

## **Sustainable and Ethical Packaging: Designing for Environmental and Social Justice**

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## **Abstract**

This paper describes a course module on sustainable and ethical design practices in engineering. The module consists of low-stakes' activities, interactive lectures, and a graded Sustainable and Ethical Packaging Letter Report addressed to the hypothetical Sustainability Director in a company. To create the report (the main focus of this paper), students identify a product with unsustainable packaging, conduct and report on research that examines sustainability and ethical problems related to the selected packaging, and redesign the packaging, solving the identified problems. They also participate in groups to peer review other students' reports. This module is implemented in a junior level communication, design, and engineering core course in the Department of Human Centered Design & Engineering in the College of Engineering at the University of Washington. Outcomes were qualitatively assessed by examining samples of students' reports versus requirements and students' reflections on the module and report assignment. Outcomes have been positive and reveal that students gain an understanding of sustainable and ethical design, including its impact on social, economic, and environmental justice. Educators from a multitude of disciplines can use this assignment. It is a successful approach to having students learn about sustainable and ethical design through an analysis of product packaging. The module helps students start thinking about how to become change agents and how to be part of a sustainable and ethical future.

## **Keywords**

Sustainability, Ethics, Sustainable Design, Change Agent

## **Introduction**

We are living on a planet with finite resources. Our landfills are nearing capacity and our oceans are filling with waste because people, companies, governments, and institutions often do not take responsibility for their own actions when it comes to helping create and maintain a sustainable world. When one looks at the ethics of responsibility [1] - [2], one must consider both the intentions of an act as well as its consequences. One common practice in which some companies are failing to be ethically responsible for the impact they are having concerns unsustainable packaging [3] - [7].

According to the EPA, packaging creates "77.9 tons of municipal solid waste per year," almost 30% of the total amount of waste [8]. Packaging makes up 65% of all household trash [9], contributing to landfills. Landfills are reaching capacity and releasing toxic gases into the environment. Landfills, hazardous waste sites, other industrial facilities are most often located in communities of color. In the U.S., people of color are close to twice as likely as white residents to live near an industrial facility that contributes to air pollution, safety issues, and health concerns [10]. Annually, close to 4.8 million metric tons of plastic enter the world's oceans [11], destroying food supplies that 1 billion people rely on and creating more toxic waste [12]. Given just these few facts about packaging waste in landfills and plastics in the oceans, the economic and social injustices are alarming.

The goal of this paper is to describe a course module and graded report assignment on sustainable and ethical design practices in engineering, and discuss assessment of the module and report. In the sustainable and ethical design module and report, students investigate many topics related to sustainable engineering and design practices and the ethical implications of unsustainable practices [13]. Students research and explore sustainability and ethical issues surrounding topics such as unsustainable packaging, including ethics of design, product and design decisions related to materials, design in of itself, recycling policies, product life cycle, energy use, and marketing strategies [14]. In the Sustainable and Ethical Packaging Letter Report specifically, students identify a product with unsustainable packaging; conduct and report on research into the social, economic, and environmental challenges and solutions that relate to the problems surrounding their selected packaging; and redesign the packaging in a way that solves the identified problems.

Educators from a multitude of disciplines can employ this assignment if their disciplines are involved in the sustainable design of products and packages. Beyond helping students explore sustainable and ethical concerns surrounding product packaging, this module also helps students start thinking about how to become change agents moving toward a more ethical and sustainable future.

The module and letter report described here are part of a required 5-credit junior level communication, design, and engineering core course offered in the Department of Human Centered Design & Engineering in the College of Engineering at the University of Washington. The course is offered twice yearly to 40 students maximum per course. The course uses participatory learning and project-based learning approaches in all assignments. The course counts towards the university's required writing credits. The course leans on a number of the United Nations' 17 Sustainable Development Goals as a conceptual framework as they pertain to human-centered design and engineering, sustainability, ethics, communication, and diversity, equity, and inclusion. The sustainable and ethical design module is one of three course modules (user interface design, sustainable and ethical design, and cross-cultural user interfaces) that are taught with a goal of creating "changemaking engineers" [15].

The research report assignment described in this paper meets the requirements of ABET criterion 3 (outcomes 1-7) for accreditation of baccalaureate programs, which briefly summarized concerns (1) identifying and solving problems, (2) applying engineering design to produce solutions meeting specific needs, (3) communicating effectively, (4) recognizing ethical and professional responsibilities and considering the impact of engineering solutions, (5) functioning on a team in an inclusive environment, (6) analyzing and interpreting data, and (7) acquiring and applying new knowledge [16].

This paper describes the course module activities that help students succeed in this project, the components of the letter report, and its grading criteria. This paper also describes the assessment of students' reports and student feedback in a reflection assignment. The paper ends with a discussion and conclusions.

## **Sustainable and Ethical Design Module, and Sustainable and Ethical Packaging Letter Report**

This module consists of multiple activities that occur over a three-week period: four low-stakes activities and the graded Sustainable and Ethical Packaging Letter Report. The low stakes activities seek to prepare students for a successful experience with the graded assignment. The module is inclusive of different learning styles and includes the following activities:

1. Guided written analyses of two videos concerning planned obsolescence, and environmental and human health, followed by class discussion of student analyses.
2. A journal reflection in which students reflect on three articles about inequities and sustainable design practices. Students also reflect on a third article of their own choice concerning inequity and design. Students' reflections are followed up on in class discussion.
3. A reading summary of articles concerning materials and designing for sustainable and ethical packaging design, followed up on in class discussion.
4. Interactive lectures, in which students listen and answer questions offered by the instructor, and participate in discussions of 3-4 students/group and report out on group findings. These discussions occur regarding class readings, lecture topics, and the assignments listed above and below.
5. The Sustainable and Ethical Packaging Letter Report.

In the **Sustainable and Ethical Packaging Letter Report**, a major graded assignment, students select an example of a product with unsustainable packaging and related ethical issues, report on research discussing sustainability and ethical issues relating to their selected package, and redesign the package, solving problems they identified. Students are tasked with formulating solutions to problems that present a course of action (i.e., unsustainable packaging) and communicating their recommendations persuasively in writing and design.

The learning objectives of this report assignment are for students to:

- LO-1. Increase understanding and appreciation of sustainability issues, sustainable packaging, and related ethical issues.
- LO-2. Use increased knowledge of sustainability and ethical issues to influence design thinking regarding sustainable and ethical design.
- LO-3. Showcase persuasive communication, and ethics and sustainability, in engineering design practices and report formats.
- LO-4. Further critical thinking skills.
- LO-5. Work effectively in teams.

In the report, students apply lessons learned in the module to identify an unsustainable package and then identify sources from the literature that provide a basis for understanding the sustainability and ethical problems with their selected packaging. Next, they synthesize their findings in a letter report directed to the hypothetical Sustainability Director of the company that produced the product and packaging. They recommend and create a high-fidelity redesign of improved packaging, using a clear figure title and annotations to reveal the redesign features. They use Figma (a prototype and interface design tool that can be used collaboratively) to create their high-fidelity mockups. Students also peer review other students' reports in teams of 3-4 students in class. Students are given a suggested format of introduction, problems, solutions,

conclusions and recommendations, and references. Students' letter reports tend to range from 1,200-1,500 words.

A letter report is a reporting format for short reports that reveal the results of work so that readers can make decisions [17]. An instructor could choose to use a simple report format with a transmittal or cover letter. This assignment involves active, collaborative, problem-based learning [18]. The report assignment counts for 20 percent of the final grade and is holistically graded with guidance from a 27-item grading checklist divided into four categories: content, organization, design, and style/grammar/punctuation (see Appendix A for this checklist). This checklist guides students while writing their reports, teams during peer reviews, and instructors during grading. For grading, instructors lean on the checklist and give about 25% of the grading weight to each of the four categories. Students, teaching assistants, and instructors have appreciated the detailed guidance provided by the checklist—assignments that meet all items receive a 100% grade. Across and within the categories, individual instructors may weight what they deem most important given what they have emphasized in class.

### **Assessment and Results**

To assess the success of the Sustainable and Ethical Packaging Letter Report, outcomes were qualitatively assessed by analyzing (1) a sample of students' reports against assignment grading criteria and (2) whether student feedback in their written reflections about the module and report assignment revealed an impact on learning and a relationship to the learning objectives.

### ***Analysis of Students' Reports***

An assessment of students' Sustainable and Ethical Packaging Letter Reports revealed that students were successful in identifying examples of unsustainable packaging. They selected from a variety of types of products, with a considerable number choosing single-use items created for one time use and for our "throw-away society" [19]. A few packages that students investigated are listed below:

- Chewing gum packaging (wax paper)
- Delivered meal kits
- Potato chip package (plastic wrapping)
- Plastic rings on soda cans
- Toothpaste tubes
- Candy wrappers
- Bubble tea cups

Students found and reported on a variety of research areas concerning sustainability related to the products they selected (e.g., research on birds tangling in plastic [20], plastic use, production, and disposal [21], consumer considerations [22]). They detailed the sustainability and ethical problems with the packaging they selected, and then designed a solution that addressed these problems. For example, one student investigated the sustainability and ethical issues with the use of non-compostable plastic rings on a 24-pack of soda cans and designed a simple solution with a low edge cardboard box. Figures 1a and 1b show the original design with plastic rings and the student's high-fidelity mock-up of a suggested redesign using a cardboard tray.



Figure 1a. Current packaging with use of plastic rings  
 Figure 1b. High-fidelity mock-up of ring-free packaging with cardboard tray

Another student analyzed bubble tea cups. In Figure 2a the student shows the original plastic packaging of bubble tea and two lid styles on the disposable cup, addressing the fact that they are made of low-density polyethylene, which is difficult to recycle and creates both a sustainability and ethical dilemma in terms of increased environmental pollution. The student includes research to support their claim [22]. The student then addresses problems with disposable cups, citing statistics to back up claims. In Figures 2b-d, the student shows two possibilities for redesigned packaging, one relying on biodegradable materials (Figures 2b - 2c) that can be disposed of and another relying on reusable glass containers (Figure 2d). In Figure 3, the student shows a prototype for upcycling [21] with a mockup of the reusable cups connected to create a storage system, in this case for holding colored pencils.



Figure 2a. Existing bubble cup with 2 lid styles  
 Figure 2b. Disposable cup high-fidelity mockup of front side with composting labels  
 Figure 2c. Disposable cup high-fidelity mockup of backside with design  
 Figure 2d. Reusable glass cup high-fidelity mockup with wide shape lid for straw



Figure 3. Upcycling: reused cups stuck together to create a storage system

These samples represent the work of two students who excelled in identifying unsustainable packaging and research that supported their claims that the original packaging had sustainability and related ethical issues, which in turn led to their redesigned high-fidelity mockups. The majority of students did an excellent job with the assignment. When thinking of the grading checklist (content, organization, design, style), an examination of student reports reveal that students found intriguing unsustainable packaging examples, strong research in peer reviewed journal articles to help them identify and analyze the sustainability and ethical problems with their selected packaging, and solved the problems with their packaging redesigns. Most students followed the suggested organizational strategy and did so effectively with good use of layout, headings, and white space. Students differed in their design skills in terms of the sophistication of their high-fidelity mockups of redesigns. This was not a major part of the grade in this assignment as the concept represented in the redesigns was more important than the actual graphic design skills exhibited. Given that students entered the class with varying levels of design skills, this approach seemed most fair. Student writing skills varied as reflected in an analysis of style, grammar, and punctuation but all reports were quite readable and highly engaging, earning high grades.

### ***Analysis of Students' Reflections***

The qualitative assessment of students' reflections concerned whether student feedback in written reflections revealed an impact on learning and reflected assignment objectives. Students were asked about key take-aways from the unit. Reflections from 32 students in a recent course offering; reflections from 19 students are shared in the next few pages. Reflections revealed a positive impact on learning and a strong relationship to many of the learning objectives (LOs). The reflections are grouped by the first four LOs described for the assignment. No reflections mentioned the fifth objective of collaborative work. Students did engage in helpful peer reviews of each other's reports—but they did not mention this in their reflections. In class, during the peer reviews they mentioned how helpful it was to get a review of their draft from peers before turning in their final reports.

Students' reflections related to LO-1 concerning *increasing understanding and appreciation of sustainability and ethical issues* (Table 1). Students recognized that sustainability “extends to social and cultural” issues, and relates to product life cycle. They found it interesting to learn about waste from packaging and flaws in everyday materials.



Table 1. Reflections on LO-1 concerning increasing understanding and appreciation of sustainability and ethical issues

- Sustainability is not only about the environment but extends to social and cultural perspectives.
- I had a narrow view of what was considered sustainable. I learned that the whole life cycle of the product can be made sustainable.
- It was interesting to learn about alternatives and the generation of waste due to packaging products.
- Identifying the flaws and materials we use daily.

Students' reflections related to LO-2 concerning using *increased knowledge of sustainability and ethical issues to influence design thinking regarding sustainable and ethical design* (Table 2). Students saw that designers should adopt sustainable design as a "win-win situation" and should think about designing for the "better good" and "long-term." Further, students noted that sustainability can be "efficient and aesthetically pleasing" as well as inclusive, accessible, and future oriented.

Table 2: Reflections on LO-2 concerning using increased knowledge of sustainability and ethical issues to influence design thinking regarding sustainable and ethical design

- Sustainable design, as well as inclusive design, is something we, as designers, should adopt instead of thinking it as the "impossible perfect" design method.
- Learning many successful sustainable design products principles for sustainable design makes me realize that there's a chance for us to reach the win-win situation.
- Encouraged me to think about how our designs could make an impact on our surroundings. It made me think about designing for the better good and long-term oriented thinking.
- Designing sustainably is possible and it can be done in ways that are efficient and aesthetically pleasing. I wish that people understood there is demand for designing sustainably.
- I think the best way to make a difference is to design in a more sustainable way. We need to design more inclusively, consider accessibility issues, and more importantly design with the future in mind.

Students' reflections related to LO-3 concerning *showcasing persuasive communication and ethics and sustainability in engineering design practices* (Table 3). They found the letter assignment to be a "good design challenge," that allowed them to showcase their work in their portfolios for job interviews. One student commented that the assignment helped the get a job; another used it in an internship interview.

Table 3. Reflections on LO-3 concerning showcasing persuasive communication and ethics and sustainability in engineering design practices

- The letter assignment is a good design challenge where people can bring novel ideas to solve unique problems.
- I showcased the sustainable packaging report in my portfolio and talked about it in a job interview. My annotated redesigns impressed the interviewer. The report helped me get hired.
- This unit really helped me at my internship interview. I talked knowledgeably about sustainability issues. I went into the interview feeling like I had a real advantage over the other candidates because I had a more holistic view of the world.

Finally, some students' reflections could be interpreted in light of LO-4 concerning *furthering critical thinking skills* (Table 4). Students described their understanding of how businesses could spend less money if they thought sustainably while also caring for the planet. They understood that current packaging practices are tied into our current behaviors, stating they are now becoming critical of companies' utilizing poor packaging. Others noted that it is hard to "unsee" poor packaging that you have become accustomed to, noticing the connection between daily life and their future work. Some students were concerned about how market products will affect society in the future and felt that it was their responsibility to create products that add value.

Table 4. Reflections on LO-4 concerning furthering critical thinking skills

- If businesses utilized sustainable ways of thinking around their packaging, then they would likely spend less money in the long run.
- This unit gave me the ability to identify ways in which packaging is failing us and how it can set up our behavior. Now when I get a package from Amazon or the mail I'm able to be critical of the companies' choices in packaging whether they used recycled materials, plastic or multiple boxes.
- Before my sustainability letter, thinking about where K-Cups end up had never even crossed my mind. Now it's hard to unsee, but I wonder how many other wasteful tendencies I unconsciously have.
- The redesign packaging assignment is very interesting because it makes a connection between our daily life and the work that we will be doing.
- The sustainable design and packaging unit made me aware of how much excess packaging there is in basic consumer goods. Doing the Blue Apron case study twice made me cancel the subscription.
- We need to consider how the products we are putting on the market will affect society decades down the road
- It is our responsibility to make sure that the things we create add value to the world.

## Discussion

Students demonstrated an ability in research and information design skills with attention to social, economic, and environmental justice regarding sustainable and ethical design. Given the activities in the module that prepared students to succeed in the Sustainable and Ethical

Packaging Letter Report, students were successful in completing their reports and creating high-fidelity mockups of redesigned packaging that solved sustainability and ethical issues noted in the original designs. Students' reports revealed positive outcomes with students identifying relevant research and issues with existing packaging. Students' reflections related those issues to sustainability and ethics, design thinking, communication skills, and creative thinking. Students also discussed how learning a new design tool with a plugin for Figma helped them exercise and grow their technical skillset with 3D designs—and they were pleased to have the opportunity to learn and use the tool (noted in some reflections not shown in the tables). Further, some students reported the module and letter report helped with their internship and job prospects in that they used the letter report in their portfolios, helping prepare them for the world of work.

## **Conclusions**

Educators from many fields can adapt this report assignment and activities like those described in the sustainable and ethical design module to any discipline involved in designing products or packaging. Educators should consider the sustainability and ethical issues concerning product and packaging design and be eager to educate students about these concerns. This module and letter report helps students consider how their material and design decisions can impact social, economic, and environmental justice. The module and the letter report help students start thinking about how to contribute to a more sustainable and ethical future. In addressing some of the grand environmental and engineering challenges of our times, students learned to use their research and design skills to lead as changemaker engineers.

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## Appendix 1: Grading Checklist

To students: Please check and see if your final letter report meets the following grading checklist. Please bring this assignment sheet to class on peer review day.

### Letter Report Content

- Identifies a contemporary sustainability/ethics problem.
- Uses reasoning, claims, and evidence to make an assertion about the problems and your solutions.
- Cites at least three sources (one published within the last three months).
- Meets Assignment Prompt Submission Criteria.

### Report Organization

- Follows a logical organization.
- Uses descriptive headings to reveal the letter report organization to the reader.
- Uses an overview at the end of the introduction that announces the main report headings.
- Uses overviews in the problems' and solutions' sections to introduce subheadings and avoid stacked headings.
- Uses topic sentences at paragraph beginnings to highlight paragraph contents.
- Uses transitions between paragraphs and sections as needed.

### Document Design

- Uses effective letter report format, including page numbers.
- Meets document design guidelines specified in Assignment Prompt Submission Criteria.
- Employs visually distinct headings, using **more** space before them than after them.
- Avoids underlining headings.
- Makes effective use of space, color (if applicable), and fonts.
- Uses clearly labeled and logically placed graphics.

### Figures and tables:

- Are described and referred to in the text before they are inserted.
- Are clearly labeled.
- Have concrete figure or table numbers and text titles above tables or below figures.
- Are placed as close as possible to the text that refers to them.

### **Style, Grammar, & Punctuation**

- \_\_\_\_\_ Uses clear and concise sentences.
- \_\_\_\_\_ Uses words precisely that relate to the report's purpose and match the audience's background.
- \_\_\_\_\_ Uses appropriate tone for the audience.
- \_\_\_\_\_ Uses correct grammar.
- \_\_\_\_\_ Uses accurate punctuation.
- \_\_\_\_\_ Uses accurate spelling.
- \_\_\_\_\_ Uses APA or IEEE formatting for in-text citations and footnotes.