

The usage of Mixed Reality in Climate Change Communication: A Case Study on the Weather Channel

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Abstract:

Merging the real-world environment with a computer-generated one has become possible thanks to mixed reality. With all the phenomena resulting from climate change impacts on earth, it has become increasingly essential to inform the audience about these impacts using a context where physical and virtual worlds can co-exist and simulate the potential environmental issues interactively.

Thus, it has become integral to explore the use of mixed reality in climate change communication and understand its role and the relationship between the usage of mixed reality and the representation of climate change.

To understand the usage of mixed reality in climate coverage, the study utilizes qualitative content analysis; the study analyzes the employment of mixed reality in the representation of climate change in the Weather Channel on Youtube from 2018 to 2022.

The study findings propose an informative role of mixed reality in climate change representation among the necessity of human intervention in facilitating and explaining.

Keywords:

Mixed Reality, Virtual Reality, Augmented Reality, Climate Change, Communication, Weather Channel

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Introduction:

Climate change is widespread because it results from human activities. Scientific evidence found an impact of climate change on glacier melting, global warming, and rainfall variability. Furthermore, it was found that climate change is factual and that human activities accelerate the rate at which climate change occurs (Hamza, Ameta, Tukur, & Usman, 2020).

One of the significant advantages of using AR technology to protect the environment is that it does not involve physical presence. Therefore, researchers and technicians have been researching the models and presenting a virtual-real experience, which reduces the carbon footprint to a certain level and leads to large-scale impact in the long term (Sakhuja, 2021).

One of the importance of mixed reality is that it enables the audience to stimulate outdoor environments. It allows the audience to help resolve current and future environmental problems. Also, the mixed reality will allow the audience to exceed the "scale or the timeframes over which changes occur." For example, Stanford Ocean Acidification Experience conducted a simulation for its students to experience the impact of an era's value of ocean acidification on reef biodiversity by shifting "amid coral as it loses its vitality" and examining how gradually acidic water impacts aquatic life (Jerowsky & Borda, 2022).

Virtual experiences can be mentally and emotionally impactful. VR helps medical fields with patient rehabilitation and psychological interventions, as stated in (Nilsson, Serafin, & Nordahl, 2012). This research raises a question about the Usage of Mixed Reality in Climate Change Communication.

Research Objectives:

1. To understand the role of Mixed Reality in the Weather Channel.
2. To identify Mixed Reality usage in climate change communication on the Weather Channel.

3. To find the relationship between Mixed Reality and the representation of climate change on the Weather Channel.

Research Importance:

The impact of VR and AR is evident and apparent in various fields, and it may have a role too in fighting environmental changes such as climate change. That is why it is essential to find answers to if its usage in the Weather Channel was beneficial or not finding out how the channel used it.

Research Problem:

This research problem lies in investigating AR &VR (Mixed Reality). These recent technological tools were embedded and used in facing climate change problems when communicated on media channels. Therefore, this research is trying to determine the importance of using Mixed reality in the weather channel.

Literature Review:

Only studies about the impact of using AR and VR (Mixed Reality) on people's understanding of environmental issues. The following is a review of such studies.

Several studies delve into the impact of immersive technologies such as Augmented Reality (AR) and Virtual Reality (VR) on people's comprehension of environmental issues, particularly climate change. (Thoma, et al., 2023) aimed to assess the efficacy of VR in enhancing climate change awareness and influencing environmental attitudes compared to traditional media. Their research revealed that VR, even in less sophisticated forms, effectively increased pro-environmental attitudes, suggesting the potential of mixed reality technologies in conveying complex environmental issues. In contrast, (ST & Kom, 2019) focused on utilizing AR to transform the promotion of apartment units, emphasizing the interactive and engaging aspects of AR for potential buyers. They developed an Android app to showcase apartment layouts and amenities, showcasing the adaptability of AR in marketing.

(Wang & Kim, 2022) explored the use of Mixed Reality to contextualize climate change effects, aiming to counteract misconceptions and motivate environmentally friendly actions. Their pilot study with a Mixed Reality system demonstrated increased motivation for eco-friendly activities and higher immersion levels among participants. As a result of using the Mixed Reality system, participants reported feeling more motivated to follow environmentally friendly activities; statistics show that system use is also associated with higher evaluations of immersion and stress levels. The outcomes clearly showed how mixed reality systems could be applied to contextualizing climate change. (Markowitz & Bailenson, Virtual Reality and The Psychology of Climate Change, 2021) conducted experimental approaches to understand the psychological impact of VR experiences on climate science understanding, finding significant influence on psychological aspects. Findings indicated that VR experiences could significantly influence the psychological aspects of climate science.

(Huang, Lucash, Scheller, & Klippel, 2020) addressed the challenge of conveying induced environments under climate change using traditional methods and utilized a combination of ecological and procedural modelling in VR to facilitate communication between the public and policymakers. As a result, ecological exploration and information reality have been achieved; the approach created forests' experiences under climate change, facilitating communication between the public and policymakers. Furthermore, data-driven virtual reality has proven essential for visualizing forests under climate change, and it eases walking in future forests. (Queiroz, Kamarainen, Preston, & Leme, 2018) conducted a systematic review of the literature, examining how Immersive Virtual Environments affect perceptions and actions regarding climate change. Their findings highlighted the benefits of IVEs for climate change engagement.

(Markowitz, Laha, Perone, Pea, & Bailenson, 2018) investigated the impact of VR in educating about climate change. They utilized controlled lab experiments and field studies, revealing that VR

increased curiosity about climate science and promoted positive environmental behaviors. In contrast, (Barnidge, et al., 2022) explored the role of VR in climate education and found a neutral effect on learning outcomes. (Xu, Liang, Campbell, & Dev, 2022) emphasized the essentiality of AR and VR educational applications for the environment. (Chen, 2016) focused on virtual world learning, improving various aspects of knowledge among Taiwanese students.

Studying how animation and augmented reality (AR) can generate density and re-allocation of visualized images to give the temporal scales at play in climate change was discussed (Raupach, 2018). Results confirmed that the visualized images helped in the elaboration of climate change, and they can effectively convey the unstable and unobservable facets of environmental change.

In (Stuart, et al., 2022), it was studied how humans succeeded in predicting the weather. The new tools humans use, like artificial intelligence, are good examples of better forecasting and data analysis. They discussed how these tools are created and that they will be helpful in many duties, especially weather forecasting. Also, humans will significantly benefit from predicting, and technology will change over time. University training and professional development are making forecasting more successful and valuable and using data skills like visualization. Seven forecaster preparation advice and career for students how to work in it. To know more about forecasting technology better and to serve the community. In the end, the result is that humans can learn about weather predictions more using technology in the future.

According to (Kaiser, et al., 2003) study, the joint disambiguation of 3D multimodal communication in augmented and virtual reality resulted in a multimodal system combining "symbolic and statistical information from a set of 3D gestures, spoken language, and referential agents".

Extent of Benefit from Literature Review:

The literature review offers general insights from various studies, but there is a lack of a detailed case study that examines how a prominent media outlet like "The Weather Channel" employs Mixed Reality to communicate climate change. A research gap exists in understanding the specific strategies, content, and outcomes associated with their Mixed Reality initiatives. In addition, the literature review mentions contrasting findings in different studies, but there is a research gap in conducting a comparative analysis of Mixed Reality approaches in climate change communication.

Research Questions:

1. What is the importance of Mixed Reality on the Weather Channel?
2. How was mixed reality used in climate change coverage on the Weather Channel?
3. What role did Mixed Reality have in explaining climate change on the Weather Channel?

Research Methodology:

This research will be qualitative. Qualitative research employs the content analysis tool to examine the usage of Mixed Reality in Climate Change coverage on the Weather Channel as a case study.

Research Sample:

The research will analyze the content of the Weather Channel on YouTube that employs immersive mixed reality or virtual reality as a case study in this research.

Research Time Frame:

The content of the Weather Channel is analyzed within a time frame of four years starting from 2018 to 2022.

Theoretical Framework:

The study used the media richness theory to evaluate the impact of using mixed reality on the ability of the medium to transmit and reproduce the information sent over it. Also, the theory is used to assess whether the use of mixed reality in climate change news makes the medium fit for its informing task.

The media richness theory was first introduced by (Daft & Lengel, 1984) who assumed that some media work better than others in the fulfillment of specific tasks, and media are arranged according to some criteria; The presence of instant feedback, the ability to transmit various cues and natural language usage are used to arrange the media from the highly rich to the lowest according to the presence of these criteria.

Extent of Benefit from the Theoretical Framework:

The Media Richness Theory provides a structured framework for assessing the effectiveness of different communication media in conveying information. In this context, it allows the research to systematically evaluate the suitability of Mixed Reality as a medium for climate change communication. It helps answer questions such as whether Mixed Reality is rich enough to transmit complex climate change information effectively.

Research Results:

The content analysis of the mixed reality employment by “The Weather Channel” on YouTube was applied to four videos that utilized immersive mixed reality or virtual reality to create the setting of the produced video. To illustrate, the content of the four videos under study was analyzed considering the following criteria: the uses of mixed reality in framing climate content, the extent of reliance on mixed reality in production, and the impact of using mixed reality on the informativeness of climate content.

Through the analysis of the short videos posted on the YouTube channel of “The Weather Channel”, it was found that mixed reality was used to create a simulation of the climate change impacts and provide visually simplified information using charts. This was

highlighted in the video titled “How wildfires spread | IMR”, where the video’s setting was a forest with high trees and living creatures that are all created using mixed reality. The employment of sound and visual effects was made evident in creating an erupting fire with the forest setting where the anchor was standing and providing information about the spread of wildfires. Also, the anchor provided information that appeared as a visualized chart, such as a chart to portray the nowadays-doubled threat of wildfire burns in comparison to the 1970s, as well as a map to show that the western US has become more conducive for wildfires. A direct correlation between what’s going on in the simulated environment and what the anchor explained was clarified in light of the anchor’s explanation of phenomena through interacting with them, as the case is in her statement, “let’s go above that smoke for a better view”. Describing a climate change phenomenon that occurred before through mixed reality instead of using archive material intensified the informative role of mixed reality in climate change portrayal. This was illustrated in visualizing the “Thomas fire” that took place in December 2017 and consumed a football field within one second to explain that fire moves faster as they move uphill. Thus, it is concluded that mixed reality was used to create a simulation of the natural environmental disasters caused by climate change in forests. It was relied on entirely in the production of the video and in making its setting. Additionally, the use of mixed reality increased the incorporation of information within the context of the media message about climate change risks.

In the video titled “the dangers of storm surge”,. The mixed reality was employed to describe the water rise of two or three feet above the normally dry ground through immersing the anchor in rising water, where his statements played a descriptively informative role concerning the phenomenon that he described as “the deadliest part of a hurricane is the storm surge”. Informativeness was achieved in the text boxes that appeared to explain the rise of water levels in terms of feet measures, through which the phases of hurricanes were described concerning the existing objects in the street. The visual immersion achieved by mixed reality was accompanied by

explanatory statements from the anchor and recommendations that correlated with the informativeness role played by the channel. Thus, it is deduced that the use of mixed reality still needs humanitarian existence in explaining and ending to conclusions or recommendations. This was clear through the anchor's advice: "The 9-foot hurricanes are non-survivable. So, please follow the advice of local officials and evacuate as ordered when a hurricane moves in".

Moving to the 3-minute video titled "The Science behind Ice storms", the video setting simulated a snowy ambient with temperature details illustrated through textual data. Both the visual and sound media formats cooperated in harmony in creating a sense of the impacts of a snowstorm on vital life aspects. This was clear in the rush of snow particles and the accumulation of snow covering the sidewalks amid the thunder in the background. In this video, the extent of reliance on mixed reality was partial, and the majority of dependence in information provision was on the anchor, who gave many examples of the potential damage on ground transportation and aviation. In such an example, mixed reality played a distracting role; the anchor was providing numeric data about the losses and damages while the camera was steady and focused on snow accumulation in a way that neither allows for a complete understanding of the information narrated nor allows for creating a relation between the narrative and the setting created by mixed reality employment. This explained the constant need to use textual data written on screen when vital information is provided.

Through a video titled "What Climate Change Will Look like on Earth", the Weather Channel used virtual reality to create a scene consisting of a green area, ocean, and sky. The video was intended to immerse the viewers in different phases that the earth has already started to witness or is yet to witness due to climate change. The footage mainly depends on three slides on which textual data is written to inform the viewers about the phenomenon. The video starts in normal conditions where one text slide reads, "Humans have increased carbon dioxide emissions, raising the temperature". Then, more information follows about the greenhouse effect,

whereby informativeness is achieved through text and the virtual reality setting. Next followed a scene where the green grass turned yellow, and the ocean became dry while the text boxes provided information about drought. The following stages used the same techniques with the change of the virtual setting to match the phenomenon. For example, forest fires appeared as erupting fires within trees, and floods were visualized in terms of water covering the ground. The option to hover to different areas of the scene provided uniqueness to the watching experience of each viewer, where it became optional to pick where you go virtually to experience the impact of any phenomenon. For instance, in the “melting ice caps” phenomenon, each viewer can rotate the 360 degree-view and zoom in on one glacier to have a closer look at its impact on it.

The fifth video in the study sample, titled “Power Grid Infrastructure”, used immersive mixed reality to portray the impact of low temperatures on the demand for energy grid to heat homes. The anchor narrated the story in light of the death of 250 people in Texas in February 2022 because of the power grid failure caused by the increased demand that led them to “prolonged exposure to the cold”. The employment of mixed reality in informing and simulating the real environment was apparent in the situating the anchor on a map where he stood in the spot representing Texas state surrounded by power grids to link with the information being narrated about power infrastructure. The mixed reality was also used to visualize the power journey through substations. Clearly, the informativeness of the visual content required being complemented by the statements of the anchor, as the case is in describing “how the higher voltage electricity is converted into lower voltage”. Moreover, the anchor was informative in illustrating the relationship between power outages and extreme weather, with the latter being a primary cause. Charts were also employed to inform the viewers, and a column chart was used to portray the increase in heat waves within the period between the 1970s and 2010s.

To conclude, the Weather Channel on YouTube used mixed reality to inform and visually describe emerging climate change phenomena using sounds and camera movements to add realistic dimensions to the coverage. Moreover, the use of virtual reality in the portrayal of climate change impacts added uniqueness to each viewer's experience through the option granted to customize the view. Considering these uses, Mixed reality employed all the capabilities of the medium to facilitate the understanding of climate change and immerse viewers within simulation environments. Despite the advanced techniques and employment of mixed reality in encouraging and informing, human intervention was proven to be required in most cases to explain the visualized content and add an informative dimension to the virtual environment. The impact of mixed reality on the informativeness of climate change content was apparent in the richness of provided information that was not only simulated but also supported by textual data, charts, and sound bites.

Compared to the literature review, the study findings agree on using mixed reality to increase engagement and its importance in covering climate change news. However, the study findings partially contradict the proposed potential reliance on technology to know more about climate change, where the current study findings proved the mutual benefit between technology and humans since humans still represent an integral aspect of climate coverage.

In particular, the research results support (Thoma, et al., 2023) findings regarding the effectiveness of Mixed Reality, specifically Virtual Reality (VR), in conveying complex environmental issues. The videos analyzed in the research results demonstrate how Mixed Reality can be used to simulate and explain climate change impacts visually and interactively.

This research results align with (Wang & Kim, 2022)'s exploration of using Mixed Reality to contextualize climate change effects. The videos analyzed in the research results show how Mixed Reality is used to create simulations of environmental disasters caused by climate change, enhancing the understanding of such phenomena.

Also, the research results align with the (Raupach, 2018) discussion about using animation and augmented reality to convey the temporal scales of climate change. The videos in the research results effectively visualize and explain climate change phenomena using Mixed Reality.

However, this research differs from (Barnidge, et al., 2022)'s findings regarding the role of VR in climate education. While Barnidge found a neutral effect on learning outcomes, the videos in the research results showcase how Mixed Reality can be highly informative and engaging in conveying climate change information.

In light of the media richness theory, the use of mixed reality in climate communications by the Weather Channel on YouTube makes use of the capacity of the video medium of YouTube to produce engaging content that achieves its task and makes good use of the cues represented in sounds and visual content to achieve informativeness. Also, in light of the diffusion of innovation theory, it was confirmed that the videos employed mixed reality to diffuse information and knowledge about climate change.

Regarding the research questions, the first concerning the importance of Mixed Reality on the Weather Channel revealed that the Mixed Reality plays a pivotal role in the climate change coverage of the Weather Channel due to its ability to enhance engagement, informativeness, and realism in conveying climate-related information. Through Mixed Reality, the Weather Channel can immerse viewers in dynamic, visually captivating environments, such as simulated forest fires, storm surges, and melting ice caps. This heightened engagement is crucial for capturing and retaining viewer attention in a media landscape filled with distractions. Furthermore, Mixed Reality facilitates the presentation of complex climate data, making it more understandable through visualizations and simulations. This not only increases viewer comprehension but also highlights the channel's commitment to delivering informative and impactful climate content. Importantly, Mixed Reality does not replace human expertise but rather complements it, emphasizing the

continued importance of experts in explaining the context and implications of climate change phenomena.

And about the usage of Mixed Reality in climate change coverage on the Weather Channel, it was revealed that Mixed Reality was utilized in climate change coverage on the Weather Channel in diverse ways, enhancing the depth and impact of their content. Through Mixed Reality, the channel created visually immersive simulations of climate change-related scenarios. For instance, in a video about wildfires, Mixed Reality constructed a forest environment with realistic fire simulations. This technique not only engaged viewers but also provided a clear visualization of the wildfire's spread. Mixed Reality was also used to visualize climate-related data, such as charts, maps, and textual information, effectively conveying the magnitude and significance of climate change phenomena. Moreover, Mixed Reality allowed for interactive experiences, enabling viewers to explore different aspects of climate impacts, such as melting ice caps or forest fires, by navigating within the simulated environment. While Mixed Reality played a central role in presenting the content, it was complemented by expert commentary from anchors who explained the context and significance of the visualized scenarios, ensuring a comprehensive and informative experience for viewers.

About the role did Mixed Reality have in explaining climate change on the Weather Channel, the findings pointed out that Mixed Reality played a multifaceted role in explaining climate change on the Weather Channel. It served as a powerful tool for visualizing and demonstrating the effects of climate change, making abstract concepts tangible and relatable. For example, in videos depicting storm surges and melting ice caps, Mixed Reality created immersive environments where viewers could witness these phenomena firsthand. Mixed Reality also facilitated the presentation of data and statistics through charts and maps, making it easier for viewers to grasp the scale and significance of climate change impacts. However, Mixed Reality did not stand alone in explaining climate change; it worked in tandem with human anchors who provided context, insights, and explanations. Anchors

helped bridge the gap between the immersive visuals and the viewers' understanding, ensuring that the climate change content was not only visually compelling but also informative and actionable. This collaborative approach between Mixed Reality and human expertise proved essential in delivering a comprehensive narrative about the challenges and consequences of climate change.

Generally, the study findings prove that using mixed reality on the weather channel and covering climate change issues is essential in facilitating the information and creating a relatable context for the viewers. The mixed reality was used by employing visual material, sound effects, textual data, and sound bites of the anchor to cover climate change through the Weather Channel on YouTube. As a result, mixed reality played a significant role in producing informative climate change content.

Research Discussion and Conclusion:

In conclusion, the research conducted on "The Weather Channel" videos employing mixed reality to convey climate change content has yielded valuable insights into the use and impact of this innovative technology in climate communication. The study focused on four specific videos and assessed various criteria, including the use of mixed reality in framing climate content, its extent of reliance on production, and its impact on the informativeness of climate content. Here are the key conclusions drawn from the research findings:

The Weather Channel effectively employed mixed reality to create immersive simulations of climate change-related phenomena. This technology was used to visually depict the impacts of climate change, such as wildfires, storm surges, ice storms, and power grid failures. Mixed reality was instrumental in providing viewers with a visually engaging and interactive experience, enhancing the channel's ability to convey complex climate-related information.

Regarding enhancing informativeness, Mixed reality significantly contributed to the informativeness of climate content. It allowed for the visualization of data through charts, maps, and textual

information on screen, making it easier for viewers to understand the context and severity of climate change effects. This visual and interactive approach helped in conveying the message more effectively.

While mixed reality played a crucial role in creating immersive environments and visualizing climate change impacts, human intervention, in the form of anchor narration, remained essential for providing context and explaining the content. This finding emphasizes the synergy between technology and human expertise in climate communication, suggesting that both are necessary for effective storytelling.

It was obvious that the use of virtual reality in some videos allowed viewers to customize their viewing experience, enhancing engagement. Viewers could explore different aspects of climate change impacts by choosing where to focus their attention within the virtual environment. This customization added a unique and interactive dimension to the content, making it more engaging.

Regarding its role in climate communication, the study concludes that mixed reality is a valuable tool for climate communication, enabling The Weather Channel to create content that not only informs but also engages viewers. It offers a unique way to present climate change information that goes beyond traditional formats, potentially attracting a wider audience.

Contrary to the idea that technology could replace human involvement in climate coverage, the study findings suggest that both technology and humans are integral to effective climate communication. While mixed reality enhances engagement and visualization, human experts are essential for providing context and interpretation.

Research Recommendations:

- Several research can be conducted on exploring the impact of mixed reality on audience understanding, interest, and behavior regarding climate change issues.

- Several research can be conducted on investigating innovative storytelling techniques within mixed reality, such as branching narratives or interactive storytelling, to enhance engagement and emotional connection with climate-related content.
- Channels can invest in the development of mixed reality content focused on climate change. Collaborate with content creators, technologists, and climate experts to produce immersive and informative experiences.
- Introduce mixed reality climate education programs in schools and educational institutions. Provide teachers with training and resources to incorporate immersive content into their curricula.

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