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**Dr. Moumita Chakraborty**  
Assistant Professor,  
Department of Journalism and  
Mass Communication, Swami  
Vivekananda University,  
West Bengal, India

**Corresponding Author:**  
**Dr. Moumita Chakraborty**  
Assistant Professor,  
Department of Journalism and  
Mass Communication, Swami  
Vivekananda University,  
West Bengal, India

## Interactive and immersive media for environmental education in India

**Moumita Chakraborty**

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### Abstract

Environmental degradation is one of the more significant global issues, and public education about the possibility of environmental sustainability has become indispensable. For decades, school curricula have been utilized as a means of providing environmental education for children in India, but traditional methods have occasionally failed to bring students and their communities onto a more imaginative plane. Interactive and immersive media such as Virtual Reality (VR) and Augmented Reality (AR) can make the process of learning really interesting and experiential in the context of environmental education in India. The immersion media's unique advantage in an educational application will strengthen this in-depth understanding of environmental issues on the part of the learners. The paper discusses the current application of immersive technologies in environmental education across the world, analyzes their application in the Indian context, and opens up challenges and opportunities, specially focusing on Virtual Reality and Augmented Reality and its application in environmental education in India. It considers the role of media as an intervening tool for environmental education, the psychological influence of immersion of media on learners, and how interactive tools can be used to foster behavior change.

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

### 1. Introduction

Environmental education is imperative for creating awareness, understanding, and action toward a more protected natural world. In the Indian context, where rapid industrialization, urbanization, and population growth significantly add to environmental degradation, never before has effective environmental education been so crucial. Lectures, textbooks, and field trips-some of the mainstays of traditional pedagogy-though valuable, tend to fail to engage students fully and impact their environmental consciousness lengthily.

With the advent of interactive and immersive media technologies such as VR and AR in recent years, new opportunities are opened to involve students in environmental education in ways that other techniques cannot. This type of experience might indeed make the difference between, say, making experiences real, engaging, and hands-on. Students can be transported to endangered ecosystems and experience environmental disasters, and data can unfold as information in a fluid manner that is both informative and emotively powerful.

This paper takes a look at how the ready-to-be-exploited and promising immersive technologies might be fitted into India's landscape in terms of environmental education, so as to work on both the key environmental challenges and culture for sustainability for learners.

### 2. Meaning of 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.

### 3. Different 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.

### 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.

### 4. Immersive Media in Education: An Overview

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.

#### 5. Several benefits in the educational setting are attached to interactive, immersive media:

- **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.

#### 6. Virtual Reality in 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) <sup>[9]</sup> 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) <sup>[9]</sup>. Additionally, a study indicated that VR may offer three key advantages for education (Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017) <sup>[4]</sup>:

- 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) <sup>[2, 3]</sup>.
- 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) <sup>[4]</sup>. 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.

#### 7. Previous experiments of applying 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) <sup>[5]</sup>. 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) <sup>[10]</sup>. 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.

### 8. Key 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

### 9. 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.

1. 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):
2. 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.
3. 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.

### 10. Implementation in India

In India, the integration of immersive technology with mass media and education has taken EE to a decent level. Organisations 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.

### 11. Effectiveness of Interactive and Immersive Media in EE

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).

### 12. 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 (Sifisheressciences.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 Sifisheressciences.com, there is a need for the interactive and participatory content so that engagement can be encouraged.

### 13. Conclusion

Interactive and immersive media is promising in 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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