Plastic Pollution: Answers and Obfuscation in Education

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Jack Chandler

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Signed: _____

Approved: _____ Date _____
Peter Norton, Department of Engineering and Society

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"Every piece of plastic we have ever touched is still on Earth" (Kantai, 2020). The United States is the world leader in overconsumption; Americans account for 5 percent of the world's population but 33 percent of global plastics consumption (Abukhalaf, 2021). In the US, only 9 percent of plastic is recycled; 79 percent goes to landfills (Morath, 2019). Recycling reduces waste, but it does not reduce the oil consumption or greenhouse gas emissions attributable to plastics manufacturing (Hopewell et al., 2009). In response, interest groups, regulators, advocacies, and consumers compete on a global level to promote the plastics policies and practices that they favor. Some groups demand cultural change to transform plastic consumption and waste patterns, for example through programs, incentives, or educational campaigns to normalize reuse and recycling or minimize use. Other interest groups, however, resist change, or use recycling initiatives to divert efforts to reduce excessive and wasteful consumption. Sustainable development is a shared theme among groups. The plastics industry, including the International Petroleum Industry Environmental Conservation Association (IPIECA) and ExxonMobil, has long obscured the global impact of plastics production and waste. Its strategy has evolved. The industry no longer denies plastic's threats to climate stability and ecosystems. Instead, it sidesteps demands to reduce plastic consumption by promoting recycling, thereby diverting responsibility to consumers. Environmental advocacies such as the Plastic Free Foundation (PFF) fight back by promoting reductions in consumption through educational campaigns.

Review of Research

Sustainability efforts can be controversial. Brulle (2022) argues that shared perspectives sustain social order. Since the 1990s, however, responses in the US to climate change have been

politically divisive. The polarization is due in part to deliberate efforts to discredit the consensus climate research findings. A climate change countermovement emerged in 1989. To protect their business interests, a loose coalition of industries, which Brulle calls the "denial machine," sowed doubt about climate change to obstruct policy responses to it. IPIECA, headed by Exxon, carried out international efforts to undermine climate science. The Global Climate Council used four strategies to undermine international climate efforts: undermining climate science, publicizing a high cost of climate action, campaigning for public opposition to emission reductions, and lobbying political figures (Brulle, 2022).

The ubiquity of plastic obscures the responsibility of the oil industry. Boetzkes (2016) argues that plastics are a demonstration of oil capital and oil culture. Responsibility for plastic waste is ambiguous. The prevalence of plastic waste in art demonstrates this as a global ecological condition (Boetzkes, 2016). Kantai (2020) agrees that a large part of the problem of plastic waste continues to be obscured. They claim that a shift in responsibility from virgin plastic producers to users is a public relations tactic driven by the plastics industry**.** Kantai refutes the argument that recycling is limited and impractically expensive by recalling the 3R slogan: reduce, reuse, and recycle. These are components of the UN Sustainable Development Goals (SDGs). These include responsible consumption and production patterns, specifically by reducing waste generation through prevention, reduction, recycling, and reuse (United Nations, n.d.). It may be more productive to redefine plastic consumption to require longevity and malleability. The use of waste plastic as an ingredient in road construction is an example (Kantai, 2020).

Current plastic usage is not sustainable. This is evidenced by the quantity of end-of-life plastic accumulating in landfills and the natural environment. Hopewell makes a connection to

industrial ecology, where a natural ecosystem recycles all wastes. Recycling resembles this reuse in the repurposing of waste plastics. The Ellen MacArthur Foundation (EMF) is a charity dedicated to creating circular economies. The circular economy is a framework for eliminating waste and pollution, circulating products, and restoring natural environments (EMF, n.d.). Recycling does not meet this standard because additional material input is required in recycling processes. A system requires less material input with increased recycling, reduction of use, and reuse (Hopewell et al., 2009). Viscusi articulates household behavior determinants: private values, income, education, and residential location. These impact individual action through commitment and access to recycling and plastic alternatives. In an economic analysis of recycling behavior and policy, five principles are identified:

Economic incentives are important. Recycling participation increases when the costs of time and convenience are diminished.

Incentive efficacy varies within populations. As an example, higher-income groups have more environmental motivation but are less affected by economic incentives.

Recycling policies produce incremental benefits and costs. Additional policy benefits are not significantly offset by substitution effects.

Warm glow benefits are self-motivated incentives for recycling. Environmentalist behavior inherently recycles but is less significantly improved by incentives.

Behavior is transformed by the introduction of incentives. A significant increase in recycling comes from the shift from non-recycling to diligent recycling.

These ideas may apply to all aspects of plastic management. Incentives for plastic alternatives, efficacy in the ability to reduce plastic waste pollution, and motivation to participate in reduction and consumption all drive plastic waste management improvements. Spivery notes that plastic

bags are among the 12 most common items found in coastal cleanups. To the U.S. Environmental Protection Agency (EPA), however, plastic bag waste is not an urgent issue (Spivey, 2003). There is high demand for recycled bags. A manager of the American Plastics Council explains that recycled resin demand is greater than its availability. The president of WeisCo Recycling in California agrees that there is a large market for clean recycled bags. Nevertheless, plastic bags account for a large share of the waste collected in coastal cleanup projects (Spivey, 2003).

Obfuscation

Interest groups influence public perceptions through misinformation and secrecy. IPIECA and the Global Climate Council are credited with undermining climate science by disputing scientific evidence and the credibility of the scientists. ExxonMobil has a notorious history of engaging in efforts to undermine climate research findings (Brulle, 2022). Early research indicating climate impact was concealed; later, the company spread climate misinformation (Finneran, 2015). As an oil and gas corporation, ExxonMobil is engrained in the plastics business. It now argues that "plastics help provide for the safe production, distribution, and preservation of food and water" (ExxonMobil, 2021). Such selective publicity diverts attention from threats that must be met. Propaganda of this kind imparts an information gap: the public does not have the information it needs. This effect is compounded by a complexity gap: even if the public had easy access to all the information it needed, its scope and complexity would preclude an optimal response to the information.

The Plastics Industry Association is a trade association representing the plastics industry. It claims that the industry “encourages policy that promotes a responsible, circular economy,”

but notably designed the resin identification code imprinted on plastic objects to help consumers sort them for recycling (PIA, 2022). This code was revised by ASTM International in 2013 to reduce confusion (ASTM International, 2013). Because the PIA code resembled an older symbol signifying recyclability, it misled consumers into thinking that any product bearing the code would be recycled. In fact, many plastics bearing the code could not be cost-effectively recycled.

Together, propaganda and complexity prevent optimal responses to plastic waste. Plastic types that cannot be cost-effectively recycled, such as those coded 3 through 7, are sometimes misrepresented as plastics that are unrecyclable. For example, in its advice to consumers, Miller Recycling claims that such plastics cannot be recycled. Yet a client that is willing to subsidize recycling costs can ensure that purportedly unrecyclable plastics are recycled. The University of Virginia claims it has a contractual arrangement with a recycler to recycle all of its plastic waste, regardless of type (University of Virginia, n.d.). National Geographic maintains a similar claim that plastic bags are not recyclable (National Geographic, 2018). Yet National Geographic recognizes the distinction between theoretical recyclability and cost-effective recyclability. Without public subsidies, private recycling enterprises will not recycle plastics unless the market for the recycled material is sufficient to cover their costs. This may explain the lack of plastic bag recycling. In the US, single-use plastic bags remain common; few are ever recycled despite high demand for recycled bags (Spivey, 2003).

Education

British Petroleum (BP) is an energy company with a history in plastic production. The BP Sustainability Report 2022 highlights the closed cycle economy idea by EMF (BP, 2022).

Circularity is explicitly listed as a company goal that entails the intention of implementing waste metrics and a circularity framework. The targets of the goal are lacking in depth and specificity:

- Enhance waste stream measurement and reporting
- Create a circularity methodology
- Set additional targets by the end of 2023

BP has shown effort towards circularity. BP Infinia is a technology to process unrecycled PET plastic waste (BP, 2019). BP allocated $25 million for a pilot plant to test the technology. The project has yet to report success, but it does demonstrate effort. Obfuscation still plays a role in the perception of company projects. While media coverage publicized the inception of the project, the status is not transparent. The future of the project and the technology are not known, and therefore cannot be acted upon by others. Shell makes a similar commitment to circularity in their Respecting Nature Goals (Shell, 2022). Shell is an energy and petrochemical group committed to "reducing waste generated and increasing reuse and recycling in our businesses and supply chains." This statement suggests Shell aims for zero waste internally, but does not imply their responsibility to reduce the end-of-life waste from their products. Shell may have made meaningful contributions, such as founding the Alliance to End Plastic Waste and developing pyrolysis oil technology (Shell Global, n.d.), but similar to BP, efforts are not openly relayed. This may be a failure to provide meaningful education. Shell's target of zero waste is defined by the Zero Waste International Alliance (ZWIA). ZWIA makes the effort to provide outreach with descriptive standards. ZWIA references videos, articles, and books explaining the problem of waste and exploring the greenwashing of recycling (ZWIA, 2022). Promoting awareness and addressing the complex systems at play produces active contribution towards reducing plastic pollution.

People who hold values associated with sustainable living are more likely to recycle and limit consumption. Formal education may introduce the implications of plastic use and recycling. Waste Management (WM), the largest trash and recycling company in the United States (Tiseo, 2022), collects and processes plastic waste. It publishes educational materials on waste management for schools, businesses, and municipalities (WM, 2020), such as elementary school curricula and business brochures. WM provides the means to recycle and explains how to use them. Its school materials promote recycling at a grassroots level. They encourage their education with the claim that "research proves there is a direct link between knowledge and active involvement." A critical note here is that the correct knowledge must be provided for appropriate action. In the Recycle Right curricula spanning elementary school to 5th grade, WM aims to "positively impact our environment, particularly the preservation of our natural resources by recycling." The material introduces waste management streams, including recycling and landfill architecture. In some resources, WM includes activities pertaining to the slogan Reduce, Reuse, Recycle, and Rethink. The material presented provides an appropriate description of the waste management industry. It contains recycling rules to ensure proper recycling, but only mentions source reduction in its conclusion. The curricula tackle the problem of low recycling rates, but do not inherently encourage moderation of consumption. It risks teaching recycling and landfills as long-term sustainable solutions. Even if this is outside the purview of WM, the knowledge provided may not paint an accurate picture of long-term sustainability for future generations.

The Nevada Division of Environmental Protection (NDEP) claims its mission is to "preserve and enhance the environment of the state" (Sustainable Nevada, n.d.). NDEP publishes abundant educational material on recycling and sustainability. Lessons span all school grade

levels. Topics include similar material to WM in recycling and landfills, but also target reduction and reuse. An example of this comes from packaging. Lesson plans instruct the educator to "discuss with students the negative consequences of packaging." Similarly, another lesson tackles the concept of "material reuse and resource conservation." Integrating these lessons involves the student in the entire scope of product management. Whereas recycling and landfill education inform about end-of-life products, education and practice in reduction and reuse expand this sphere to consumption, including material selection and product durability. Sustainable Nevada also offers scholarships. Student scholarships and classroom grants are distributed to applicants demonstrating positive environmental sustainability programs. These incentives take education a step further and encourage action by the students.

The EPA ranks methods of waste management in their activities and teaching resources published for kindergarten through 8th grades. Their preferred method is source reduction (EPA, 2005). This is defined as "designing, manufacturing, purchasing, or using materials in ways that reduce the amount or toxicity of waste". This definition places responsibility across the lifespan of products, including plastics that contribute to pollution. Participation under this model relies on the conduct of the industry and the customers. The EPA provides examples of reductions in both facets. McDonald's reduced napkin size, which increased the quantity of napkins produced with the same material input. This was an action taken by the vendor that improved the waste production of their patrons. One example for consumers is bringing a reusable bag when shopping. Both examples reduce waste generation, but occur in different parts of the product streams. In one lesson, students research and produce their own public service announcement. This assignment challenges the student to conduct their own analysis of the information they see

regarding plastic consumption and pollution. The content included by the EPA addresses a range of waste management strategies and trains independent thinking to teach sustainable behavior.

Just as marketing can train children to be consumers, other kinds of publicity can promote recycling and alternatives to single-use plastics among children (Chan & McNeal, 2004). Targeted marketing takes advantage of the malleability of children's beliefs to encourage a specific action or idea. Schools can cultivate environmental values in children, which then promote environmentally friendly practices that may last for generations. Awareness campaigns such as youth education sometimes fail. Project D.A.R.E., an educational program intended to reduce illicit drug use among students, was largely ineffective (West & O'Neal, 2004). DARE demonstrates that educational efforts in schools to change behavior among children and adolescents can fail. Yet, relative to educational efforts to promote environmentally sustainable practices, DARE was at a disadvantage. DARE was a substantially negative effort to deter recreational drug use. While sustainability education also promotes behavior change, it is essentially positive. This difference may make sustainability education more likely to succeed (Michael, 2005).

Engagement

Informal and nonformal education streams are factors in the realization of plastic waste management (La Belle, 1982). Additional streams of education that need to be considered may include social observation, pervasive misinformation, and behavioral incentives. This may be utilized for the propagation of any ideal. Campaigns That Work analyzes behavior change, psychology, and environmental issues (Moss, n.d.). They report several strategies in current campaigns. The listed mistakes include stopping at awareness and reinforcing bad practices.

Strategies with pitfalls include altruism and incentives. Effective campaigns demonstrate impact, define action, and make concrete commitments. An example of informal education comes from social robotics. A robot was designed to teach children recycling behavior through serious games (Castellano et al., 2019). This approach teaches sustainable behavior by example, but requires neither a formal program nor sufficient role models.

Learning is not restricted to the classroom setting. PFF is a nonprofit advocacy organization seeking to reduce the consumption of plastics. PFF was founded as the Plastic Free July Initiative, a movement of 140 million members demanding better management of plastic pollution and reductions in personal plastic consumption (PFF, 2022). The Impact Report for 2022 reports increasing participation among "schools, councils, businesses, and government agencies". The report states that 87% of survey respondents supported taking action to reduce plastic waste. PFF propagates these results through global policy development, research, engagement, and advocacy. In 2022, NASA and the New York Times joined the challenge by encouraging staff to take part in the initiative. The contributions of the Plastic Free July Initiative may be seen in the United Nations Member States endorsement of a global treaty to end plastic pollution. This movement reaches populations of all ages. The organization aims to reduce plastic pollution by improving production, design, consumption, and disposal, all of which are addressed in the global treaty. PFF demonstrates that it follows effective campaign strategies in its events and published material.

Industry organizations publicize their participation in sustainable development. IPIECA states its commitment to the SGDs in a roadmap for the oil and gas sector (IPIECA, 2023). The roadmap lists vague impact opportunities that oil and gas companies can contribute to the SDGs. The opportunities list goals for sustainability, but fail to meet the effective strategies described

by Campaigns that Work. ExxonMobil's Alliance to End Plastic Waste claims several projects across Southeast Asia, India, and Africa (ExxonMobil, n.d.). Listed project milestones fail to escape an agenda of solely advancing plastic recycling:

Project STOP is a solid waste management and recycling service.

The End Plastic Waste Innovation Platform with Plug and Play supports specifically plastic value chain startups.

Planks of Promise is another plastic collection and recycling service.

These examples are not insignificant developments, but the plastic industry behavior observed perhaps intentionally stops at awareness of these projects.

Incentives can promote recycling and supplement educational drives for pollution awareness. When recycling costs fall, recycling rates rise (Viscusi, Huber, & Bell, 2012). Germany's Green Dot system, which charges manufacturers for the goods they produce, stimulates recycling. The Green Dot introduces a symbol for circular economies (Der Grüne Punkt, n.d.). The symbol recognizes the manufacturer's contribution to recycling costs, and a visible logo allows consumers to actively contribute by purchasing Green Dot products. The model targets a closed-cycle economy by incentivizing reuse. Closed-cycle economies can also reduce waste and benefit businesses (Abukhalaf, 2021). Charging manufacturers may promote adjustments in design and manufacturing. Thus, incentives are utilized to push innovation. Incentives must be met with knowledge of their purpose. Unexpected behaviors may develop when people find convenience in detrimental practices (Weilil and Peter, 2019). Consequently, the awareness of waste management fostered by educational resources and outreach is critical for the reduction of plastic pollution.

Conclusion

Education is an important angle for cultivating shared social values. When plastic pollution response is inspected, organizations striving for long-term sustainability are demanding individual awareness and participation. Formal education curricula vary in their ideas of long-term sustainability. There exists competition between the industry and environmental groups driving towards more sustainable solutions; resolution is hampered by the lack of transparency and conflicting aims of sustainability. This analysis presents a frontier between organizations with mixed sustainability goals. The research could benefit from future investigation into the utilization of curriculum and informal and nonformal education streams. Published curriculum will not be expressed the same way in all classrooms. Microscopic analysis of received formal, informal, and nonformal education streams would observe localized factors in plastic perception and pollution. Plastic pollution exists on a global scale; connections to other countries and international responses are required to account for the entire scope of the plastic pollution problem.

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