement by offering real-time information on sustainability issues, responding to questions, and directing users to resources.

Predictive Analytics for Environmental Campaigns: AI is able to forecast public reactions to environmental campaigns, enabling the optimization of messaging and outreach.

Automated Content Generation: AI technologies assist in creating informative content for particular audiences, enhancing environmental engagement.

Sentiment Analysis and Public Perception: AI processes public sentiment towards environmental campaigns, assisting organizations in optimising their communication strategies.

AI-Powered Translation for Global Advocacy: AI-powered language processing facilitates smooth translation, enabling environmental messages to reach a wider global audience.

Social Media as a Catalyst for Environmental Advocacy:

Influencer and Community Outreach: Social media influencers are a key driver of environmental awareness.

Hashtag Campaigns: Campaigns such as #FridaysForFuture and #ClimateAction demonstrate the power of digital activism to shape public opinion and policy.

Real-Time Information Sharing: Twitter and Facebook allow for real-time reporting of environmental crises, rallying communities in a matter of minutes.

User-Generated Content and Crowdsourced Activism: Social media allows grassroots movements to amplify compelling environmental narratives and attract international support.

Live Streaming and Virtual Events: Instagram Live, TikTok, and YouTube permit environmentalists to reach millions in real-time.

Social Media Algorithms for Targeted Advocacy: Artificial intelligence-based algorithms enable the targeting of environmental content to the right people based on their interests and behaviours.

Case Studies:

Fridays for Future: Greta Thunberg's climate activism, amplified on social media, has propelled worldwide awareness and political response.

AI in Climate Prediction: IBM's AI-based environmental research efforts enable the prediction of climate shifts and guide policy measures.

NGO Digital Advocacy: Groups such as Greenpeace use AI resources and social media to mobilize supporters and battle disinformation.

The Influence of YouTube Documentaries on Climate Awareness: Ecological documentaries presented on social networks have reached millions of viewers across the world.

Facebook's Climate Science centre: Facebook introduced this program to offer reliable climate change information and combat misinformation.

AI-Based Disaster Response by Google and NASA: AI technologies from leading technology firms help predict and respond to environmental disasters.

Challenges and Ethical Considerations:

Misinformation and Digital Manipulation: The threat of greenwashing and misinformation discrediting credible advocacy campaigns.

Data Privacy Concerns: AI technologies gather enormous amounts of data, which raises ethical concerns regarding user privacy.

Accessibility and Digital Divide: Inequalities in internet access can restrict the scope of AI-powered and social media-oriented environmental campaigns.

Algorithmic Bias and Echo Chambers: Recommendations based on AI may perpetuate existing beliefs, restricting exposure to a range of opinions on environmental matters.

Over-Reliance on AI and Automation: Too much reliance on AI tools might diminish human control and participation in environmental activism.

Regulation and Policy Gaps: Inadequate policies to govern AI and digital environmental advocacy may result in misuse or ineffectiveness.

Directions for the Future of Eco-Communication:

Virtual Reality (VR) and Augmented Reality (AR) Integration: Immersive experiences can be used to enrich environmental storytelling.

Improved AI-Powered Sentiment Analysis: Improved understanding of public response can result in more

successful advocacy campaigns.

The Use of Blockchain in Transparent Eco-Reporting: Authenticity in environmental claims through decentralized verification.

AI-Driven Personalization of Sustainability Learning: Adapting environmental learning for various audiences for enhanced effect.

Hybrid Digital-Offline Campaign Models: Fusing digital advocacy with offline action to establish a more integrated style of environmental advocacy.

Decentralized Green Networks: Applying blockchain and decentralized websites to build transparent, community-based environmental action networks.

Conclusion:

AI and social media have revolutionized environmental campaigning, giving robust tools to educate, involve, and mobilize communities. As technology continues to evolve, leveraging these digital strategies will be crucial in advancing sustainability efforts. However, addressing ethical challenges and ensuring inclusive access remain essential for maximizing the impact of eco-communication. Future research should explore the long-term implications of AI-driven advocacy and the role of emerging digital tools in fostering sustainable change. With proper implementation, social media and AI can be game-changers in the battle for a healthier world.

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From Screens to Streams: Interactive Media and Its Influence on Conservation Efforts in Digital Learning Environments

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Abstract

Interactive media present a recent and potent vehicle for advancing the stories of environmental protection. With the popularity of digital learning environments and streaming sites increasing over the last couple of years, interactive media have proven to be an excellent way to advance the stories of protecting the environment. The present paper explores the impact that digital media have had on the public perception of conservation issues. Some examples include immersive documentary experiences, virtual simulations, and educational games. These are documentary experiences, virtual simulations, and educational games. Based on the two strands of theory; media interactivity (Jenkins, 2006) and environmental communication, we conclude that interactive digital media are a better tool for engagement through experience-based learning, increased empathy, and actionable insight toward environment stewardship. As an example, on the platforms of EcoQuest and Endangered Earth, gamified elements trigger participation through rewards toward real-life activities of conservation, leading to vast public awareness and participation (Smith & Lee, 2021). This paper would explain the role interactive media would assume in digital learning environments for conservation education and propose some ways to maximize such a potential while limiting the negative aspects of interactive media.

Keywords: Digital learning, Digital media, Interactive media, Virtual simulations, Environmental communication.

Introduction

As society unfolded from traditional media screens to dynamic streaming platforms, the way people seek information has now become definitely different. Moving forward with interactive media, it led to the extension of possibilities in highlighting conservation within an educational setting. It reaches out to learners as it provides real-time data and varied simulations of interactive experiences; ecological challenge understanding and probably the prospects for solutions. This is changing with interactive media, and now it is among the most important sources of information concerning environmental conservation, especially through individual learning paths and interactive educational experiences.

Once emphasizing static means of information delivery, such as books or documentaries, conservation efforts are increasingly becoming interactivity-based via digital platforms. The interactive nature of streaming media, especially in conjunction with such other interactive media as quizzes, virtual reality (VR), and augmented reality (AR) permits individuals to be actively part of their learning processes (Jackson, 2019). This makes gaining access to the same information relatively more democratic, and for the learner, the apprehension can thus be relieved while appreciating the diverse aspects surrounding an environmental issue. For example, VR can place people within threatened ecosystems and provide them with first-hand experiences with the ramifications of deforestation or climate change without having to read or listen passively (Miller & Reynolds, 2020). One of the other more influential impacts interactive media can have on learning about conservation is its potential to engage the global community. The use of social media sites and participative sites offers a means of sharing information from one user to another worldwide. It helps in gathering data and putting them together to present for joint digital activism on local conservation fronts. Such an

interface promotes global citizenship and the sense of shared responsibility over environmental stewardship (Thompson & Gupta, 2021).

The gamification of learning in the digital space serves as a singular vehicle to address the youth on conservation issues. By adding conservation issues to engaging gaming formats, it makes the students want to learn and become action implementors in an entertaining yet educational manner. Research studies have revealed that if interactive simulations are undertaken with the incorporation of conservation goals, then there are high levels of sympathy and behavioral intention toward environmental issues (Clark et al., 2022). In summary, the shift from static screens to streams of interactive interactions opens up extraordinary possibilities for integrating conservation efforts into digital learning environments. All these technologies allow the teacher to create incredible, involving experiences that foster environmental consciousness and urge proactive actions towards conservation.

Objectives

The analysis is guided by the following objectives:

1. To explore the extent to which interactive media facilitates learning and participation in conservation activities.
2. Assess the effects of digital media, such as virtual reality, interactive videos, and social media, in raising environmental awareness and calling attention to issues affecting the environment.
3. Identify any gaps of the utilization of interactive media for conservation education in digital learning environments.

Outline how conservation organizations could effectively use interactive media to foster global environmental sustainability.

Literature Review

Installation of interactive media shifts the mode of learning in multiple ways, especially in the aspect of conservational education. This literature review explores former studies on how interactive media facilitates effort in the aspects of conservation in the context of digital learning. From such previous work, we seek gaps for further analysis.

Interactive Media in Education

Interactive media is the collective term applied to digital materials that provide support for learner interaction, such as video games, simulations, and virtual reality. Researches have confirmed that interactive media cognitively and emotionally engages the learner, therefore, enhanced results of learning. For instance, it has been observed that gamification in learning triggers eagerness and participation from learners (Deterding et al., 2011).

Conservation Education

Conservation education deals with sensitizing people to environmental concerns and behavior change. It has been proven through various research works that innovative educational tools have played a significant role here. For example, digital platforms have extensively been used in sharing conservation knowledge and its more engagement than others (Kirk & Reid, 2014). Interactive media, in particular, offers experiential learning experiences in which one can develop a personal sense of belonging to environmental issues (Hsu et al., 2018).

Role of Interactive Media in Conservation

Interactive media has been claimed to provide great opportunities to assist in environmental stewardship. Duvall et al. (2020) in a study successfully demonstrated that exposure of VR to real-world conservation challenges improved the understanding and empathy of ecological issues for participants. Analogous is the case with other interactive

simulations that allow decisions regarding conservation topics: such multiple demonstrations on decision-making can bring about new appreciation for and a thought of deeper difficulty of the complexity of environmental management (Harris & Cummings, 2019).

Moreover, research shows that the incorporation of interactivity in media can mobilize communities into taking conservation action. According to Garcia et al. (2021), online platforms that facilitate and allow social interaction and user-generated content enhance community engagement in conservation work. This is a departure from the previous methods of instruction to more participatory and interactive approaches.

Limitations of the Literature

Although encouraging results abound in current literature, several limitations are noted. Most of the reports tend to focus on a type of interactive media that may be either virtual reality or mobile applications without considering further implications of other formats. Most research has been based on controlled conditions which are far from real life conditions (Rogers & Yusof, 2021). Few longitudinal studies have addressed the long-term impacts of interactive media on conservation behaviors.

Research Gap

It indicates a vast range of significant research gaps regarding literature. First, there is a need for extensive comparative studies on the types of interactive media existing in conservation education on their effectiveness. The research should explore how interactive media impacts diverse demographic groups because current studies often neglect cultural and socioeconomic factors. Finally, there is an urgent need for longitudinal studies in examining the sustained impact over time for conservation-related behaviors.

Methodology

The study uses a qualitative approach of content analysis in exploring the role of interactive media to influence conservation education. This is because qualitative content analysis is appropriate for this kind of study that can be focused and scrutinized on the content and contexts under which interactive media is put into use in the conservation.

Data Collection: A wide variety of interactive media platforms was considered, including virtual reality applications, streaming platforms, and social media tools that focus on education for conservation. Selection was based on conservation campaigns and educational programs via these platforms. Educational content was also reviewed from NGOs, environmental agencies, and academic platforms.

Sampling: The strategy was a case of purposeful sampling focused on digital media content that aimed efforts toward awareness creation and thus behavioral conservation. This comprised virtual tours for protected ecosystems, interactive documentaries, and social media campaigns propagated with conservation messaging.

Data Analysis: The collected media was critiqued against three criteria:

Interactivity and engagement: How interactive the platform or tool was in fostering engagement with conservation messages.

Knowledge retention: Evidence as to how well users retained the information presented and whether it influenced their awareness or actions with respect to conservation.

User behavior: How interactive media had an impact on the attitudes and behaviors of the users toward conservation over time.

Interpretation: The findings were interpreted as one form of making sense of the patterns underlying the data and in

mapping how possibly, though with what consequences, interactive media might influence conservation in education settings.

Findings

From the content analysis, several overarching trends emerged concerning the impact interactive media has on learning for conservation. Interactive media provides a more engaging experience for the learner as opposed to traditional media. There were more self-reports of emotional engagement regarding virtual reality tool use due to the immediacy and personal nature of environmental problems created by these tools.

Knowledge Retention: Students who were exposed to the interactive documentaries and virtual simulations better retained more conservation knowledge than those taught with materials. Immersive, visual and kinesthetic learning methods contributed to this increased retention.

Behavioral Influence: Social media campaigns with interactive tools like polls and quizzes have primarily influenced the most in active participation in activities relating to conservation. For example, campaign #PlasticFreeChallenge led to concrete behavior like waste reduction.

The biggest obstacle to this influence, however, is the availability of technology. In many poor and rural regions, infrastructure to access and to benefit from interactive media is not available. Other users were swamped by the volume of content and these may counterbalance particular conservation messages.

Discussion

Interactive media clearly has the potential to improve conservation education, but its widespread adoption remains challenging by a number of barriers. The impact of digital learning environments is contingent upon ensuring access to quality technology and training. The results, as outlined

clearly, indicate that immersion will increase engagement, knowledge, and behavior; however such benefits are not equitably distributed across socio-economic contexts. Going by these findings, educational institutions and NGOs ought to adopt more inclusive approaches because interactive media tools need to reach every corner of society irrespective of any geographical location and economic status. There is also a great need for more research to ascertain the long-term behavioral impact toward conservation by interactive media.

Conclusion

Exploring interactive media in digital learning environments has proven to have appreciable potential in improving the cause of conservation. As Leduc et al. point out, “the integration of immersive technologies, including augmented reality (AR), virtual reality (VR), as well as others, into educational frameworks not only captures the learner’s attention but forces learners to delve deeper into environmental issues on an emotional level.”. This affective engagement is crucial in the promotion of pro-environmental behavior because research studies show that people act and behave more towards conservation if the course matter falls within the personal feelings (Miller, 2019). Interactive media also facilitate participatory learning and encourage users to interact with content rather than becoming passive consumers. This shift in engagement can contribute to better retention of knowledge and an improved understanding of ecological principles (Talan et al., 2022). Regarding the possibility of interactive platforms to support the exchange of ideas and strategies for conservation among users, it increases the strength of efforts of the community toward sustainability (Seymour, 2020). Of course, one must not forget that the digital divide is still there to inhibit access to such technological innovation. Therefore, disparity in accessing technology must be addressed so that the learner benefits from such innovations in interactive media (Helsper & Reisdorf, 2017). Thus, educational practitioners and policymakers ought to get down to making these tools and resources available to a wide audience yet emphasize the

concept of inclusiveness.

In other words, interactive media is a method of learning about digital change that can strongly aid in shaping conservation. Through enhancing emotional involvement and facilitation of collaborative learning and improving access, these institutions can utilize such technologies to foster yet another generation of stewardship that could become even more informed and actively engaged in the management of the environment.

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Immersive Experiences in Environmental Learning: How Interactive Media Can Drive Sustainability Awareness

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Abstract

Immersive technology can take the difficulty out of complex ideas and re conceptualize them into more easily digestible forms, radically enhancing learning. Few studies have investigated the newest evidence-based immersive learning programs employed in the classroom or distributed to the general populace. A user-friendly VR headset like Oculus Rift and improvement in mobile technology have eased the process of creating an application that offers both pleasant and captivating experiences to users. For this reason, VR and AR have great popularity in gaming and entertainment; on the contrary, some believe that XR has other practical uses than those mentioned above. Large companies like Microsoft and Meta have funded new projects and invested in developing the current work and collaboration capabilities for XR. Such investments aim at setting up XR, with the seamless integration of embodied interaction modalities, as the leading media delivery platform that can redefine computational settings. Besides this increasing interest in XR within a variety of fields, including retail and occupational training, there is a body of studies that environmental researchers have developed. Although communicating about climate and environmental changes can be difficult and abstract, there are other barriers to public action, such as physical and human issues. In fact, as evidenced by ongoing

studies looking for obstacles to public action, the problem is complex as it can possibly be, much like environmental change itself. This attribute creates a situation in which it is even more difficult to devise means of reducing or working around these problems and heightens the need for public awareness of environmental alteration through various forms of media. Given the scope of the impact technology has on our life, a decent starting point in that respect would be to consider our technological habits. The same sentiment is echoed by researchers in human-computer interaction—indeed, sustainable human-computer interaction has emerged as a subfield of the discipline.

Keywords: Augmented Reality, Climate Change, Environmental Sustainability, Extended Reality, Systematic Literature Review, Virtual Reality

Introduction

Virtual reality, also known as VR, is the technology capable of simulating a realistic environment. Virtual reality has been in development for many decades and has reached every other professional field known today, including engineering, health, and education. People can access virtual reality through mobile devices, desktop software, or VR headsets. VR is an effective tool in education because of how immersive and interactive it can be. Moreover, as 360-degree films and photographs may occupy the gaze of the audience from all sides, they are among the items that can be experienced through virtual reality and offer a high level of immersion.

The use of digital technology has also been motivated by a deeper concern for environmental justice. To confront colonial and corporate epistemologies, limits, and practices, advocates and activists for land and environmental justice, for instance, have used digital cartography to disseminate and support counter and commune centric mapping initiatives. In addition, modern environmental activists

frequently use social media and digital technologies to plan events and disseminate images, videos, and other materials that may supplement or contradict the views of the corporate sector, the government, or the mainstream media. In order to generate visual artefacts that depict, dispute, and disrupt socio environmental issues, injustices, and hierarchies, environmental educators, scholars, practitioners, artists, and activists are also increasingly interacting with and connecting digital and non-digital traditions.

Influence of Immersive Technology on Environment Education

There is a lack of any collective efforts to explore, discuss, and debate the influence of digital technology on EE (Environmental Education) research and practice, and previous efforts to present and call for critical perspectives and the emerging pervasiveness of digital technology in EE. Through citizen science initiatives and other similar programs, digital technologies have the potential to serve as exceptionally powerful tools for collecting, monitoring, and distributing key ecological data and trends to students and the public. Instructors and students who are less willing or able to take their learning out of the classroom will naturally be attracted to these technologies for many reasons, including institutional risk management concerns, lack of funding, experience, knowledge, or access.

The term “immersion learning” has been defined in various ways by different authors. For example, immersive learning has been described by some authors as learning made possible through the use of immersive technologies. On the contrary, some researchers reasoned that technology and its impact should be distinguished. The term “immersion” characterizes both the technological aspects of a medium and the response emerging from integrating the human motor and perceptual systems. Immersion learning becomes ageless and unaffected by technological advancements when it focuses on the effects of immersion on learning and perceptual processes rather than technical qualities. Therefore, by utilizing technology

affordances, immersive learning promotes learning while fostering a sense of presence the sensation of being there co-presence the sensation of being there with others and identity construction the process of establishing a link between oneself and the visual representation.

A number of frameworks and models that focused on the educational uses of immersive affordances were introduced and discussed. For example, a framework for the use of IVR technologies based on cognitive theory about multimedia learning, to identify the objective and subjective elements of the presence, is utilized. The objective elements are immersion technology, while the subjective elements include motivational, emotional, and cognitive factors. Due to these reasons, another model was also presented, which is known as the cognitive-affective model of immersive learning. It was introduced in order to understand better the usage of immersive technology in learning environments based on cognitive and emotional factors such as interests, motivation, self-efficacy, cognitive load, and self-regulation. It explains how these elements make a contribution to obtaining procedural, conceptual, and factual knowledge. Immersion technology can improve instruction.

Generally, VR is understood as a combination of technology and software that creates an artificial experience, which may either be similar or different from the real world. The concept of virtual reality was talked about in the writings of ancient times before this was developed as a technology. However, Ivan Sutherland introduced it, according to many, for the first time as a computer technology in his PhD thesis. He contributed to the Sketch Pad man-machine graphical communication system. However, it is Jaron Lanier, who founded the virtual programming language research community that is credited with popularizing VR. The technique was then researched and studied by the researchers in minute detail. The engineering, physics, and chemistry communities have contributed to the changing

faces of the technology over time.

A virtual reality technology is a technique of simulation that simulates the physical world. Morton Heilig developed the concept of virtual reality and came up with the idea in the 1950s. He built Sensorama, a multisensory, immersive device and among the first virtual reality systems. However, Sensorama was far from what today's VR headset is. Ivan Sutherland and his research group created the first functional interactive head-mounted display system later in the 1960s. After years of research and development in the field, several varieties of VR equipment exist. Various gadgets can be employed to adjust the degree of immersion of the VR experience. Normally, an immersive VR experience requires a head-mounted display, abbreviated as HMD.

The alternative virtual reality experience is a non-immersive VR system, more accurately called a desktop VR system. An HMD is normally a helmet-shaped device that provides a three-dimensional view and monitors the movement of the user in order to refresh the view on the HMD accordingly. Nowadays, it is universally acknowledged that immersion and interactivity are the two most important advantages of VR. Corresponding to the two conceptions, there are five key characteristics of virtual reality technology in relation to creating a simulated realistic setting and providing people with a high degree of immersion and interaction.

Key features of VR

Three-dimensional viewing provides a more real environment compared with two-dimensional viewing.

2. Dynamic display: Enhancement of realism in user experience.
3. Closed-loop interaction: A VR system provides greater mastery to the user over the virtual environment because one is both an active navigator and an observer.
4. Inside-out frame of reference: Sometimes also referred to as ego-referenced frame of reference, this approach projects an image of the virtual world onto the mind of the explorer from a camera viewpoint.

5. Due to recording the user's movements and then feeding this information back to the VR system via a headset and gloves, it will open up a completely new dimension in sensory experience. Since VR has all the above-mentioned qualities, it is useful for environmental education.

First, to understand how VR can help, one needs to consider where VR fits in with the fundamentals of environmental education. Especially, we want to consider how VR might support these ideas in order to provide better environmental education.

1. Representative and inclusive: All environmental education resources must be inclusive and representative in the capturing of the nature of the environment in all its forms.
2. Emphasis on the development of skills: The center of gravity for environmental education must be to provide lifelong skills to the students.
3. Depth of learning: The educational materials should enhance students' ecological awareness and self-consciousness.
4. Civic and personal responsibility: Both of these pillars form a very important base on which actions and decisions should be made in relation to the environment.
5. Instructional effectiveness: It is very important that educational resources establish inclusive, productive learning environments for all learners.
6. Ease of Use: Products should be designed and intuitive to use from both the instructor and student perspectives.

We can make some connections between environmental education and VR tools and approaches based on these concepts and the features of VR identified above in the

Introduction. In other words, VR could be useful both as a tool and in relevant content for environmental education.

Features of AR

Augmented reality systems integrate real-world and virtual imagery. AR can enhance the interaction with the real world by showing concepts and principles in their real environment, since this happens in real time when a user is working with the system. Multiple taxonomies of augmented reality considers input/ output, popular uses, technology used and education-related factors.

These systems can be both marker-based and marker less AR systems. The marker-based AR systems depend on the use of fiducial markers, such as bar codes or QR codes, which are placed strategically and detected by the camera to present an enhanced reality. The markers can also be printed onto a sheet of paper. Using a handheld device or a see-through head-mounted display, users scan the marker to view imagery. Instead of using fiducial markers for tracking, natural features are relied on by marker less AR systems. Calibration, precision, and ergonomic comfort are some of the objectives of tracking systems. Evaluation of marker less augmented reality systems should therefore include the user experience. Systems that depend on location, projection, and superimposition are examples of marker less augmented reality. This type of AR uses a GPS, an accelerometer, and a gyroscope in order to present information with respect to its user's position. Location-based augmented reality make use of such technologies as those used by Google Maps, whereby users are given directions and information about places of interest in the vicinity. Projection-based AR projects images on to their surfaces for the enhancement of 3D surroundings or objects in the real world.

While the scientific community has clearly separated the concepts of VR from AR, as long as AR changes the way users perceive things by giving them an opportunity to interact with the real world, VR allows users to handle

digital objects in an artificial environment. Mixed reality is a new type of immersive technology. On the other hand, there is a difference of opinion on what MR is. Many practitioners do not differentiate between MR and AR. Yet others view MR as a superset of AR. For our purpose, however, we stick to the definition in, which says that MR extends AR in that users are allowed to touch and even walk into virtual objects superimposed on the real world. Currently, this technology has increasingly pushed by giant tech companies.

Compared to other areas of human-computer interaction, immersive technologies render task performance more complicated in an actual or virtual 3D spatial environment. Immersion technologies create a plethora of possibilities for interaction since they require non-traditional methods of device setup, techniques, and metaphors, besides a wide variety of input and output methods. It would be possible to obtain the interaction strategies from both the task and input levels. The interaction can be inputted by a range of methods ranging from hand gestures, voice commands, gaze, orientation, or head gestures; hardware-based controllers can also be used. Menu-based selection, rotation, pointing, selection, translation, scaling, and abstract functions can be supported by the interaction.

Immersive Technologies for Environmental Sustainability

The other most important factor that determines how well the leveraging of XR to meet environmental sustainability objectives is down to human-computer interaction. In whatever context, the design of technology and user experience have played a vital role in the development and success of XRs technology. While early large, non-immersive displays made for a bad user experience and thus were not well-received, over time, improvement in display technology along with greater emphasis on HCI design for XR has significantly improved the said technology. Along this line of reasoning, HCI is vital to all technical advancement-not only for improvements in the practicality of the use of XR for the accomplishment of aims within ES but also general

advancement. A new topic in HCI(Human-Computer Interaction, namely Sustainable HCI-abbreviated as SHCI- is concerned with using technology in order to solve issues related to sustainability. Two over-arching themes in SHCI research relate to the environmental and societal dimensions of sustainability: minimizing impact on the environment, stopping depletion of natural resources and the social, political, and economic issues of sustainability. Even as ES (Environmental Studies) focused on the necessity for changing individual behavior, SHCI has pressed for shifting away from these techniques and presenting questions about their efficacy. The meager decrease in unsustainable behavior with the former techniques as well as the lack of empirical proof about long-term change are compelling reasons for worry. A move away from SHCI contradicts others in the field of environmental psychology and environmental communication who argue that its inclusion is necessary, notwithstanding that the nature cannot be focused solely on this level, because individual action may directly affect the creation of a culture of sustainability and the establishment of an environment of sustainability. The focus on the person is not irrelevant to reach the broader objective: the fulfillment of sustainable transformation. However, those who can effect change are usually kept aloof from issues affecting our society and environment. Research into the impact of VR on human rights beliefs and helpful behavior toward others suggests it could be a useful tool for SHCI to bridge this gap and reach such individuals using XR. The type of work, such as those mentioned above, illustrates how XR can also serve as a participant in the wider-scale, societal changes which SHCI strives for-by way of changing beliefs and behaviors. This study hence aims to provide new insights for the SHCI researchers into how their work can address the issues of sustainable consumption and behavior change, with regard to XR technologies.

Designing of Interactive Game can also have impact on Environmental studies

The video game has grown to be one of the defining features of contemporary life, with billions worldwide regularly engaging in it. According to studies, games have the ability to influence attitudes and behavior among players; hence, they are an effective method of lobbying and teaching. Immersive experiences through games can simulate real-world experiences and afford players the opportunity to test different outcomes and understand what the consequences of their decisions will entail. With the potential to create memorable and powerful experiences, video games are poised to be one of the more unique mediums through which social change can be mobilized. While the main aim of game design is always entertainment, now there is a growing trend toward positive purpose in games; more moral dilemmas, social, and instructive content are being added by a growing number of game developers into their productions. Such change points to one greater movement within the media sector for sustainability and social responsibility. A further obvious extension of this is to take the so-called sustainable development goals-SDGs-in game design, providing a framework to create games that inspire, educate, and entertain. The goals of sustainable development range from social justice to the preservation of the environment. Activism, behavioral change, and increased awareness can be elicited by the goals of these games. For instance, emulation of some of the environmental challenges through games can spur their players into the practice of sustainable behaviors by teaching them about the complexity of climate change. Similarly, video games that raise awareness of social issues such as discrimination and injustice develop feelings of empathy and may probably prompt their players into community activities.

Conclusion

This is not hyperbole, but rather fact, that the media and content are positioned to influence consumption habits,

community building, and well-being around the world. They will also play an important role in promoting sustainability. Given the cultural importance and potential of the media industry to shape investor, customer, and even congressional decisions, there are varying ways and vehicles through which to educate and inform consumers. Sustainable development encompasses a range of goals, including those related to social justice and environmental preservation. Games based on these goals have rallied people to take action, shift behaviors, and increase awareness. For instance, games based on simulated environmental challenges can spur players to engage in greener behaviors-exposure to the complexity of climate change in these games does. Likewise, video games that outline social issues like discrimination and injustice can show empathy and stir the player into action within their communities. Future research should take into consideration the development of immersive learning opportunities outside of STEM areas, including the arts and humanities. Future researchers are encouraged to conduct experiments using the tools available to them that will facilitate virtual learning environments. Researchers may study how easily these tools can be used and if they are appropriate for a learning environment. Moreover, in addition to providing support for deployment and integration into classroom settings, further research could be directed toward the development of a conceptual framework guiding educators on how to identify cases for deploying immersive learning experiences. Last but not least, assessing immersive learning experiences on the grounds of usability should be a job for future scholars during the design stage.

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