David J. Brier

Making the Invisible Visible

Teaching Students About the Hidden Environmental Costs of Digital Activities

The environmental impact of digital consumption remains largely invisible to students. While universities increasingly promote artificial intelligence (AI) and digital expansion, few students are encouraged to consider the environmental costs of these technologies. Drawing from my experience incorporating ecological lessons into library instruction sessions at the University of Hawai'i at Mānoa (UHM), this article explores how information literacy sessions can highlight the resource use of online behaviors. Through interactive exercises and discussions, students understand how their digital habits contribute to global environmental challenges and learn sustainable digital practices.

Institutional Context: Sustainability at UHM and the Rise of AI Initiatives

UHM integrates a distinct cultural commitment to *aloha 'āina*—the Hawaiian principle of love and care for the land—into its mission.[1] This value emphasizes environmental stewardship, sustainability, and responsible resource use, all deeply embedded in Hawaiian culture and education. Raising awareness about resource considerations encourages students to engage in more sustainable digital practices.

UHM's Institutional Learning Objectives (ILOs) reinforce this commitment by identifying "Stewardship of the Natural Environment" as a core component of students' personal and social responsibility. Sustainability education is embedded in the university's vision for all graduates, ensuring they recognize their *kuleana* (responsibility) in caring for the environment.[2]

Simultaneously, the university is positioning itself as a leader in AI development under the direction of President Wendy Hensel.[3] With proposed legislation to establish the Aloha Intelligence Institute,[4] UH is taking significant steps to drive AI innovation across the state. As the university advances AI initiatives, it must also raise awareness of AI's environmental impact. Preparing students to engage with AI responsibly aligns with UHM's sustainability goals and mission.

The Hidden Environmental Costs of Digital Activity

Though the internet seems intangible, its infrastructure relies on data centers that consume vast amounts of electricity—often from fossil fuels—as well as water for cooling. This leads

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to carbon emissions and particulate pollution, impacting both climate and health.[5] Green Information Literacy teaches students how their digital behaviors, from streaming to AI searches, contribute to this footprint, motivating more sustainable information practices.

Numerous librarians argue that library instruction should incorporate green practices and sustainable thinking, including the demonstration of factual figures on the environmental impacts of information behaviors.[6] Green Information Literacy emphasizes teaching users about the environmental impact of digital information use, including its life cycle from production to disposal. Academic libraries can play a key role in educating students on how information behavior contributes to carbon footprints and what sustainable digital practices look like, increasing user awareness and motivating responsible information-seeking activities.

Hands-On Learning Activities

I incorporate ecological lessons into library instruction sessions varying in length from 50 to 120 minutes, spanning both undergraduate and graduate courses. The majority of these sessions are conducted in person, but aspects of these exercises can also be woven into online sessions via Zoom. While the primary focus of these sessions remains on searching and evaluation skills, these ancillary ecological lessons offer students a broader understanding of the hidden environmental consequences of their digital consumption. To make abstract environmental consequences more tangible, I incorporate a variety of interactive exercises into these lessons:

- Ecological Impact Drawings: Students visually depict the concept of the "cloud" and the physical resources required to support their online activities.
- Water Usage: Different amounts of water are poured to represent digital activities' varying water demands.
- Carbon Emissions: M&Ms are used to visualize how different online behaviors contribute to greenhouse gas emissions.
- Particulate Pollution: Various amounts of black pepper are dispersed in water to illustrate pollution from electricity generation.
- Data Center Noise: Recordings of actual data center noise are played at various decibel levels to give students a tangible sense of the sound intensity.
- Eco-Friendly Search Engines: Students explore search engines like Ecosia and OceanHero, comparing their environmental impacts to mainstream engines.
- Mineral Extraction Mapping: Students analyze global maps to connect digital devices with resource extraction and its environmental impact.

Due to time constraints, I typically conduct one or two exercises during these sessions, though a longer 120-minute session allows for more in-depth exploration. In these extended sessions, we can engage in multiple activities such as drawing the internet "cloud," mapping the digital device life cycle, and exploring the resource consumption of various online activities. However, even in a 50-minute session, I strive to incorporate practical elements, such as introducing eco-friendly search engines or using prefilled water containers to visually demonstrate the water used in a single search. These brief interventions effectively highlight the tangible impact of digital consumption, ensuring that students grasp key concepts regardless of the session's duration. I customize the exercises to fit the specific class context; for instance, in geography classes, we explore data center maps to assess their proximity to

water resources or analyze mineral extraction maps to evaluate whether the communities supplying these resources also benefit from the digital devices they help create.

Student Reactions and Learning Outcomes

The drawing exercises often reveal students' misconceptions about the physical nature of the internet cloud and their lack of awareness regarding the ecological footprint of digital consumption.[7] By visualizing these concepts, students confront the tangible infrastructure behind online services and begin to grasp the environmental implications of their digital activities.

During and after these sessions, students often express surprise at discovering the environmental impact of their digital habits. Many are astounded by the resource demands of everyday activities, with one student remarking, "I never thought about how much energy streaming a video takes—it's wild to think my Netflix habits actually contribute to electricity demand." The water usage of data centers is equally surprising, as a student notes, "I was shocked to learn that my Google searches use water and that cooling data centers uses billions of gallons of water. I thought only agriculture and factories had that kind of impact." Another adds, "Even more shocking is the difference in electricity and water needed for an AI search versus a standard Google search."

The carbon footprint of internet use prompts reflection, with one participant stating, "Hearing how much CO_2 is released from internet use makes me think twice about keeping unnecessary tabs open all the time." Students also realize there are less obvious consequences, such as particulate and noise pollution. "I had no idea that using the internet could actually contribute to air pollution," one student admits, while another adds, "I never considered that data centers make so much noise that they impact nearby communities. It's a hidden cost of the internet." The issue of electronic waste resonates strongly, with one student confessing, "I feel guilty about how often I upgrade my devices. I'll definitely look into recycling options for my old electronics."

These revelations often lead to behavioral shifts, as exemplified by a student who declares, "I didn't realize there were search engines like Ecosia that plant trees with ad revenue. I'm switching to that from now on!"

Faculty members were equally unprepared for this, with one professor admitting, "I've been assigning students to use ChatGPT without once considering the environmental implications. I need to rethink this." Some instructors expressed alarm at learning about data centers' responsibility for greenhouse gas emissions and their significant water consumption for cooling systems, especially in water-scarce regions. Another instructor was struck by the impact of e-waste and the resource extraction for everyday gadgets like chargers and earbuds.

Several students expressed guilt about the resources they used. To emphasize that the goal of this lesson is awareness rather than guilt, I remind students that small behavioral changes can collectively reduce digital pollution. At the same time, I encourage them to think beyond individual choices and consider the broader political and economic systems that drive these hidden environmental impacts. While some expressed frustration about the limited influence of personal actions, others take practical steps such as downloading videos instead of streaming, adjusting cloud storage settings to reduce unnecessary backups, deleting unnecessary emails and digital photos, choosing eco-friendly search engines, and opting for energy-efficient devices.

Conclusion

I have found that most students have never been encouraged to think about the ecological impacts of their digital consumption. These green information literacy lessons are eye-opening for both faculty and students, as the internet and digital devices seem so clean and detached from environmental concerns. Many do not associate their technologies and digital consumption choices with resource extraction, pollution, and social consequences in distant regions.

As UHM and other universities prioritize AI use, and as our vendors increasingly integrate AI into their products, librarians have a unique responsibility—even if just for a few minutes—to raise students' awareness of these issues. Such education not only aligns with institutional sustainability initiatives but also supports the broader goals of the Association of Research Libraries' partnership with the Sustainable Libraries Initiative.

The ACRL Framework for Information Literacy currently overlooks the ecological impacts of information consumption. Introducing a new green information literacy threshold concept can help students recognize the environmental footprint of their digital activities—an aspect often taken for granted. This addition would encourage students to make connections between their online behavior and its broader ecological consequences, empowering them to make more informed, responsible choices and contribute to a sustainable future.

Notes

1. University of Hawai'i at Mānoa, *Mānoa 2025: Our Kuleana to Hawai'i and the World-Strategic Plan 2015-2025,* accessed February 20, 2025, https://manoa.hawaii.edu/strategicplan/.

2. University of Hawai'i at Mānoa, *Institutional Learning Objectives (ILOs),* accessed February 20, 2025, https://manoa.hawaii.edu/ovpae/institutional-learning-objectives/_undergrad_ilo/.

3. University of Hawai'i, "A New Era of Leadership: UH's New President Wendy Hensel," *UH News*, December 26, 2024, https://www.hawaii.edu/news/2024/12/26/a-new-era-of-leadership/.

4. Hawai'i State Legislature, *Senate Bill 1622, Relating to Artificial Intelligence,* introduced January 2025, accessed February 20, 2025, https://www.capitol.hawaii.gov/sessions/session2025/bills/SB1622_.HTM.

5. For examples of pieces on the ecological impacts of the digital activities see Steven Gonzalez Monserrate, "The Staggering Ecological Impacts of Computation and the Cloud," *The Reader* (MIT Press), accessed February 20, 2025, https://thereader.mitpress.mit.edu/the-staggering-ecological-impacts-of-computation-and-the-cloud/ and Robert Istrate, Victor Tulus, Robert N. Grass, Laurent Vanbever, Wendelin J. Stark, and Gonzalo Guillén-Gosálbez, "The Environmental Sustainability of Digital Content Consumption," *Nature Communications* 15 (May 2, 2024): 3724, https://doi.org/10.1038/s41467-024-47621-w.

6. For examples of pieces contending that library instruction should incorporate green practices and sustainable thinking see Şehnaz Kurbanoğlu and Joumana Boustany, *From Green Libraries to Green Information Literacy* (Springer, 2014) and Megan R. Stark, "Information in Place: Integrating Sustainability into Information Literacy Instruction," *Electronic Green Journal* 1, no. 32 (2011).

7. For examples of pieces on using drawing in library instruction sessions, see David James Brier and Vickery Kaye Lebbin, "Learning Information Literacy through Drawing," *Reference Services Review* 43, no. 1 (2015): 45-67 and David J. Brier and Vickery K. Lebbin, "Using Drawing and Short Stories to Teach Information Literacy," *School Library Journal* (March 25, 2019), https://www.slj.com/story/using-drawing-and-short-stories-to-teach-information-literacy and David J. Brier and Vickery Kaye Lebbin, "Engaging the ACRL Framework Through Short Stories and Drawing," *LOEX Conference Proceedings* 2017. 34, (2022), https://commons.emich.edu/loexconf2017/34.