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ENVIRONMENTAL ISSUES ON TIKTOK: TOPICS AND CLAIMS OF MISLEADING INFORMATION

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Abstract. *In light of the increasing frequency of misleading information in social media regarding environmental issues, this study aimed to identify misleading information spread through TikTok videos and to discuss why such content is considered misleading, drawing on relevant literature. Hashtags with large numbers of views, such as #climatechange, #sustainability, #pollution, #biodiversity, #environmentalprotection, #environmentalissues, #energysource, and #environmentalproblems, were used for data collection through web scrapper called Apify (https://apify.com/). A total of 29 misleading videos were found. Content analysis was applied to identify and classify the topics and misleading claims. The topics of misleading videos, according to the most frequent mentions, were energy sources, followed by climate change, pollution, biodiversity, and environmental degradation. Among the misleading claims, videos related to pyramids as non-pollutant power plants and conspiracy related to pollution exhibited the highest frequency. The results show various misleading claims in videos related to environmental topics. Also, emphasized the importance of science education in addressing misleading information. In addition, the importance of an interdisciplinary approach for addressing environmental issues was reinforced.*

Keywords: *TikTok videos, misleading information, environmental issues, content analysis, science education*

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Introduction

In recent years, with the advancement of information technologies and social media, easy access to information has a problem, that is, the propagation of misleading information. As pointed out by Petratos (2021), misleading information can occur in different forms such as misinformation, disinformation, or fake news, which is easily spread through social media. Flintham et al. (2018) have pointed out that the advent of social media changed the consumption and exposure to various news. Aldwairi and Alwahedi (2018) also emphasized that fake news is an old concept; it has existed since publishers first used misleading information to further their interests even before the Internet. However, the advent of the web further increased and redefined it.

In general, different types of misleading information have been influencing diverse areas of society, such as health (Pulido et al., 2020), politics (Farkas & Schou, 2019), and the sciences (Scheufele & Krause, 2019). In terms of environmental topics, misleading information currently targets climate change (Lutzke et al., 2019), global warming, and the influence of greenhouse gas emissions (Lopez & Share, 2020). These topics emerge especially as doubts about human influence on problems such as climate change, increase in greenhouse gas emissions and global warming. This spread of misinformation can be disastrous during environmental crises, which emphasize the importance of drawing attention to misleading information related to environmental topics spread on social media.

In the context of misleading information, education can be viewed as an essential tool for enabling society to address this current issue. Previous scholars have pointed out the importance of education for coping with fake news (Black & Fullerton, 2020; Keselman et al., 2021; Santin, 2021). Specifically, in the case of the environment, environmental education plays an important role and can be considered a strategy for changing attitudes toward the future (Carvalho, 2001; Latif et al., 2013; Novo, 2009; Varela-Candamio et al., 2018; Zsóka et al., 2012). Following this notion, Breiting and Mogensen (1999) highlighted that the major focus of environmental education is teaching about "the environmental issues man faces through his use of natural resources and the possibilities of overcoming and preventing them in the future" (p. 349) instead of the environment.

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In the context of science, Scheufele and Krause (2019) shed light on a few probable causes of misleading information on scientific topics, such as the "lack of understanding of science," which includes "knowledge about scientific facts" and "epistemic knowledge about science." Other examples include "holding beliefs inconsistent with the best available science" such as "inaccurate views of scientific consensus and the willful rejection of scientific consensus" and "conspiratorial beliefs." In this sense, science is a fundamental tool for confronting misleading information.

The increase in the spread of misleading information gained scholarly attention toward the detection of fake news mainly with the use of algorithms (Aldwairi & Alwahedi, 2018; Alonso-López et al., 2021; Flintham et al., 2018; Shu et al., 2017). Additionally, many social media platforms have implemented policies against the spread of fake news. For example, Meta, the company who owns Facebook, Instagram and Whatsapp, has been removing content that violates its policies, which includes fake news and misleading content (Combating Misinformation | About Facebook, 2020). For climate change, the company also clarified that despite the topic being part of a low percentage of fake news on the platform, any fake news is taken very seriously (Meta Sustainability, 2022). Toward this end, it partnered with a network of more than 90 independent fact-checking leading entities to evaluate and rate climate-related content in more than 60 languages. Content found as false receives a warning label and obtains reduced visibility. In addition, pages, persons, groups, or ads that constantly share false information are penalized. However, in terms of controversial issues, the position of the platform is described as follows:

> For example, content may use true information or opinion to express uncertainty about the impacts of climate change, distrust in scientific expertise or skepticism about climate solutions. We don't believe it is our place as a company to penalize this type of speech or referee legitimate debate, which is why we take the approach of educating and informing people with authoritative information (Meta Sustainability, 2022, para. 8).

Other platforms, such as Instagram, follow similar steps, because they are managed by the same company, Meta (How Instagram addresses false info, n.d.). Users of Instagram and Facebook also can report misinformation, and the company will verify if the claim is valid. The former Twitter current X, also uses a labeling information tool that alerts it when information can be misleading (How We Address Misinformation on X, n.d.). The labeled information, similar to the other platforms, is penalized with reduced visibility.

For Tiktok, Keenan (2022), the head of trust and safety of the platform, shared that they are working to improve measures for reducing misinformation on the platform. For example, they use machine learning to detect misinformation, which is redirected to a moderation team that analyzes and removes it in the case of violation of their policies. The platform also relies on fact-checking partners that review content in more than 30 languages. In a recent update, Tiktok (2023) informed that it will also begin to enforce measures against the spread of misinformation on climate change.

Among these social media, Tiktok has been gaining considerable attention recently. In 2020 and 2022, it was the most downloaded app worldwide (Ditrendia, 2020; Most Downloaded Apps Worldwide 2022 | Statista, 2023). In addition, as pointed out by Alonso-López et al. (2021) and TikTok: Distribution of Global Audiences 2023, by Age and Gender (2023), Tiktok's userbase mainly consists of *Generation Z*. The platform was launched locally in China in 2016 and internationally later in 2017. In 2018, it merged with Musical.ly and became accessible in the United States (Zulli & Zulli, 2022). As explained by Hautea et al. (2021), Tiktok features videos lasting for 60 s, oftentimes even shorter, "the in-app interface is used to record and edit video content, annotate it with text and graphics, and post with captions and hashtags" (p. 3) based on likes, shares, and comments, and other interactions, which guide the recommendation algorithms of the platform. However, tracking misleading videos uploaded on the platform can be difficult due to its popularity, ease of features, and large number of videos uploaded per day. Moreover, compared with other social media, Tiktok can still be considered new; thus, examining its contents from the platform can lead to interesting results.

Theoretical Background - Misleading Information

According to Collins Dictionary (n.d.), misleading information is a type of information that can confuse or mislead. It can also be defined as a type of information that can be considered deceptive. In the literature, various fields of research focus on defining this type of information. For example, Wardle and Derakhshan (2017) highlighted the definition of terms and strategies as policy-making to combat misleading information or information disorders. Lecheler and Egelhofer (2019) focused on the terms and impact of misleading information. Brisola and Doyle (2019) emphasized terms and proposed the critical information literacy approach for addressing this type of

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information. Bailey and Hsieh-Yee (2019) examined the history and terms and proposed a framework for addressing false information through information literacy.

In addition, various studies on misleading information can be found in the literature, and the number of studies on the topic is continually growing. For example, Ha et al. (2021) found that research on misleading information is increasing. Specifically, their review demonstrated a spike in the number of studies on misinformation and fake news after 2016. Moreover, the review highlighted that quantitative research was the most commonly used method and that diversity exists in the disciplines that conducted research on this topic at the time.

The majority of research on misleading information is still related to computer science (Ha et al., 2021). In this field, many researchers proposed an algorithm detection for fake news on social media. (Figueira & Oliveira, 2010; Natarajan et al, 2022; Shah & Kobti, 2020; Sheikhi, 2021; Shrivastava et al., 2022). Guo et al. (2020) reviewed the different methods used for the detection of false information on social media. Among other analyses, Zannettou et al. (2019) also considered the detection of false information in which the authors found that the most commonly used method was machine learning. When analyzing misleading information on social media platforms, Zanettou et al. (2019) and Kumar and Shah (2018) cited that the majority of researchers used Twitter followed by Facebook as the object of study.

As mentioned by West and Bergstrom (2021), the majority of research on misleading information is related to the public consumption of misinformation, models of spreading misleading content, social network effects, and crowd-sourced mediation. Scholars also examined the strategies for addressing misinformation, one of which is the inoculation method, which has produced interesting results. As explained by Lewandowsky and Van Der Linden (2021), the inoculation method, which is analogized to inoculation for vaccines, consists of the idea of exposing people to weak examples of misleading information beforehand, such that they become increasingly resistant or immune to such misinformation. Many researchers have used this strategy (Compton et al., 2021; Lewandowsky & Van Der Linden, 2021; Maertens et al., 2021; Roozenbeek et al., 2022; Van der Linden, 2017).

Scientific topics are also frequent targets of misinformation. For example, as illustrated by Wang et al. (2019), health topics, such as vaccines, cancer, cardiovascular diseases, diet, and nutritionism, are constantly the target of misinformation. Del Vicario et al. (2015) conducted a study in Italy on the environment, diet, health, and geopolitics, which are the most consumed conspiracy topics on Facebook.

Climate change is another topic that has been examined in relation to misinformation. Treen et al. (2020) pointed out that misinformation on climate change is related to skepticism, denial, and contrarianism. The authors also highlight the importance of interdisciplinary strategies to deal with this problem. Other studies on misinformation about climate change have also been conducted. For example, Samantray and Pin (2019) analyzed climate change conversations on Twitter, while Wright (2022) conducted a review on misinformation on climate change and extreme weather across social media platforms. Lastly, Chu et al. (2023) explored the semantic features of climate change on Weibo.

As a result of scientific topics being frequently the target of misleading information, many researchers point out the importance of science in combating misinformation. Scheufele and Krause (2019) explained different reasons why citizens are misinformed such as the lack of understanding of science. In a different context, Hopf et al. (2019) associated the propagation of misinformation with the lack of trust in science. Various researchers, such as Sharon and Baram-Tsabari (2020), Howell and Brossard (2021), and Serpa et al. (2021) pointed out scientific literacy as a means of addressing misleading information.

Moreover, education is a seemingly positive influence on addressing misinformation. Brisola and Doyle (2019) emphasized that critical information literacy and education are tools for solving this problem. Other researchers, such as Hopf et al. (2019), also emphasize that education is important in this process. The authors proposed that education, as part of life skills development and especially in the culture and methods of science, is an important component of long-term solutions for misleading information.

In the specific case of science education, science literacy is one of the goals of the science curriculum in different countries as mentioned by Osborne and Pimentel (2023). For the authors, the science curriculum is failing in addressing misinformation and promoting appropriate scientific literacy. They also propose basic competencies for evaluating scientific content, which are related to an enhanced understanding of science and its nature. In another paper, Osborne and Pimentel (2022) highlighted the role of education in the age of misinformation. They posited that education plays an important role in well-known strategies for handling misinformation such as inoculation, debunking, or lateral reading. The authors also named three concepts that are important for understanding and evaluating misleading claims. Science education can be helpful in the use of the three concepts, namely, "(i) the social practices that the scientific community uses to produce reliable knowledge (10); (ii) the criteria of scientific

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expertise; and (iii) the basics of digital media literacy." (p. 247). The researchers emphasize the importance of prioritizing science literacy in education. They address misinformation by proposing fundamental strategies and underscore the significance of education in instilling critical concepts for assessing scientific content in an era of misleading claims.

Research Problem

A stream of research has examined climate change on social media; however, research that explores beyond this topic in environmental issues remains lacking. On Twitter, for example, Samantray and Pin (2019) analyzed conversations about climate change denial, and Fownes et al. (2018) conducted a review on conversations about climate change on social media. Furthermore, other researchers created datasets of opinions about climate change on Twitter (Effrosynidis et al., 2022). On Facebook, scholars focused on testing different approaches for evaluating the credibility of fake news (Lutzke et al., 2019), analyzing contents created by non-government organizations (NGOs) (Vu et al., 2020), and examining rhetoric on climate change denial on social media (Bloomfield & Tillery, 2019). On Instagram, studies explored how climate change communication is implemented on the platform (Kober, 2022) or analyzed the content of the hashtag #fridaysforfuture (Herrmann et al., 2022). On Tiktok, research was conducted on the hashtag #climatechange (Basch et al., 2022), and semantic network analysis was used to investigate hashtags such as #climatechange, #ecofriendly, #sustainability, #ecotok, #forclimate, and #environmentalactivism (Nguyen, 2023). However, other topics of environmental issues (apart from climate change) remain under-explored, and the majority of research is still quantitative. Furthermore, an in-depth analysis beyond the number of likes and views in Tiktok is necessary. Expanding the understanding of misleading content on social media platforms becomes crucial in the international context, particularly given the importance of science education in mitigating misinformation. Osborne and Pimentel (2023) have highlighted challenges within current science curricula, emphasizing the need for innovative approaches. Studies exploring scientific content on social media platforms provide valuable insights. Beyond merely detecting misinformation, understanding the topics used, their arguments, and misleading claims can greatly benefit the global science education curriculum. However, as noted, the analysis of misleading information on social media still lacks in-depth research. Based on the literature review in this study, no research has explored the different types of misleading information on the aforementioned platforms.

Research Aim and Research Questions

This research aimed to analyze the nature of misleading content found on Tiktok videos and to discuss why such content is considered misleading through the relevant literature. Especially, there was an intention to identify misleading content in videos on Tiktok regarding environmental issues, analyzing it by topic, and identifying specific misleading claims in these videos. Thus, the study posed the following research questions.

1. What are the main topics of misleading videos related to environmental issues in Tiktok?
2. What are the misleading claims made in these videos?
3. What does the relevant literature say about these topics and misleading claims?

Research Methodology

General Background

This research is qualitative because it aims to analyze the nature of misleading content in TikTok videos on environmental issues and understand why it is considered misleading. This type of research aligns with qualitative research approaches that intend to examine the intentions and meanings underlying the data, exploring meanings and generating insights instead of focusing on statistical analysis. Data were collected using hashtags (#climatechange, #sustainability, #pollution, #biodiversity, #environmentalprotection, #environmentalissues, #energysource, and #environmentalproblems) through a web scraper called Apify (https://apify.com/) on June 2, 2023. For the data analysis, qualitative content analysis by Kripendorff (2004) was used. This analytical method is frequently used to analyze textual, visual, or audio data to identify themes, patterns, and meanings within the content. After sampling materials, speeches, and text (if presented and if different from speech) were transcribed. These data transcriptions were used to build categories to identify the general topics of the videos and each misleading claim presented in them.

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Sample

The sample consisted of 3,840 videos posted on Tiktok from 2019 to 2023. All videos that were private, unavailable at the time, or unrelated to environmental issues were excluded. The remaining videos were considered relevant. The total number of relevant videos was 2, 198, which were watched again to identify misleading information. To identify potential misleading information, the current study used a method similar to that used by Sharma et al. (2017) and based the analysis on the quality of information and citation of credible sources. All videos that provided doubtful information were separated for fact checking. A total of 40 videos presented information that was considered doubtful, which was examined to verify the contents on the basis of the relevant scientific literature. Out of 40, 29 were considered misleading. The videos and their specific data were grouped under three categories (i.e., relevant, misleading, and non-misleading) and systematized using Excel sheets. The average duration of the misleading videos was 2.1 min. Table 1 presents an overview of the number of views, likes, comments, and shares of the misleading videos.

Table 1
Overview of Tiktok Videos Related to Environmental Issues

Videos	Number of videos	Total views	Total likes	Total comments	Total shares
Misleading	29	19,405,383	2,437,860	35,703	116,538

Table 1 indicates a significant amount of engagement with misleading videos, which can be seen by the total high number of views, likes, comments and shares. Thus, analyzing their content is relevant.

Data Collection and Analysis

For data collection, Tiktok videos were assessed using hashtags. The method used by Basch et al. (2022) and Huber et al. (2022) was followed and included the hashtags #climatechange and #sustainability to identify videos related to environmental issues. An additional reason for including these hashtags was that they displayed the highest number of views (5.3 and 4.6 billion views, respectively) at the time of data collection compared with the other hashtags identified as relevant by the current authors.

Furthermore, based on these two hashtags and number of views, additional hashtags were derived using snowball sampling (Noy, 2008) as follows: #pollution (1.1 billion), #biodiversity (263.7 million), #environmentalprotection (152 million), #environmentalissues (3.8 million), #energysource (2.5 million), and #environmentalproblems (1.7 million), which were also included in the analysis due their relevance and high number of views.

Data from these hashtags were extracted through a web scraper called Apify (https://apify.com/) on June 2, 2023. Apify enables data scraping from web pages and has been used by many researchers to examine videos from social media platforms (e.g., Dubrosa et al., 2023; Nallakaruppan et al., 2023; Wu et al., 2023). According to the definition of the Apify website, web scraping is a method for automatically extracting data from webpages and other online sources. It entails accessing online pages, parsing the HTML content, and retrieving particular data—like costs, descriptions or locations—using software tools or scripts (Explore Web Scraping Tools, Methods, and Frameworks, n.d.).

Specifically, for this research, Apify was used to retrieve data from TikTok videos related to environmental issues and the mentioned hashtags. Through Apify, data such as the number of likes, views, shares, comments, and the URL of the videos were collected. The current study is interested in the content of misleading videos; thus, all contents of the 29 videos were transcribed into a Word document. Each video was identified using the link of the video and the code used for identification of the videos (e.g., V1 and V2). The qualitative content analysis with reference to Krippendorff (2004) was employed, this method is defined as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the context of their use" (p. 18). This method appeared to be suitable for the aims and questions of this research, providing a flexible, exploratory, and in-depth approach to understanding misleading content in TikTok videos related to environmental issues. Given the exploratory na-

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ture of this study, aligned with its aims and questions, qualitative content analysis is deemed appropriate. Several studies have utilized content analysis for exploring videos, indicating their validity and usefulness for this type of research (Fowler et al., 2021; Kousha et al., 2012; McCashin & Murphy, 2022; Waters & Jones, 2011). First, the videos were categorized into their main topics in relation to environmental issues. The categories were created on the basis of the topics for environmental issues as discussed in the book of Haper and Snowden (2017). Second, each misleading claim that appears in the videos was categorized. Table 2 systematized and presented these data. The researchers discussed all topics and misleading claims using scientific papers and books as references.

Research Results

Topics of Misleading Information

The analysis focused on the content presented in TikTok videos related to environmental issues that contained any type of misleading information. Furthermore, the results were organized based on the main topic of the videos and the misleading claims made in each one. The summarized results regarding the main topics of the videos and each misleading claim are presented in Table 2 as follows.

Table 2
Topics on Environmental Issues and Misleading Claims Presented in Misleading Tiktok Videos

Topic	Frequency (%)	Misleading Claims	Frequency (%)
Energy sources	12 (41.4)	Non-pollutant energy source: Free fuel generator of energy	1 (2.9)
		Dark energy as a source of clean energy	1 (2.9)
		Non-pollutant energy source: Pyramid as a power plant and Nikola Tesla	8 (23.5)
		Renewable energy is too expensive	1 (2.9)
		Renewable energy sources are not reliable	1 (2.9)
		More people are killed installing solar panels every year than are killed by nuclear power	1 (2.9)
		CO2 has no influence on climate change	1 (2.9)
Climate change	7 (24.1)	Earth is cold most of the time	1 (2.9)
		We can live on Earth when it is warm	1 (2.9)
		The Earth is warmed up without human intervention	1 (2.9)
		The future of the climate is going to be decided in Asia and in Latin America by poor people	2 (5.9)
		The source of climate change is a tire graveyard	1 (2.9)
		Investments won't help to reduce global temperatures	1 (2.9)
		Earth goes through cycles and, therefore, it is warmed up without human intervention	1 (2.9)
Environmental degradation	1 (3.4)	People from Mars suffered from global warming	1 (2.9)
Biodiversity	2 (6.9)	Rating animal appearance: Beauty and ugliness of animals	2 (5.9)
Pollution	7 (24.1)	Three-eyed fish found in Argentina mutation due nuclear waste	1 (2.9)
		Conspiracy related to pollution: Disbelief in government, companies, science, or news	8 (23.5)
Total	29 (100)	Total	34 (100)

Table 2 indicates a diverse range of topics related to misleading content on Tiktok and presents each misleading claim by topic. Moreover, the topics are related to the main topic of the video. Misleading claims have a higher number of topics because some videos presented more than one misleading claim. The topics with the

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most misleading content were *Energy source* (*n* = 12, 41.4%) followed by *Climate change* (*n* = 7, 24.1%), *Pollution* (*n* = 7, 24.1%), *Biodiversity* (*n* = 2, 6.9 %) and *Environmental degradation* (*n* = 1, 3.4%).

The results show that among the misleading claims the ones with higher mentions in the videos were *Non-pollutant energy sources: Pyramid as a power plant and Nikola Tesla* (*n* = 8, 23.5%) and *Conspiracy related to pollution: Disbelief in government, companies, science, or news* (*n* = 8, 23.5%). These claims were succeeded by others, such as *The future of the climate is going to be decided in Asia and in Latin America by poor people* (*n* = 2, 5.9%) and *Rating animal appearance: Beauty and ugliness of animals* (*n* = 2, 5.9%). Other misleading claims spread in fourteen different claims were mentioned only once (2.9%).

Energy Source

This topic is the most mentioned one. The videos were related to green energy sources, the idea of a fuel-free generator, dark matter as a source of energy, and natural energy from pyramids as well as Nikola Tesla. Out of the 12 videos related to energy sources, eight were related to pyramids being a power generator that produces clean and non-pollutant energy. In addition, among the misleading claims about energy sources, one of the videos was related to the denial of climate change, the influence of CO_2, and global warming. Overall, the video was about renewable energies, but they mentioned a misleading claim related to the denial of climate change. The following text presents examples.

The first is the idea of clean energy produced by pyramids and its relation to the work of Nikola Tesla.

> He discovered that electricity occurred naturally throughout the Earth's atmosphere and ground. This energy was not the kind of energy that we have that pollutes. It was a completely passive energy. That had no byproducts. (…) Carmen, can you explain to me why do you think the Great Pyramids of Giza in Egypt are not tombs? It has nothing to do with that. And they keep repeating. They get a story, and they repeat it over and over, and they get the students to repeat it, to get their mark to get out of college. And none of it. They have no proof of any of it. They never found a mummy in a pyramid. Why do you think they were power generators? Christopher Dunn has shown how the pyramids could have been used as energy plants. He's written several books that he's a power plant. He's an engineer. And so his research isn't psychic and, you know, esoteric in any way. It's mechanical. (…) (V20, audio transcription)

First, it is important to note that the assertion suggesting that the Great Pyramid is not a tomb lacks support from relevant literature. Theories, such as the Great Pyramids being energy power plants, are considered alternative theories and are not widely accepted by experts in the field. The claim that students are forced to accept and repeat that the pyramids are just tombs to pass exams is seemingly conspiratory. Schools and teachers bear a moral responsibility to teach students the most accepted knowledge in society. Lastly, the association between Nikola Tesla and the Great Pyramids is also not supported by relevant literature.

In another example, a video discussing issues in green energy sources presented a misleading claim regarding the denial of climate change:

> Green energy also has a significant impact on price growth. Its tariff is the most expensive, but the rules of the energy market oblige us to buy green energy in full. We are being persuaded that the transition to green energy will reduce CO_2 emissions and save the world. (…) But even if we cover the entire surface of the planet with solar panels and wind turbines, the energy they will produce won't be enough. Has it only now dawned upon us that the sun doesn't shine at night, and the wind doesn't blow all the time? In such conditions, power outages are unavoidable. (...) Wouldn't it be easier for us to move straight into a cave, or better yet, straight into a grave so as not to emit extra CO_2? Which, by the way, has nothing to do with climate change. (V16, audio transcription)

Based on this example, several noteworthy claims emerge that need further scrutiny. First, the argument that green energy is more expensive than fossil fuel energy is only partially true. Formulating a strong claim necessitates consideration of various analyses, yet the video fails to provide evidence or analyses supporting this argument. Secondly, the claim that wind and solar energy sources are not reliable is also partially true. To support such a claim, it is essential to present evidence, studies, and an explanation of the factors considered, which is notably absent in the example from the video. Lastly, the claim that green energy sources are not reliable in extreme weather conditions is also not completely true. Different energy sources can suffer damage due to weather conditions. Based on these considerations, notably, analyzing these energy sources and their costs, tariffs, and performances under

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various conditions is difficult; however, the claims made by the author of the video do not seemingly consider all other variables and can, thus, be viewed as misleading.

Another claim made in V16 is regarding the influence of CO_2 on climate change. This kind of denial of the impact of CO_2 on the climate change is also not well supported by relevant literature. In the video, this argument is merely presented without substantial argumentation to validate the claim. Scientific discourse supports the understanding that increased levels of CO_2 contribute to global warming and climate change. The lack of in-depth analysis or citation of credible sources weakens the credibility of this particular claim.

Another video on energy sources proposes the existence of an engine called a fuel-free generator (FFG) that produces less pollutant energy.

> Thus, the fuel-free generator (FFG) is not a perpetual motion machine since it requires an input of energy, but a smaller amount than what energy it can produce. An obvious question arises: how, then, will energy be generated if no fuel is required? That we know from the school physics class that according to the law of energy conservation we can't get more network output than we had spent on it. But this law only works in closed systems. Whereas FFG is an open system, and it receives energy from the surrounding space, scientists of the Russian Academy of Sciences experimentally confirmed that, for example, during the operation of magnetic FFG, the space around the generator does not heat up but cools down instead. (V27, audio transcription)

The claim that FFG is not a perpetual machine is false because FFG, as it is described in the video, continues the movement once set in movement, which is basically the definition of a perpetual motion machine. Second, the claim that according to physics and the law of energy conservation, "we can't get more network output than we had spent on it" (V27), which is made in the video, is also inaccurate. The law of energy conservation states that energy will be conserved, that is, it cannot be created or destroyed. According to the law of thermodynamics, the output energy of a system cannot be higher than the input; in fact, no engine is capable of manufacturing 100% of the input energy into energy output. It is also important to emphasize that the law of energy conservation applies to open and closed systems, not only to closed systems, as is claimed in the video. The differences between these types of systems rely on the transfer of energy and matter from the system to its surroundings. Regarding the claim that space around the machine becomes cooler, the idea that heat is transferred from a warmer to a cooler body until both achieve equilibrium is well known. Becoming cooler for the surrounding of the machine indicates that the surrounding is transferring heat to the machine, which seems very unlikely. A working machine would naturally generate heat due to movement, such that having a lower temperature than its surroundings is very unlikely for the machine.

Lastly, another claim identified in this study is related to dark matter as a source of energy as stated in the following example:

> We just discussed how dark matter and dark energy are literally an energy source that is like 0.0. We can figure out how to harness this energy. We would literally be able to do anything. The aliens have been trying to help us and trying to get us to understand that we don't need to be so greedy about things like oil and all this. If we were using dark matter for what it could be used for, then we would be able to do anything and everything that the aliens do. In order to solve the dark energy equation, you have to be able to use at least 3% of your brain. It said most people only can use 1 to 2% if you're lucky. (V17, audio transcription)

In relation to dark matter as an energy source, there is no evidence to support this claim. Regarding the idea of aliens talking is even more misleading compared with the other statements because no scientific evidence exists of aliens contacting humans or attempting to teach humans. Another misleading aspect of the video that is not necessarily connected to environmental issues is the use of a percentage of the human brain, which has no scientific basis.

Climate Change

The study identified videos that presented denial of global warming and climate change. It found ideas, such as the Earth being cold most of the time; the use of cycles to explain why climate is changing; or even speeches blaming low-income countries for climate change. A few representative examples are presented below.

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> Speaker 1: I think that the true data on Earth is that the Earth is cold most of the time, that right now, we should be grateful that it's nice and cozy because we can live when it's warm. But I think that the data might indicate that Earth is cold more often than it's hot.
> Speaker 2: Well, that's what Randall Carlson has said and what Randall Carlson said really freaked me out. He says global warming is not scary. Those global cooling, that's what's really scary. (V1 audio transcription)

The first claim in this example is that Earth has been cold most of the time. However, this assertion lacks evidence in the relevant literature. Another claim made in the speech from V1 is that humans can live when the climate is warm, but evidence for this claim is also lacking. In human history, climate change has been identified as a reason for the collapse of early human civilizations. To gain credibility, these claims need a more comprehensive examination of historical and scientific literature. Analyzing documented cases of civilizations affected by climate change and presenting empirical evidence would contribute to a more nuanced understanding of the intricate relationship between climate and human civilization. The absence of such evidence in the video weakens the persuasiveness of the claims, highlighting the need for a more thorough and well-supported discussion on these complex topics.

In another example, the idea of cycles appears in one of the speeches from the video, which summarizes diverse parts of the speeches. The video does not seem to intend to spread misinformation; however, the creators added a few misleading claims combined with scenes of animals on Earth, such as polar bears and penguins, and a sad song in the background. Nevertheless, misleading claims have been presented:

> Speaker 1: Oh, the world goes through cycles.
> Speaker 2: Oh, what? You mean the world warmed up without human intervention? (V4 audio transcription)

This video claims that Earth undergoes cycles, suggesting that it warmed up without human intervention. While it is true that certain elements affect the climate in cyclic periods, there is no evidence to support these elements being solely responsible for the dramatic changes our planet has been experiencing. The video introduces this concept without a discussion or supporting evidence, revealing a misleading nature. This misleading aspect arises from presenting information without credible sources or in-depth discussion, potentially leading viewers to misunderstand the intricacies of the topic.

Another example related to the topic of climate change is the responsibility of and action on climate issues. The same speech appeared in two videos; the first presents only the full speech; the second reacts to that speech in which the person reacting agrees:

> Let us all accept right here, right now, that we are living through a climate emergency and our stocks of polar bears are running extremely low. I join you in this view. I truly do. Now what are we to do about this huge problem facing humanity? What can we in Britain do? We can only do one thing. Do you know why? This country is responsible for 2% of global carbon emissions, which means that if Britain was to sink into the sea right now, it would make absolutely no difference to the issue of climate change. You know why, cause the future of the climate is going to be decided in Asia and in Latin America by poor people who couldn't give a shit about saving the planet. (…) It's going to be decided by poor people in Asia and Latin America who don't care about saving the planet. Do you know why? Because they're poor. (V5 and V8, audio transcription)

Regarding the claims made in these videos about the responsibility of the United Kingdom on climate change, it is important to note that the claims are not taking a broader approach to making such conclusions. The video claims that Britain is responsible for 2% of global carbon emissions. However, when we examine the data for Brazil and Mexico, the only two Latin American countries with emissions higher than the UK, their values are also relatively low. It is crucial to note that total emissions alone are insufficient for drawing conclusions. For instance, when looking at the same data for some Asian countries with higher CO2 emissions, such as China and India, they have large populations. China, the United States of America, and India occupy top positions in the ranking, but their large populations contribute to higher total emissions. Examining the data further, the emissions per capita of the United Kingdom are higher than those of Brazil. Therefore, considering only total emissions is inadequate for the conclusions made in the video; countries with larger populations will naturally have higher total emissions. Hence, considering various variables is necessary, an aspect seemingly overlooked by the video.

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Pollution

The study identified four videos under this topic, which were related to a chemical spill that occurred in the United States due to a train derailment. The videos refer to the East Palestine train derailment that occurred on February 23, 2023. The videos about the accident are considered misleading because they claimed that the accident was intentional:

> I see a pattern here, and I have a prediction. Now, some of you might call me absolutely insane and, boy, I do hope that I am. I hope that I am wrong. But if you see me, if you're seeing me, and we're on the same channels, there's a good chance that you're woke and you're aware that American history is ripe with horrible atrocities and genocide. I don't think this is an accident. I don't think that all of the poison going into the water in Ohio, in Philadelphia, now in Montana, there was another one recently in Hawaii, all of their aquifers are being polluted. (V29, audio transcription)

In this first example, the content creator claims the intentionality of the train derailments; however, the fact that the government and corporations caused it intentionally lacks a scientific basis. The videos have a conspiratory nature, which are centered on disbelief in the news and the government; for this reason, they are considered misleading videos.

The study identified another video that fits into this topic:

> I now have to become a farmer because, well, all of our food is poisoned. And I also have to become an herbal medicine doctor because, like, our doctors are just prescribing poison. And I now bathe in apple cider vinegar, because, well, everything I was using on my body was poison. Oh, and laundry detergent. Yeah, now I use baking soda and vinegar, because, well, laundry detergent and fabric softener are poison. And oh, and bottled water is like a fake thing. It's not really good for you or better for you. Also, it might be a little bit better for you than tap water because, well, that's full of poison. I don't believe any fucking doctor, any politician. I cannot trust the news. I have to be a fucking PhD to dig and find the truth in everything. (V12, audio transcription)

In general, the author of the excerpt expresses disbelief in various sectors of society. The video has a conspiratorial nature; for this reason, it is considered misleading. Regarding the idea of food being poisoned, the creator does not specify any particular ideas, but the video likely refers to pesticides, which are considered problematic for human health and the environment. However, previous studies have demonstrated that people who apply pesticides are at actual risk. Making an assumption about poisoning from food to consumers is relatively more complicated. Governments implement regulations for the use of pesticides in food. Thus, further studies on the consequences and effects of the use of pesticides in food for consumers are required before making a strong claim that 'all food is poisoned.'

Other claims made in the video refer to the idea that doctors are prescribing poisoning to their patients; using soap is bad for the body, problems regarding laundry detergent and softeners, and bottled water and tap water being poisoned. These claims lack scientific evidence. The argument that using soap is bad for the body, for example, has no scientific basis. The prolonged use of soap may be problematic for the skin, but its normal use is not considered a significant problem. Regarding laundry detergent and softeners, these products can indeed cause more serious environmental problems. The claim that bottled water and tap water are poisoned is also conspiratorial; there is no credible source cited in the video to support this argument, and scientific evidence points to their general safety, as will be discussed further.

Another video was related to nuclear waste, which led to a mutation in a fish in Argentina:

> How did The Simpsons know this was going to happen? In an episode of The Simpsons that aired in the 1980s, Lord Simpson catches a three-eyed fish from the waters near a nuclear plant. This fish is named Blinky, and later in the episode, it's revealed that the nuclear waste dumped in the water from the plant was responsible for the creation of this fish. Fast forward to 2017. An actual three-eyed fish was found in the waters of Argentina near a nuclear plant, and scientists determined that the cause of the mutation was the nuclear waste in the waters. Well, it might seem like a coincidence, but. (V18, audio transcription)

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This study discovered several news articles related to the case, dated as far back as 2011, and identified the use of the same picture as that in the video. The incorrect timeline already suggests that the information may be misleading. In summary, the absence of trustworthy news reports on the case contributes to classifying it as potentially misleading information.

Environmental Degradation

Under this topic, one video was found:

> Speaker 1 (Moon): Hey, yo Earth, why you look so sad? You the only rock with intelligent life on it in this solar system. Be happy like the sun over there.
> Speaker 2 (Sun): I'm going to explode and kill everything I know and love in 200 billion years.
> Speaker 1 (Moon): Wow. Too bright. Too bright.
> Speaker 3 (Earth): I'm sad because I just found out I'm dying.
> Speaker 1 (Moon): Lying by what?
> Speaker 3 (Earth): No, dying. My people are slowly killing me.
> Speaker 1 (Moon): Oh shit.
> Speaker 3 (Earth): Yeah.
> Speaker 1 (Moon): Don't they need you to, like, breathe and live and scroll through social media on their iPhones?
> Speaker 3 (Earth): That's what I thought.
> Speaker 1 (Moon): We gonna get the sun to burn they assess. Just tell them what happened to the people on Mars. (V28, audio transcription)

V28 contains two instances of misleading information. The first, though not directly related to environmental issues, is noteworthy. It falsely claims that the sun will explode in 200 billion years, which is incorrect. The second involves the mention of people on Mars, lacking scientific evidence.

Biodiversity

The videos under this topic were related to animals who were rated by their appearance. However, the audio is no longer available in one of the videos due to sensitive content, which may be an indicator that people on the platform reported the video. Nevertheless, the video has subtitles:

> Hello, and today we'll be rating different species of armadillo. First up, we have the pink fairy armadillo 1,000 out of 10, partially because it's the smallest armadillo species, but also partially just because it doesn't look real. It looks like sentient sushi, and I really vibe with that. Next up, we have the giant armadillo — 15 out of 10. If I saw this in the forest, I would run. I understand that it's not trying to eat me, but if you look at its claws, I think it successfully could eat me. (V9, audio transcription)

The example shows the rating for armadillo species, which is the intent of the full video — rating different species. Initially, the video is seemingly harmless, but it can have consequences for the conservation of species. Speeches that emphasize the esthetic traits of animals can be misleading and lead to consequences for the future of the species. Another video that rated fish appearance seemingly attempted to emphasize these fish as endangered species, but rating their appearances is not beneficial for the future of the species.

Discussion

Energy Source

Based on our results, it can be seen that there was a diversity of misleading claims related to the topic of Energy sources. First, the claim of V20 is about Pyramids as an energy source and the association of Nikola Tesla's works with this pseudo-theory. There was no mainstream archaeological or scientific evidence found in relevant books such as Brier and Houdin (2008), Lehner (1997), Shaw (2003), Smith (2018) and Wilkinson (2003) that supports the

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claim that the Great Pyramid was not a tomb. For example, Brier and Houdin (2008) explicitly mentioned that the purpose of the Great Pyramid of Giza was to "house the body of the dead king" (p. 14). Regarding the association of the works of Nikola Tesla and the Great Pyramids, no association was found in books about the scientist's life and work, such as Cheney (2001) and Seifer (1996).

Through the example of V16, some other misleading claims emerged, as can be seen from the results. The first one is about the expensiveness and reliability of renewable energy sources. Examining reports, renewable energy sources have become cheaper overtime. In fact, according to a report by the International Renewable Energy Agency (2023) in 2022, "solar PV's global weighted-average LCOE is 29% lower than the cheapest fossil fuel-fired option" (p. 17). Second, about the reliability of wind and solar energy sources. Tong et al. (2021) analyzed the capability of solar and wind as energy sources to meet electricity demand in 42 countries and demonstrated that these energy sources can be considered reliable. The authors reported that solar and wind energy sources would be able to satisfy around 72%–91% of hours of energy for the 42 countries in a scenario that does not consider the storage of energy. In a context considering the storage of energy, with 12 h of storage, the results go to 83–94% of hours being satisfied with the use of solar and wind energy sources for the 42 countries. Nevertheless, even for high-performance systems, unmet demands may occur annually for hundreds of hours. Regarding extreme weather, different types of energy sources are susceptible to damage in extreme weather conditions, as pointed out by Zamuda et al. (2013) in a report by the United States Department of Energy.

In V16, a claim regarding the denial of CO2's influence on climate change could also be found. As discussed by Oreskes (2018), the relationship between CO_2 and climate change is widely accepted. For example, the author provides extensive references to reports from respected scientific institutions such as the Intergovernmental Panel on Climate Change, the National Academy of Sciences, the American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science. Moreover, the author emphasized that in an analysis of 928 abstracts of papers published from 1993 to 2003, none of them presented data to refute the consensus position on global climate change, which is defined by the author as the human influence on climate change and consequently the influence of CO_2 on global climate.

Another misleading claim found in the topic of energy sources is related to free, non-pollutant energy sources as the free-fuel generator (FFG) presented in the example of V27. In the example, it is said as if this generator is not a perpetual machine. However, in the literature, the definition of a perpetual motion machine, according to Tsaousis (2008), a perpetual machine is, "a machine which, since set in function, continues to function perpetually without supplying any energy" (p. 53). Regarding the difference between closed and open systems, Kittel and Kroemer (1969) explained that a closed system can transfer energy but not matter, whereas an open system can transfer both to its surroundings. This is exactly what is being described as an FFG in the video, and, in this sense, the claim is misleading. A perpetual motion machine cannot work based on simple thermodynamics laws.

Lastly, V27 presented claims regarding dark matter being an energy source. In the mainstream literature about dark matter, there is no support for these claims. For example, according to the definition by Ryden (2017) in a book entitled *Introduction to Cosmology*, dark matter can be defined as "any massive component of the universe which doesn't emit, absorb, or scatter light at all" (p. 27). Weinberg (2008) explained the nature of dark matter as, "most likely it is made of exotic particles, which do not interact electromagnetically and hence do not produce light" (p. 84). Another misleading claim presented in this video is about aliens trying to contact us. Regarding the argument of aliens talking and teaching humans, according to Talbert (2003), this has no scientific evidence. Also, the claim about how much percentage of the brain is used, according to Herculano-Houzel (2009) and Zjacic (2023), has become a common myth in the past century but has no scientific basis.

Climate Change

As shown in the results, the topic of climate change also presented a significant number of misleading claims. The first video on this topic (V1) presented a dialogue that claimed that Earth is cold most of the time. Firstly, an analysis by Scott and Lindsey (2023) includes a graphic demonstrating the estimated temperature of Earth in the last 500 million years. Moreover, the graphic indicates that global surface temperatures have been mainly warm. Therefore, no evidence exists to support the claim. Second, the claim that humans can live when the climate is warm is discussed by Ruddiman (2014) in a book entitled 'Earth's Climate: Past and Future,' which explores the collapse of the Mayan civilization. The author cites evidence that the collapse was due to drought, as this period coincides with a higher amount of lake sediments, an indicator of drought. Despite the evidence pointed out by Ruddiman (2014), designating climate change as a unique cause of changes in early civilizations is difficult.

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V4 presented another misleading claim related to Earth working on cycles, and for that reason, it warmed up without human intervention. Regarding the cycles that affect climate on Earth, Ruddiman (2014) in his book explained that tectonic, orbital, or millennial time scales are unable to explain the recent increase in global temperature. The researcher also explained that short-term forcings, such as volcanic explosions or El Nino events, cannot account for the changes in global temperature. Alternatively, approximately 10% of the total increase in temperature could be related to solar irradiance. In summary, the majority of changes in global temperatures can be attributed to human activities (Ruddiman, 2014).

The claims presented in the videos V5 and V8, are related to the responsibility and action on climate change. According to the speech presented, the United Kingdom has little responsibility because the amount of emissions from the country is very small on a global scale. According to data from a report by the International Energy Agency (2022), sourced from the Emissions Database for Global Atmospheric Research, the United Kingdom accounted for 335.36 Mt (0.89%) of global carbon emissions in 2021, ranking 17th among countries worldwide. The only Latin American countries emitting more total CO2 than the United Kingdom are Brazil, with a total of 489.86 Mt (1.29%), and Mexico, with 418.35 Mt (1.11%). When comparing emissions per capita, the United Kingdom and Brazil present totals of 4.95 and 2.28 t CO2/cap, respectively. Additionally, if you take into account the respective populations of nations, the United Kingdom is more polluting than Latin American countries measured by CO_2 emissions per capita. Climate change is a global problem and demands cooperation from different countries. Trying to take responsibility for data that does not take all variables into consideration is misleading.

The V5 and V8 also argue that "poor" countries are responsible for climate change on Earth. However, data from Ritchie et al. (2020) reveals that high- and upper-middle-income countries are responsible for 86% of global emissions, indicating that poverty is not necessarily an aggravator of CO2 emissions. Moreover, developing countries are frequently more vulnerable and affected by the consequences of climate change (Abeygunawardena et al., 2004). Other studies on the impact of climate change and poverty consider low-income populations more vulnerable (Hallegatte & Rozenberg, 2017; Hallegatte et al., 2018; Marotzke et al., 2020).

One might argue that the video intends to emphasize that developing countries have the urgency to grow. However, stopping their growth is impossible, as per this excerpt: 'You're not going to get them to stay poor' (V5). Consequently, they will pollute and become the main agents responsible for climate change in the future through their growth. However, this argument overlooks the fact that developed countries will also continue to grow and, hence, contribute to climate change. According to the economic model that governs the world, the need for continued growth will persist, with developed countries also working toward growth.

Pollution

From the results, it can be seen that misleading claims on the topic of pollution were related to conspiracies. V29 presented a conspiracy related to the chemical spill from a train derailment in the United States. In V12, also elements of conspiracy can be identified, those which are related to disbelief in different sectors of our society. These kinds of speeches have no scientific evidence.

Specifically in V12, the claim was made regarding food poisoning. Probably related to the use of pesticides. According to Rani et al. (2021), the higher risk for people concerning pesticides is for those in direct contact with them, indicating that farmers and agriculture generally suffer more from pesticide poisoning. As mentioned, governments generally have regulations for the use of pesticides; for instance, according to data from Granby et al. (2019), violations of the safe levels of pesticide use were detected in 1.9% of domestic fruits and 6.7% of imported vegetables in the United States in 2003. In other words, a low percentage of food violates the country's regulations. Another example presented by Carvalho (2017) points out that 97% of the 87,000 food samples of the European Union analyzed in 2014 were within legal limits; out of those, 53.6% did not present quantifiable residues, and 43.4% had residues within regulations.

Other misleading claims identified in V12 were about doctors prescribing poison to their patients. Additional misleading claims were related to soaps, laundry detergents and softeners being bad. In the literature, arguments related to medicine are emphasized by Boudolas et al. (2017), highlighting that advances in medicine have significantly contributed to the increase in human life expectancy. Regarding soap, Wolf et al. (2001) state that the negative effects of soap on the skin are occasionally exaggerated, and 'with ordinary use for general personal hygiene, the majority of consumers will tolerate any kind of soap without any harm' (p. 396). When it comes to laundry detergent and softeners, various researchers have pointed out the negative impact of these products,

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specifically due to their ingredients and future disposal, which may contaminate water resources (Bajpai & Tyagi, 2007; Gupta & Sekhri, 2014; Pettersson et al., 2000; Sabharwal, 2015).

Lastly, V12 made a misleading claim regarding water being poisoned. Research on bottled water has reported little to no concern about its safety, and the same is true for tap water. Napier and Kodner (2008) emphasized that access to the full content of water quality is difficult, but bottled water is generally considered safe. Jain et al. (2019) also expressed that bottled water is generally safe to consume. According to the authors, tap water is even healthier and more environmentally sustainable, but evidently, it should be boiled and/or filtered before consumption. Raj (2005) conducted a study on stored bottled water and demonstrated that bottled water stored for a long time produced more bacterial growth over time than tap water did.

V18 also made a misleading claim related to pollution. V18 presented a report about fish mutation due to nuclear waste. As mentioned in the results, the wrong timeline presented in the video for the report and the lack of credible news on the case already indicate the video as misleading. In the literature, various studies explore the effects of nuclear waste, radiation, and other types of waste on animals, including fish (Hoshina et al., 2008; Kolar & Gugleta, 2019; Lourenço et al., 2017; Souza & Fontanelli, 2006). However, no reliable report exists regarding the case of the three-eyed fish in Argentina.

Environmental Degradation

V28 presented a dialogue between Earth and the Moon. In this dialogue, some misleading claims are presented. First, the wrong statement is that the Sun will explode in about 200 billion years. In fact, this will occur in about 5 billion years due to the evolution of the Sun into a red giant star. Secondly, the idea of Mars being home to people in the past. The video presented the idea that people died on Mars by not taking care of the planet as we are doing to Earth now, but this claim has no scientific evidence.

The relevant literature sheds light on these issues. According to Frazier (2019) and the National Aeronautics and Space Administration (n.d.), in approximately 5 billion years, the sun will evolve into a red giant star, expanding to 200 times its current radius. Regarding the presence of people on Mars, as explained by Furfaro (2023), there is evidence supporting the past existence of liquid water and a thicker atmosphere on Mars. However, these facts do not prove that Mars was a home for people as stated in the video.

Biodiversity

The example provided by V20 presented a video where armadillo species were rated based on their appearances. This content can also be considered misleading due to its consequences and influence. Research on the conservation of animals demonstrated that differences exist in the process of conservation, support, and attention for diverse species, based on human preferences for specific aesthetic traits (Papworth & Curtin, 2022; Pinho et al., 2014). For example, animals that are considered cute or charismatic frequently receive more media attention and more conservation support if compared with animals that are considered ugly or less charismatic. Colléony et al. (2017) and Martín-López et al. (2007) also found that people are willing to donate to more charismatic animals regardless of ecological or scientific considerations. Small (2012) highlighted that considering not only the aesthetic or economic value of a species but also the diversity and vital ecological roles they play in sustaining the necessary ecosystems for human survival is important.

Conclusions and Implications

This research aimed to comprehend the dissemination of misleading information concerning environmental issues through TikTok videos. In contrast to prior literature primarily focused on climate change, this investigation broadened its scope to explore a wider range of environmental issues. The analysis of results and subsequent discussions led to insights into the nature of misleading content within the videos. The findings revealed that TikTok videos with misleading information predominantly centered on topics such as energy sources, climate change, pollution, biodiversity, and environmental degradation. Furthermore, among the diverse array of misleading claims, topics such as non-pollutant energy sources (e.g., the Great Pyramids as power plants and Nikola Tesla) and pollution-related conspiracies expressing distrust in government, companies, science, or news were frequently mentioned.

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This research concludes that, unlike previous literature that predominantly focused on climate change denial, the diversity of topics targeted by online misleading information on environmental issues extends beyond just climate change. The range of topics addressed underscores the pervasive impact of online misleading information across various facets of environmental discourse. This suggests the need for educators and education systems to broaden their focus on specific topics to effectively address the current issue of online misinformation.

The identification of specific topics and misleading claims in this research serves as a valuable resource for science educators dealing with these subjects. Grounded in relevant literature, the specificities identified in this research can serve as exemplary resources for educators aiming to address misleading claims related to environmental issues in their classrooms. The findings also provide insights for enhancing science education curricula, emphasizing the necessity of a multidisciplinary approach in addressing environmental issues and combating misinformation.

Within the predominant monodisciplinary educational structure, successful implementation of a multidisciplinary strategy requires cooperation and strategic planning among educators. For example, science teachers from various domains can collaborate to identify common ground facilitating integrated exploration of online misleading information on environmental issues. Projects on climate change, involving contributions from physics, chemistry, biology, and earth sciences, can help students analyze scientific data, explore societal impacts, and articulate their findings, incorporating specific skills like source evaluation, fact-checking techniques, and awareness of bias.

In summary, this study, through content analysis, deepens understanding of topics often targeted by misleading information. It offers a detailed examination of video content, analyzing discourses, identifying specific misleading claims, and discussing each in the context of relevant literature. Future extensions could involve analyzing non-misleading videos to explore how science is utilized and studying misleading information across various scientific topics to comprehensively address this ongoing issue. Additionally, examining other platforms and comments on misleading videos can provide new insights into addressing misinformation in social media for science education.

Declaration of Interest

The authors declare no competing interest.

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