Article

Undisciplining Environmental Communication Pedagogy: Toward Environmental and Epistemic Justice in the Interdisciplinary Sustainability Classroom

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Abstract: This article moves beyond an understanding of environmental communication as merely the "translation" of scientific knowledge for the general public and advocates for environmental science and sustainability (ESS) educators to understand environmental communication as a critical practice with complex social, cultural, and political stakes. Due to the interconnectedness of environmental issues and social, political, and cultural contexts, environmental communication pedagogy is an important site of both environmental and epistemic justice. This article addresses the question: What forms of environmental communication pedagogy contribute to dynamic communication competencies for students while also promoting environmental and epistemic justice? The authors begin with a literature review of environmental communication and environmental justice research. Subsequently, they develop a theoretical argument advocating for an "undisciplining" of environmental communication pedagogy to promote critical thinking about the exclusionary politics of environmental knowledge production and communication. In doing so, the authors advocate for cultivating dynamic and ethically engaged real-world literacies for students through social and participatory media, including Wikipedia and podcasts. The article concludes with two sample assignments that instructors can adapt to their classrooms.

Keywords: pedagogy; environmental communication; environmental justice; epistemic justice; learning outcomes; sustainability communication; social media

1. Introduction

Since the birth of the modern American environmental movement in the 1960s, mass media has played a central role in exposing environmental problems, contesting claims about environmental issues, and communicating the underlying values, perceptions, and opinions that guide our uses and abuses of the environment [1]. Public perception figures significantly into environmental decision-making about issues as diverse as ocean acidification, deforestation, melting ice caps, resource extraction, agriculture, and greenhouse gas emissions, among many others. Research increasingly shows that public perceptions of environmental problems are "as much to do with communication aimed at 'winning hearts and minds' as they are to do with communicating science-based or expert evidence" [1]. Thus, environmental problems and their solutions are inextricable from the ways we communicate about them. Our ideologies, values, beliefs, and experiences—i.e., our "hearts and minds"—deeply influence our responses to environmental issues. For these reasons, it is vital to cultivate environmental pedagogies that make space for our own and students' "hearts and minds," and empower our co-thinkers in the classroom to cultivate egalitarian approaches to environmental communication.

Today, both the research community and the general public are flooded with information about environmental problems, from climate change and species loss to deforestation, crumbling infrastructure, and natural disasters. We live in a cultural moment that one

scholar dubs "the infowhelm," a term that captures the dizzying array of data at our fingertips, and also our collective inability to tell a coherent story about how we got here, where we need to go, and the paths we must forge to get there [2]. Public discourse on climate change is increasingly polarized between climate denialism—a growing reality in the United States—and appeals to scientific expertise as recourse to misinformation [3]. Increasingly, however, scholars in the environmental humanities and social sciences emphasize that insufficient data is not the problem [2,4–6]. Rather, the problem is how to bring the wealth of knowledge we already hold about environmental issues into meaningful presence, not only for our students, but also for the broader public. Part of this work involves cultivating broader understanding about socially just and sustainable solutions to environmental issues. Moving beyond an understanding of environmental communication as merely the "translation" of scientific knowledge for the general public, it is vital that students of environmental science and sustainability (ESS) understand environmental communication as a critical practice with complex social, cultural, and political stakes. In turn, environmental educators must consider both the practical and theoretical dimensions of communication approaches in the classroom in order to promote informed, ethical, and justice-oriented communicative competencies for students.

Because of the interconnectedness of environmental issues and the social, political, and cultural landscapes through which they emerge, environmental communication pedagogy is an important site of both environmental and epistemic justice. While there are differing definitions of environmental justice, the term broadly refers to the rights of all people to enjoy equal protection from environmental harm and equal share in environmental benefits and decision-making [7]. Epistemic justice refers to the right of all people to make sense of their own experiences and to express their knowledge in order to increase society's understanding of their experiences [8]. Both environmental and epistemic justice are forms of social justice, as they are mutually concerned with the distribution of resources, power, and privileges in a society. Research shows that the current generation of college students is increasingly vocal in their commitments to social and environmental justice [9]. It is therefore especially incumbent upon environmental educators to develop critical environmental communication pedagogies that bring together the fields of communication, ESS, and social justice. This article addresses the question: What forms of environmental communication pedagogy contribute to dynamic communication competencies for students while also promoting environmental and epistemic justice? Throughout this qualitative study, the authors perform a review and analysis of extant literature on interdisciplinarity, communication pedagogy, and environmental justice, and advocate for an "undisciplining" of environmental communication pedagogy that promotes critical thinking about the often exclusionary politics of environmental knowledge production and communication while cultivating dynamic and ethically engaged real-world literacies. This theory of "undisciplined" environmental communication pedagogy brings together scientific, data-driven evidence about environmental issues with the interlocking socioeconomic contexts that define peoples' environmental realities. This "undisciplined" environmental communication pedagogy comprises two distinct yet interlocking considerations for educators: (1) the types of publication and/or expertise of authors taught in the classroom; (2) the publication venues from which these materials are sourced. The approach outlined here builds fluency for students through an egalitarian approach to communicative media. It recognizes the environmental authority of both conventional scholarly research channels, as well as participatory media venues such as Wikipedia, Twitter, and podcasting platforms, where communities who have been historically excluded from academic research and democratic decision-making voice their knowledge and concerns. An "undisciplined" environmental communication pedagogy, the authors suggest, is well-positioned to introduce relevant and dynamic communicative competencies to students while also promoting environmental and epistemic justice.

In order to establish the relevance of this pedagogical approach, the authors situate their research in conversation with existing literature on interdisciplinarity; environmental

communication and pedagogy; the relevance of humanistic and beyond-academic forms of environmental communication such as fiction, art, and social and participatory media; and environmental and epistemic justice. Following a review and discussion of existing literature, the authors present two sample environmental communication pedagogy assignments that can be implemented in the ESS classroom and adapted to various levels of the curriculum. These assignments reflect the core values of an "undisciplined" environmental communication pedagogy and center forms of communication that involve multiple publics in the value-creation process. The authors discuss how these assignments promote multiple communication literacies for ESS students while also rejecting modes of communication that privilege the epistemic authority of elite environmental researchers at the expense of everyday experts who live, research, and enact environmental change beyond the bounds of academia.

In keeping with the ethos of open-access knowledge and the goal of "undisciplining" environmental communication models that privilege one-way transmission, the authors have made the decision to cite only sources that were free and publicly accessible at the time of writing. Embodying what we term a *critical scavenging* methodology, the authors accessed peer-reviewed sources exclusively via Google Search, Google Scholar, Google Books, ResearchGate, and Academia.edu, rather than via electronic databases or repositories that are locked behind paywalls and not accessible to the general public who do not benefit from the privilege of institutional access. Critical scavenging, as a research strategy, embodies an environmental justice ethos that centers equity of access while also performing the creative and nimble research approaches necessitated by the instability and unpredictability of free and open-access virtual knowledge archives. While this approach expands its knowledge archive beyond strictly peer-reviewed scholarship, a formalized system of assessment was implemented to ensure rigor and critical evaluation of sources. In conducting research via peer-reviewed scholarship published in the openly accessible venues identified above (Google Scholar, ResearchGate, and Academia.edu), assessment methods consistent with those used in traditional literature review research were implemented (i.e., the relevance of extant scholarship was identified on the basis of both its quantitative impact and the qualitative novelty and currency of its findings). Frequently, sources found through Google Scholar linked to publicly accessible repositories such as ResearchGate and Academia.edu, from which the authors retrieved relevant sources. Periodically, sources deemed relevant based on an article abstract, but that appeared to be inaccessible, were searched for via Google to determine pre-print versions or versions available via the authors' personal or professional websites. For non-academic sources collected through search engines such as Google Search and its service Google Books, the authors applied standard, widely available models of digital media literacy while relying on "lateral reading," whereby sources and content are verified and evaluated continuously throughout the online research process [10–12]. While critical scavenging on principle excludes peer-reviewed scholarship that is only accessible via paywalled venues, the expansive approach to knowledge archives and critical engagement with non-scholarly sources outlined here nevertheless adheres to widely-accepted protocols of media literacy that promote broad yet rigorous engagement with a variety of publics and knowledge communities. Throughout this article, peer-reviewed scholarship is complemented by non-academic sources that reflect the perspectives, experiences, and critical insights of individuals from marginalized communities. The following sections review and discuss the primary knowledge foundations of this research.

2. Theoretical Background

2.1. Interdisciplinarity and Undisciplinarity

Interdisciplinary learning has long been a hallmark of environmental studies and other fields that bring together diverse academic knowledge traditions, and it remains an important research subject in its own right (a quick search of the term *interdisciplinarity* on Google Scholar yields over 230,000 results). Increasingly, scholars and practitioners across

the social sciences and humanities are turning toward a new model of research: *undisciplinarity* [13–16]. Undisciplinarity has been primarily discussed as a research methodology, and we expand this concept to the environmental classroom to consider its pedagogical possibilities. A guiding principle of undisciplinarity is that researchers engage with creative and imaginative approaches to problem-solving that move beyond disciplinarity, interdisciplinarity, and its kin (multidisciplinarity, cross-disciplinarity, transdisciplinarity, etc.), which generally denote an integration or meeting of disciplines but not necessarily a bridging of academic and non-academic epistemologies. This bridging of academic and beyond-academic knowledge traditions is central to tackling the compounding challenges we face as a global community. The imperatives of climate change invite rebellious methodologies: "We need more playful and habitable worlds that the old forms of knowledge production are ill-equipped to produce" [17]. Houser & LeMenager (2022) articulate a common thread running through critical engagements with undisciplinarity, including "a sense of imperilment" that calls for "disassembling entrenched institutions and values" [18]. Haider et al. (2018) identify undisciplinarity as an "iterative and reflexive process of balancing methodological groundedness and epistemological agility to engage in rigorous sustainability science" [13]. Ramirez (2021) uses the related concept of "epistemic disobedience" to describe researchers' "resistance" to the "unmarked subjectivity and zero-point epistemology" that defines traditional Western academe [19]. As environmental educators, adopting not simply an interdisciplinary approach but an *undisciplined* approach to communication pedagogy that engages with communities and knowledge traditions beyond academia offers an expansive and socially just approach to sustainability education. Doing so can empower the next generation of college students to embrace equitable, socially just, and egalitarian approaches to our most pressing environmental challenges. At the same time, it is also necessary to consider the potential challenges or risks of an "undisciplined" approach to environmental communication pedagogy, particularly given the rise of climate misinformation in today's fractured media landscape. For example, by 2014 the World Economic Forum had identified online misinformation as a top trend facing the global community; additionally, scholars have identified the signifcant role of sustained misinformation campaigns specifically related to the changing climate [20,21]. While the authors acknowledge the inevitable risks that accrue to research in the public media sphere, students can and should be educated in the digital media literacy skills noted earlier. From this perspective, the authors suggest that the practical skills and egalitarian potential of an "undisciplined" environmental communication pedagogy outweigh the potential risks, which are, unfortunately, part and parcel of digital citizenship in the twenty-first century. Moreover, an approach to environmental communication that emphasizes inclusive methodologies, archives, and discourses speaks directly to many of the core values embodied by the current generation of college students, who share a common interest in social justice and a recognition of the entanglements of ideology and everyday life [9].

2.2. Environmental Communication: Theory, Praxis, Pedagogy

Environmental communication research is an increasingly important field and is crucial to the success of sustainability goals. Lindenfeld et al. (2012) outline three key intersections between environmental communication and sustainability efforts [22]. First, environmental communication research contributes to nuanced understandings of the way that public participation intersects with sustainability practices. Second, sustainability science requires interdisciplinary collaborations, which environmental communication can facilitate. Additionally, environmental communication can "play a vital role in reorganizing the production and application of disciplinary knowledge," which is a key component of epistemic justice, discussed below [22]. Additionally, environmental communication research is especially valuable for shifting communication processes away from a one-way transmission model that perceives communities and citizens as passive receivers of information, and toward engaged communication models that recognize communities as

active agents of change in their environments [22]. Over the past three decades, scholarly and popular interest in environmental communication has consolidated across numerous book-length studies, university curricula, and academic journals. Over this time period, two significant trajectories have emerged: first, a broadening of environmental communication to address not only explicitly "environmental" problems but also those relating to public health, science and technology, and social justice [1]. Second, the field of environmental communication has seen a shift away from a narrow focus on mainstream news coverage of environmental issues and its influence on public opinion, toward a more robust and diverse corpus of approaches and theories that illuminate the broader political, social, and cultural roles of environmental communication [1].

The increasing influence of social-constructionist analysis has shifted the focus of environmental communication research away from traditional journalistic concerns over bias and objectivity and toward more nuanced sociopolitical and discursive understandings of media's role in framing, interpreting, and making visible—or invisible—environmental issues [1,23]. In this vein, critical discourse analysis has proven particularly useful in uncovering the meanings of media content about the environment [1]. Communication is central to the ways that individuals come to know and contextualize environmental issues, and to their understanding of how environmental problems are raised, contested, and addressed [1]. In the third decade of the twenty-first century, vast swaths of individuals and communities around the world are experiencing the realities of environmental crises, and communication media play a key role in contextualizing these experiences and drawing connections between disparate environmental problems and overarching structures of inequality and exploitation, including sociopolitical systems such as capitalism, colonialism, neoliberalism, and democratic decision-making.

The unfolding climate crisis, among other environmental issues proliferating around the world, impacts everyone. It follows that solutions to these problems also belong to everyone, and that all communities have a right to share their environmental experiences, strategies for resilience-building, and articulations of what a more just and sustainable future looks like—as well as equal access to the resources to enact those futures. Yet, as environmental justice scholars and activists have long demonstrated, marginalized communities, including Black, Indigenous, and people of color groups, disabled folks, LGBTQIA+ people, low-income populations, and immigrants, have borne a disproportionate burden of environmental harm while also being denied the rights and opportunities to redress these harms [24–29].

Increasingly, it is necessary to understand mediated communication about environmental issues in tandem with sociological concerns about the way that power and inequality circulate in the public sphere [1]. Democratic civic engagement is core to successful social change efforts, and particularly the "massive social and economic changes necessary to address global warming" [30]. Environmental and political discourse that revolves primarily around messaging from elite interest groups such as academic researchers, mainstream news media, and NGOs remains a dominant form of one-way communication, yet an over-reliance on this model can undermine democratic processes of change and weaken mobilization efforts to address the climate crisis, which necessarily require broad civic engagement [30]. Moreover, centering environmental communication from dominant or elite interest groups can reinforce existing power relations and institutional dynamics that may contribute to the climate crisis in the first place [30]. A one-way transmission model of communication significantly impacts the ability of marginalized groups to participate in and influence the nature of public communication about pressing environmental issues [22]. For these reasons, it is incumbent upon environmental educators to cultivate communication pedagogies that promote critical thinking about the politics of mediated environmental knowledge, while also encouraging student engagement with media forms that democratize environmental knowledge production and communication. This can manifest through both an emphasis on beyond-academic venues of knowledge communication (social and participatory media, for example) and on diverse, dynamic, and inclusive environmental

methodologies (e.g., community or "citizen" science, grassroots organizing and activism, and community gardening, among others).

Cultivating environmental communication pedagogies that center the experiences, knowledges, and communication strategies of marginalized people is a meaningful way to teach dynamic and practical skills for students, while also promoting environmental and epistemic justice in the classroom. At the same time, it is valuable to recognize the ways that communication and democratic pedagogy have long been a key component of environmental education. For example, research on informal learning in science education has been a space for educators and students to explore connections between democratic citizenship and STEM research [31,32]. Researchers working in the humanities and social sciences argue that environmental communication strategies practiced by marginalized communities are vital for enacting more just and sustainable futures. As Pellow (2016) explains, minoritized peoples are "indispensable" to our collective flourishing [27]. For these reasons, it is especially important to focus on communities and social movements that can intervene in mainstream environmental communication regimes that may reinforce existing unequal power relations [30]. For example, Rochen (1998) identifies "critical communities" as small groups of people whose experiences and knowledges create shared cultural values that are "out of step" with the larger society [33]. "These alternatives and their dissemination by a movement are a critical condition for the collective perception of a social problem, creating an alternative map of the social world around which individuals can collectively mobilize" [30]. One such example of a tactical critical community emerges in social media spaces, where hashtags such as #BlackinSTEM and #BlackInNature virtually connect a range of individuals around shared experiences, concerns, and solidarities.

Attention to the communicative strategies of critical communities is central to helping students imagine and build a sustainable and just environmental future. Many dominant environmental communication strategies focus on appealing to individual self-interest and/or "core progressive" values, such as "green" consumption of electric or hybrid vehicles, for example [30]. These approaches often rely on ideas of technological utopianism or an over-investment in techno-scientific innovation and sustainable growth, viewing environmental crises solely as challenges for science and technology [30]. Many of these perspectives come around to the idea that capitalism can simply be modified to be sustainable while requiring no changes in conspicuous consumption lifestyles or institutions [34]. Brulle (2010) advances the idea that effective environmental communication "critiques the current situation and offers a Utopian vision of where society needs to go. It is this combination of threats and opportunities, nightmares and dreams—that fuels social movement mobilization and social change" [30]. Similarly, Taylor (2021) emphasizes the necessity of "radical reworlding" through environmental storytelling from Indigenous communities [35]. Due to the exclusionary and colonialist legacies of academe, many of the urgent, nuanced, and critical articulations of these "alternative maps of the social world" emerge from environmental justice (EJ) communities and communication networks that exist beyond the boundaries of academic knowledge production [36,37]. Through these perspectives, we can better understand the connections between environmental communication, social and political power, and communication pedagogy, which we can bring forward into our classrooms.

For example, sustainability educators can incorporate imaginative media such as science fiction into the classroom, an approach supported by a robust corpus of scholarship on the connections between imaginative storytelling and environmental awareness [2,38,39]. As Streeby (2017) explains, "people of color and Indigenous people use science fiction and other speculative genres to remember the past and imagine futures that help us think critically about the present and connect climate change to social movements" [38]. This focus on imaginative environmental storytelling by BIPOC communities in the United States produces valuable insights that are missed when our sole focus is on research scientists, transnational corporations, NGOs, and politicians as "agents and explainers of change" [38]. For example, several Indigenous scholars note that for Indigenous peoples, the apocalypse already happened [39–41]. From this perspective, storytelling about speculative apocalyp-

tic worlds can offer a way to make visible the interrelated violence of settler colonialism, resource extraction, and climate change. For example, the first author regularly teaches the science-fiction short story "Cloud Dragon Skies" by Hugo Award-winning writer N.K. Jemisin. The story situates the reader in a post-apocalyptic, postcolonial landscape in which familiar blue skies have been replaced by angry red and pink ones, where tempestuous cloud "dragons" twist and swirl, controlling the upper atmosphere. When an exploratory group of "sky people" (research scientists)—members of the human exodus to a planet beyond Mars—return to Earth to experiment with the biochemical reactions in Earth's atmosphere, protagonist Nahautu and her father, a village elder, are skeptical about their intentions. "We like it the way it is," Nahautu's father tries to explain to the scientists [42]. Despite the protests of Earth's last remaining residents against the incursion of tests and experiments on the "cloud dragons," the sky people conduct an experiment with catastrophic results: the entire village and surrounding area are vaporized by the angry cloud dragons, and the ecosystem is completely destroyed. As the first author has discussed with her students across several classes, this story interrogates not only the epistemic and ecological violence carried out under the banner of scientific exploration and environmental research, but also the necessity of listening to frontline communities and their desires to adapt to rather than continually *intervene* in ecosystems via technological means. As this example demonstrates, science fiction and other imaginative arts offer avenues for understanding the dispersed environmental injustices of our present moment through speculative world-making. Here, the authors follow Streeby's (2017) articulation of world-making to "center the transformative dimensions of the worlds and futures imagined by Indigenous people and people of color" in confronting the legacies of settler colonialism and environmental racism, rather than the conventional understanding of sci-fi "world-building" as the realistic literary construction of an imaginary world [38]. Additional examples of relevant environmental justice fiction and cinema include National Book Award-winning novelist Jesmyn Ward's works centered in the post-Katrina U.S. Gulf South, including *Salvage the Bones* (2011) and *Sing, Unburied, Sing* (2017), and popular sci-fi/fantasy films *Snowpiercer* (2013) and *Beasts of the Southern Wild* (2012). Engaging with these materials in the classroom, and acknowledging them as forms of research in their own right, is a valuable step toward undisciplining environmental communication pedagogy.

As demonstrated above, environmental communication is a vital practice and field of inquiry, and our classrooms remain an important site of this work. Environmental communication pedagogy has been shown to enhance problem-solving and collaboration for adult students and community partners while promoting environmental sustainability [43]. At the same time, environmental communication pedagogy remains a diverse "field in the making" [44]. Two key themes influence recent environmental communication pedagogy research: (1) an epistemological approach that theorizes discourse as a powerful mediating agency; and (2) an "ethical commitment" to bring environmental communication students and their newly developed "ecological wakefulness" and "communication competencies" into relationship with, and intervention in, broader discourses about environmental issues [45]. It is therefore important that we recognize our students as co-thinkers in the classroom and active environmental "knowledge-negotiators" [46]. Critical communication pedagogy offers a helpful model for bridging the concerns of environmental and epistemic justice with sustainability educators' approaches in the classroom.

Critical communication pedagogy (CCP) names a growing body of scholarship in communication studies that emphasizes critical frameworks for examining teaching and learning. Specifically, CCP affirms the responsibility to explore how each of us participates in social systems that both privilege and marginalize others, and to act on that analysis "toward social justice" [47]. The goal of CCP is to "identify knowledge as a site of privilege/oppression, the uses of communication to perpetuate/reclaim power, and the ability of communicative actions to open spaces for intervening into normative structures of education" [48]. These findings support the authors' suggestion that in order to promote an environmental communication pedagogy invested in collective liberation and multispecies

climate justice, environmental educators must "undiscipline" environmental communication and teach students dynamic, civically engaged literacies beyond the academic. Doing so empowers students to engage more ethically in their communities.

2.3. Environmental and Epistemic Justice

Environmental communication researchers are increasingly attendant to not only the environmental issues that erupt in public consciousness, but also the environmental problems that are invisibilized, ignored, or erased through unequal access to communication spaces and democratic decision-making. From this perspective, it is valuable to explicate the linkages between environmental communication research and the interdisciplinary terrain of environmental justice. While there are differing definitions of environmental justice, it broadly refers to the rights of all people to enjoy equal protection from environmental harm and equal share in environmental benefits and decision-making [7]. Environmental justice describes both a vibrant social movement and a critical framework for understanding the connections between environment, culture, power, and inequality. The modern US environmental justice movement gained momentum in the 1970s in response to the growing recognition that low-income and Black, Indigenous, and people of color communities were bearing a disproportionate burden of environmental harm from close proximity to landfills, polluting industry, and hazardous waste, or as a symptom of ongoing legacies of spatial injustice such as redlining that result in the denial of public resources, such as shade trees and urban heat islands [26,49,50]. Hundreds of studies have documented the ways that people from marginalized communities, including low-income people, communities of color, Indigenous and immigrant populations, LGBTQ+ folks, and disabled people, are impacted by ecologically harmful infrastructures such as mines, landfills, incinerators, and fossil-fueled transportation systems, in addition to experiencing more acutely the impacts of climate change and the pesticide use that is central to industrialized agriculture [24–29,51].

Today, there are many different—and sometimes competing—definitions of environmental justice, as well as related movements such as the Climate Justice and Just Transition movements [7,52,53]. Connecting all environmental justice movements is the recognition that nature and environment do not only comprise the wilderness "out there," but also the places where we "live, work, play, and pray," a frequent term used in EJ discourse. This expansive understanding of the environment encompasses the beautiful (national parks, "pristine" wilderness), the degraded (landfills and brownfield sites), and everywhere in between. Humanities scholars and those in the humanistic social sciences play a key role in interrogating the conditions that produce environmental injustices around the world. Pellow (2016) notes that environmental humanities scholars in particular are increasingly illuminating how gender, sexuality, citizenship, indigeneity, and nation "shape the terrain of ecological inequalities" [27].

Epistemic justice helps to bridge the connection between environmental justice and communication approaches. Epistemic justice as a concept has gained increasing traction across a range of humanistic and social scientific fields. An epistemic injustice occurs when a person is discriminated against in their capacity as a knower based on prejudices related to the individual's race, gender, social or economic background, sexuality, accent, ability, or other marginalized subject position [8,54]. In turn, epistemic justice redresses these forms of knowledge-based discrimination to ensure that all people have the right to make sense of their experiences, and to communicate their knowledge to the broader society in order to affect change.

Epistemic injustice disadvantages an individual both epistemically and practically, particularly in the ways that individuals or marginalized groups may be silenced in democratic decision-making processes [54]. It is inextricable from broader systems of structural inequality, socioeconomic distribution, domination, and inequality [48]. These injustices also enter our classrooms: "unfair and unjust communicative and educational structures have the potential to reproduce and further exacerbate existing socioeconomic inequalities and injustices" [54]. These epistemic injustices occur, for example, when educators privilege the

authority of credentialed, professionalized, and academic experts by assigning only texts and course materials written by these experts, which can serve to marginalize or silence other forms of knowledge and expertise while reifying rigid hierarchies of knowledge. In the environmental or sustainability classroom, this may mean rehearsing scholarship, learning materials, and assignments that ignore the robust knowledges held by EJ communities, such as those living on the frontlines of hazardous waste, industrial pollution, poor air quality, and urban heat islands. In this scenario, credentialed researchers claim significant epistemic advantages while community experts and citizen scientists are epistemically disadvantaged. To deny the environmental knowledges of marginalized communities who are directly impacted by discriminatory environmental policies and practices is to commit an epistemic injustice. By extension, epistemic injustice can also be perpetrated when educators privilege peer-reviewed research and mass-mediated science communication to the exclusion of other genres of environmental knowledge transmission that may be more relevant to EJ communities, such as social media and arts and culture. To ensure that ESS educators do not inadvertently rehearse epistemic injustices, educators must recognize epistemic injustice as a social injustice and teach students to think critically about not only the complexities of environmental inequality but also the politics of environmental knowledge production. Returning to the earlier example of N.K. Jemisin's short story "Cloud Dragon Skies," teachers can discuss with students the ways that the "sky people" in the story, as conventional Western scientists, impose their positivist understanding of the "cloud dragons" as a "simple chemical shift" rather than an agentive force, which is how the local community views them [48]. Doing so not only forecloses the sky people's understanding of the consequences of messing with the "chemical" reaction; importantly, it also undermines and dismisses the villagers' cosmology—a knowledge system that, not coincidentally, promotes respect for atmospheric forces and constitutes a meaningful adaptation strategy in the face of grave climate impacts.

A key component of actualizing epistemic and environmental justice is a shift away from the natural-scientific emphasis on disinterested objectivity, and a movement toward a more robust, comprehensive, and inclusive form of "strong objectivity." "Strong objectivity" requires that the subject of knowledge—the researcher(s)—be understood on the "same critical, causal plane as the object of knowledge," meaning that the researcher can never be truly separate from their object of study [55]. This is because unconscious culture-wide beliefs "function as evidence at every stage in scientific inquiry," from the identification of problems to the formation of hypotheses, research design, data collection, and the interpretation and reporting of data [55]. Halpern (2019) further illuminates the necessity for science communicators to understand the perspective from which they research and share knowledge, and to actively seek insights from marginalized groups in order to disrupt the ways that dominant views of science can reinforce cultural hegemony [56]. Feminist science scholarship, and specifically feminist standpoint theory, emphasizes the *location* of observation and knowledge production, in direct opposition to natural science's traditional "view from nowhere" [57]. Rather than claiming disinterested objectivity, "embracing the multitude of perspectives" is "part of what makes science so powerful" [56]. "By first situating ourselves, and then those with whom we'd like to communicate, we are better able to understand the strengths of our own scientific knowledge, and the place from which it comes. We are also better able to learn from others to understand how scientific knowledge fails them or falls short, and then use that knowledge to help our communication research and practice" [56].

2.4. Communication Pedagogy Practices in the Environmental "Infowhelm"

Many individuals in minority-world countries such as the United States experience environmental "infowhelm" [2]. Research emphasizes the emotional toll of environmental education for students, wherein learning about climate change and other environmental crises may leave them feeling overwhelmed and anxious [58–60]. Many of our students in the ESS classroom are quick to identify the major actors in carbon emissions, such as

multinational corporations and extractive industries, as well as the major systems at play (capitalism, neoliberalism, colonialism), yet they may also experience feelings of powerlessness, especially when confronted with "damage-centered" approaches to environmental education that center the environmental harms experienced by the world's most vulnerable and marginalized communities, without also discussing these communities' activism and resistance [61,62].

Cairns (2021) discusses the necessity of guiding students in confronting the violent systems that harm and degrade people and environments *without* reinscribing this damage [62]. Exploring the tendency of environmental education to reproduce senses of overwhelm and trauma for students, Cairns (2021) theorizes two pedagogical approaches to student empowerment. Pedagogies of immediacy "mobilize feelings of personal accomplishment through immediate action in the local environment"; while pedagogies of excavation "interrogate the historical and structural underpinnings of environmental injustices and channel associated affects into collective visions for more just futures" [62]. Concluding that pedagogies of excavation promote a more sustained impact for students and longer-lasting change in their communities, Cairns (2021) notes that pedagogies of immediacy promote "speedy" remedies for historic problems, but can inadvertently reinscribe the belief that the solution to these problems is individual action and its accompanying "good feeling" [62]. By contrast, pedagogies of excavation offer a valuable alternative: "excavating systemic injustices and channeling associated feelings into collective action. Central to this transformative approach is a historical perspective on the racist policies and exploitative practices that have produced contemporary conditions, as well as a collective orientation toward building more just futures" [62]. Interestingly, pedagogies of immediacy are most often associated with programming involving white leadership and mainstream institutions, whereas pedagogies of excavation are "practiced in grassroots organizations led by people of color with strong links to social movements" [62]. This suggests that while ESS programs often emphasize community engagement that promises the satisfaction of immediate action, grassroots organizations led by people from marginalized communities in fact emphasize *slow* environmental justice pedagogies that excavate historic and systemic injustices in order to enact long-term change. This underscores the importance on the part of environmental educators of recognizing how deep and sustained discussions of historical injustices serve as meaningful, active, and empowering steps toward environmental justice.

3. Discussion

3.1. Undisciplined Environmental Communication Pedagogy in Action

In order to discuss real-world applications of the pedagogical frameworks elaborated in this article, the authors present two sample assignments for sustainability educators to incorporate into the interdisciplinary college classroom. These assignments are designed to critically analyze questions of epistemic injustice and environmental inequality and chart pathways toward justice. The two assignments below can be used in the ESS classroom to promote critical thinking about the politics of environmental knowledge production and cultivate beyond-academic (undisciplined) literacies for college students. The class projects detailed in the subsequent sections have been previously incorporated into one or both of the following upper-level courses in our institution's Department of Environmental Science and Sustainability curriculum between Spring 2021 and Spring 2022: Environmental Justice, and Culture, Power, Environment. Each assignment was developed by the first author with the intention of cultivating students' facility across an inclusive range of environmental communication approaches that move beyond traditional science communication genres (academic articles; grey literature; reports, issue briefs) and toward more dynamic and culturally competent modes of communication, including social and participatory media.

3.2. Using Wikipedia to Build an Inclusive Environmental Knowledge Archive

Social media has soared in popularity over the past few decades. It has also motivated many researchers to make use of social media tools and technologies in both their research

and teaching [63–66]. In contrast to the one-way transmission of legacy media venues (journal articles, academic books, magazines, newspapers, documentaries), social and participatory media emphasize collaboration, participation, and knowledge-sharing [67]. Over the past decade, for example, Wikipedia—a web-based social knowledge-sharing platform—has become an increasingly influential presence in the landscape of higher education [68–71]. In their study of a university in Liverpool, UK, Knight & Pryke (2012) found that 75% of academics and students use Wikipedia regularly, particularly in the early stages of research, yet only about 25% of faculty provide explicit guidance on how to use Wikipedia effectively and discerningly [68]. They found that although Wikipedia is a ubiquitous presence, it is not "the" dominant information source and is not supplanting other venues of research [68]. Chu et al. (2017) found that students across disciplines generally hold positive attitudes toward the use of wikis for project-based learning in higher education [67]. At the same time, many college students are familiar with the notorious imperative from professors not to "cite" Wikipedia in their research, with many professors outright forbidding the use of the online resource, based on the assumption that it lacks credibility and may undermine the rigor of student writing [65]. Indeed, Wikipedia's role in education has been controversial as a teaching and learning resource since its founding in 2001. Yet, increasingly, research has shown Wikipedia to be a "vital part of the undergraduate and graduate curricula" [71].

Wikipedia is the most well-known wiki, which names any free web-based resource that can be edited by multiple anonymous users. Wikipedia is a multilingual and free online encyclopedia developed and maintained by a community of volunteers who contribute and edit entries as well as review content. It is an open-collaboration system involving individual contributors or "Wikipedians." With over 6 million English-language articles, Wikipedia remains one of the largest and most referenced encyclopedias in history. It is also a valuable resource for participating in, and thinking critically about, the democratization of knowledge. Davidson & Goldberg (2009) explain that "to ban sources such as Wikipedia is to miss the importance of a collaborative, knowledge-making impulse in humans who are willing to contribute, correct, and collect information without remuneration: by definition, this is education" [72]. STEM fields in particular have been quick to recognize the value of Wikipedia and its contributions to knowledge production [71]. For example, Haslam (2017) notes that some scholarly journals stipulate that accepted contributors should submit a corresponding Wikipedia article summarizing their work. This and similar efforts reflect a shared goal of "contributing to and improving Wikipedia as a global educational resource" [71]. The educational and curricular value of Wikipedia extends across all disciplines and plays a crucial role in preparing students to become more rigorous writers, scholars, and critical communicators [71].

Research on Wikipedia as a critical pedagogical tool emphasizes its potential for disrupting exclusionary epistemologies. For example, Bjork-James (2022) connects Wikipedians' recent critiques of systemic bias in the online encyclopedia to efforts in "Western/Northern academia to decolonize and diversify scholarship" [73]. A key strategy for countering systemic bias in knowledge production, which inevitably appears in Wikipedia as in other knowledge archives, is "the application of scholarly understandings of systemic bias to systematically review, and eventually improve, Wikipedia articles" (p. 17). Additional research emphasizes the decolonial and egalitarian implications of Wikipedia in the context of knowledge production [74–76]. Certainly, Wikipedia is neither a peer-reviewed journal nor a print encyclopedia published by an established trade or university press. At the same time, it is important for students to think critically about the politics of environmental knowledge production and to recognize that "credibility" is not a static, objective quality [56,57]. Rather, it is a rhetorical and epistemic situation dependent on context and audience. While it is vital to ensure that students understand the import of the peer-review process and its pivotal role in promoting accuracy, rigor, and timeliness of research, too often the directive not to cite Wikipedia assumes the neutrality, objectivity, and equality of academic researchers and their foci. In other words, this dictum assumes that any

topic students are interested in—any topic worthy of research—is already the subject of peer-reviewed scholarship available and accessible for students to consult. However, when we recognize the colonial legacies of academic research that exclude, devalue, and often ignore the environmental concerns of marginalized communities, the casual dismissal of Wikipedia and other knowledge venues in the public sphere constitutes a form of epistemic injustice [19,77]. At worst, the resistance to Wikipedia in the college curricula seems to reflect problematic and anti-democratic assumptions that equate open-access and public collaboration with an absence of rigor.

Courses on environmental justice and related topics are generally premised on the recognition that environmental knowledge should be liberatory and widely accessible, not cloistered or out-of-reach. For this reason, the first author developed a classroom project that requires students to engage with the public record through Wikipedia. Haslam (2017) notes that in general, many student writers lapse into opinionating or over-reliance on one familiar source; in both cases, student writers often "affirm the status quo bias of their respective social positions, and generally reinforce what they already think they know or are comfortable with" [71]. Precisely because of Wikipedia's explicit editorial stance as an encyclopedia requiring a "neutral point of view" and engagement with multiple perspectives, students who produce Wikipedia-based writing assignments must move beyond these familiar intellectual habits and "into a more cognitively challenging effort" at neutrality [71]. Following is the prompt for an assignment developed by the first author, titled *Wikipedia Project: Expanding the Environmental Record*:

Your end-of-term assignment requires you to engage with the public environmental record and speak to a broad audience about an environmental issue of your choosing that disproportionately impacts a specific marginalized community (BIPOC individuals, low-income folks, LGBTQ+ people, folks with disabilities, immigrants, religious minorities, Global South populations, etc.). After selecting a relevant issue in consultation with your instructor and peers, you will decide on a corresponding Wikipedia entry to edit and expand. The entry you choose may be about a specific place, event, ongoing injustice, or activist movement, and your contribution should reflect the values, words, perspectives, and histories of the marginalized communities directly impacted by the issue. This project will require each of you to conduct research on a particular environmental justice topic and to mobilize that research toward a more inclusive public archive.

Depending on how the assignment fits into the syllabus and course schedule, instructors may require students to contribute anywhere from 500 to 2000 words to an existing Wikipedia article. Instructors can begin by devoting a portion of class time to a demonstration of how to edit a Wikipedia page, including Wikipedia's specific guidelines for citing sources and linking to corresponding articles, which are easily and freely accessible through the Wikipedia website. In this way, the Wikipedia assignment simultaneously cultivates critical thinking about the politics of environmental knowledge production and communication, while also promoting fluency and familiarity with a range of different citation practices in and beyond academia. The first author notes that via anonymous course feedback, students have repeatedly shared that this public-facing project felt like it had higher stakes and relevance to their lives because its audience was the public, rather than just their instructor.

3.3. "Another World Is Possible": A Collaborative Ecotopian Podcast

For this scaffolded group project, students work in teams of four to research and produce a 15–20-min. podcast about a topic of their choosing related to environmental futurity. The goal of the project is for students to work collaboratively to cultivate their critical, imaginative, analytical, and storytelling skills. Inspired by the collection *An Ecotopian Lexicon* edited by Schneider-Mayerson & Bellamy (2019), the project is animated by the premise that language mediates the ways we understand reality and what's possible (or impossible) [78]. Student groups are tasked with creating, theorizing, and contextualizing their own "ecotopian" word or phrase to guide the broader public in conceptualizing a more

just and sustainable environmental future. Groups are given the following instructions, developed by the first author:

Introduce your word, give an example of it in a sentence, and explain the context surrounding the need for this new word: What are the problems it seeks to address? How can this word help us understand possible solutions to an environmental problem? What kind of world does this word help bring into being? To answer these questions, your collaborative podcast will require interdisciplinary research that will take you through the sciences, the arts, and the humanities. To this end, the sources you cite in your podcast must span at least five different disciplines and knowledge traditions; include references to at least two grassroots environmental movements responding to the environmental topic you identify; and it must incorporate at least one popular culture source (a song, film, novel, documentary, comic book, poem, artwork) and one relevant social media thread (Twitter, TikTok, Instagram, Facebook, YouTube, etc.).

As a scaffolded assignment, the *Another World is Possible* podcast project includes a group proposal and annotated bibliography; an individual blog post from each group member in which they reflect on using their group's ecotopian word at least once per day for a week; a script for peer review; a finished 15–20-min podcast published via http://Anchor.fm, and an individual de-brief where students reflect on the collaborative process. In addition to engaging with and producing new critical environmental research for the public, the illustrative public-facing assignments outlined in this section embody the principles and practices of an undisciplined environmental communication pedagogy that centers issues of environmental and epistemic justice.

4. Conclusions

Understanding the media landscape that college students inhabit today is key to educating the nuanced and multiliterate environmental communicators of the future. Young people born between the early 1990s and the 2000s, often referred to as Generation Z or the "climate generation," are the first to have spent their entire lives alongside the unfolding global climate crisis and the explosion of the World Wide Web [9,79]. There are several characteristics of the climate generation, including: a strong awareness of the links between environmental issues and social justice; an acute sense of financial insecurity; simultaneous technological connectivity and high rates of depression and anxiety; and increasing cynicism toward the political status quo and the compounding disparities between the rich and poor [9]. At the same time, it is this generation who is most poised to make meaningful change. Importantly, the climate generation's "environmental politics are also eminently *cultural*," embodying a recognition that "culture and society, not just science and technology" are vital arenas for addressing environmental problems [9]. These characteristics underscore the value of environmental communication pedagogies that promote critical thinking about culture, society, and inequality alongside the ability to engage in conversations about science and technology with a range of publics.

Given college students' awareness of the entanglements of social and environmental systems and their increasing sense of political powerlessness, it is essential for ESS educators to develop strategies that help students cultivate more just and sustainable visions for their future, as well as the communication skills to engage in meaningful dialogue with broader communities and networks. How can we, as educators, teach students diverse and inclusive communication methods that embrace a range of knowledges, subject positions, and media, while paying particular attention to communities that have historically been excluded from environmental decision-making and democratic spaces? At the same time, how can educators promote responsible, research-based communication on the part of students? This latter question gestures toward the potential limitations of an "undisciplined" environmental communication pedagogy. For example, educators and students might wonder what to do if scientific consensus is misaligned with the perspectives and experiences of marginalized communities: whose perspective should be privileged in this case? While this is certainly a legitimate concern—particularly given our current landscape

of online misinformation—a potential answer to this question can be found in the annals of environmental justice research. Anthropologist Melissa Checker has found that in the case of a predominantly low-income African American community in Augusta, GA who experienced unusually high rates of disease and disability attributed to nearby hazardous waste, standardized data collection methods and findings, including those implemented by the Environmental Protection Agency and the Agency for Toxic Disease Registry, failed to account for the environmental hazards that were subsequently uncovered by citizen scientists in the economically and socially marginalized community [80]. Checker found that the limitations of environmental science research on risk assessment, which include an over-reliance on lab vs. real-world findings; neglect of multiple exposures impacting a socially marginalized community; and implicit researcher bias, further exacerbate the dismissal of marginalized communities' environmental concerns [80]. This illustrative example underscores the necessity of humility in the research process and the meaningful collaboration of credentialed researchers with local, frontline experts. It also suggests the importance of understanding how social identities, politics, and historical injustices converge to produce inequality of experience and epistemic injustice. From this perspective, the critical scavenging method the authors introduce can be incorporated to promote a wider breadth of perspectives on environmental issues while also encouraging critical thinking about a core concern of epistemic justice: whose knowledge matters?

The "undisciplined" environmental communication pedagogy described in this article encourage ESS educators to promote critical thinking about the politics of environmental knowledge production and communication, a pivotal step toward empowering students to recognize that "another world is possible." This research contributes to emerging scholarship on decolonial knowledge production, critical media pedagogy, and environmental communication by analyzing both the source and venues of extant environmental research and their locations within complex social, political, and cultural fields. Future research would explore students' qualitative experiences producing "undisciplined" environmental research for the public sphere, while also conducting additional research on the relationship between climate misinformation and the disparities between media literacy strategies taught in the classroom and those practiced by the general public.

Undisciplining environmental communication pedagogy to incorporate and center perspectives, media, and modes of storytelling beyond the narrow strictures of academic research can equip students with the tools and strategies to work toward the environmentally and socially just futures they desire and deserve.

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