One Million Bottle Caps Design Challenge

Promoting sustainable design to K-12 students by upcycling plastic waste

Case Study
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This project aimed to address the following United Nations Sustainable Development Goals (SDG) and targets

6 - Clean Water and Sanitation

6.3 - By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

6.6 - By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes.

6.B - Support and strengthen the participation of local communities in improving water and sanitation management

12 - Responsible Consumption and Production

12.4 - By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water, and soil in order to minimize their adverse impacts on human health and the environment.

12.5 - By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse.

12.8 - By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.
14 - Life Below Land

14.1 - By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

14.2 - By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.

17 - Partnerships for the Goals

17.14 - Enhance policy coherence for sustainable development.

17.16 - Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.

17.17 - Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships data, monitoring and accountability
Abstract

This case study describes the pilot programme to teach K-12 students (ages 11-13) the basics of industrial design and design thinking through hands-on experience: the upcycling of 1.3 million plastic bottle caps. The objective of the project was to demonstrate, through elaborate coaching lead by young, professional designers, the design thinking process to 135 students, and to develop a framework for similar projects for K-12 students internationally. The Million Bottle Caps Design Challenge is a unique opportunity for all stakeholders to promote and use sustainable design and best practices as a learning tool for K-12 students to create a better world.
The Problem

How can we expose K-12 students to design and design thinking through a fun activity? Learning about and understanding design thinking and the power of design is a powerful tool that can last a lifetime and a skill that students can leverage for personal use and in their future careers. Convinced of these benefits, the World Design Organization® (WDO) created a new pilot programme.

WDO teamed up with two US-based organizations, SoundWaters and SPE Foundation to develop a hands-on experience for 135 K-12 students from two schools in the Long Island Sound coastal city of Stamford, Connecticut (USA).

Already aware of the problems caused by plastic waste - the students and their teachers at these schools had been challenged by SoundWaters in September 2019 to turn their education into action. Their unprecedented efforts led to a unique collaboration with top plastics engineers and industrial designers to contribute to a solution to the local and global problem of microplastics.

Over the course of a single school year, Stamford middle school students were on a quest to collect one million plastic bottle caps to prevent them from ever reaching the Long Island Sound. Despite the onset of the COVID-19 pandemic in the early spring of 2020, they reached their goal by the end of the school year, collecting 1,028,177 plastic caps.

But what do you do with more than one million plastic bottle caps? SoundWaters and the students' goal had always been to turn their two tonnes of plastic waste into usable products that could benefit the community.
Enter two global organizations, the Society of Plastics Engineers (SPE) Foundation and the World Design Organization (WDO). Beginning March 2021, teams of 11 to 13-year-old students at Stamford’s Rippowam Middle School and Rogers International School participated in a series of virtual workshops to learn more about the design thinking process. Over the course of eight weeks, WDO paired ten industrial designers from its Young Designers Circle (YDC), to coach the students in designing an upcycled product made from the plastic bottle caps collected.

The students also had access to the SPE Foundation’s new PlastiVideo™ STEM-focused plastics education programme, learning why it is important, and how their bottle caps can be recycled or upcycled. With the assistance of students from Penn State Behrend, a product mold was created, allowing to produce a recycled product in series. Ultra-Poly Corporation, SPE’s partner in plastics education, processed the bottle caps to produce the plastic pellets used to manufacture the students’ winning design.

Overall, this pilot programme and extensive coaching process allowed for the students to explore new terrain, acquire design thinking skills, and familiarize themselves with a novel way of viewing the world through a hands-on project.

From the onset, the goal of this project was to encourage young people to become innovators, by using their creativity and imagination, and to help the community solve the marine debris issue. We are hopeful that through this experience, the students will continue to be motivated by this experience to eventually join the professional designers and engineers around the world who are seeking equitable solutions through sound engineering and science.
Capsule:

Plastic in our Oceans

There are 5.25 trillion pieces of plastic waste estimated to be in our oceans. 269,000 tons float, 4 billion microfibers per km² dwell below the surface. 70% of our debris sinks into the ocean’s ecosystem, 15% floats, and 15% lands on our beaches. In a business-as-usual scenario, the ocean is expected to contain one tonne of plastic for every three tonnes of fish by 2025, and by 2050, more plastics than fish (by weight). To solve plastic waste and pollution, in a way that also helps us address climate change and biodiversity loss, we need a circular economy for plastic, which addresses its entire lifecycle. A recent study found that infants have more microplastics in their feces than adults. Human exposure to microplastics is a possible health concern, but little is known about its extent.

Recycling plastic far from home

Since China banned importing plastic waste from developing countries in 2017, the shipment of it has continued to places that are already virtually drowning in it, such as Malaysia, Vietnam, Bangladesh, Turkey and the Philippines. But often local and imported plastic waste is mismanaged and dumped or inadequately disposed of at sites such as open landfills, in water streams or burned illegally. Instead of shipping it to poor countries, plastic waste producing countries could recycle it locally, creating jobs and a cleaner environment.
1.3 million plastic bottle caps recycled

About design challenge participation

2 tonnes of plastic waste
2 middle schools involved
135 K-12 students 11-13 years old

12 student teams
2 teachers
10 international coaches/designers from 9 countries
100 hours of coaching
8 weeks
2 playback sessions
To better understand the issues at stake, the pilot programme started with extensive, preparatory discussions with both partner organizations: SoundWaters and SPE Foundation. To help configure and structure the project, multiple challenge statements were determined. Eventually, a simple, straightforward statement was selected that would be practical and enticing for K-12 students to develop. Let’s design a product that could be useful in the kitchen!

In a home, the kitchen is often the centre of a family’s day-to-day living. As such, it allowed the students to explore familiar terrain that is easily recognizable and also to engage with other family members about the project and their needs in the kitchen. This would be very useful when developing an early assignment: Creating a Persona.
Implementation

Over a period of eight weeks, the 135 K-12 students, divided into 12 teams and guided by two teachers and 10 YDC coaches, were introduced to the challenge statement and design thinking process. In weekly one-hour, virtual meetings, the students tackled different assignments. In total, students received more than 100 hours of coaching.

Due to the pandemic, all meetings had to be organized online. The upside was that design coaches from 9 different countries could participate, share their design knowledge, and cultural background. However, a downside was that everything happened on screen and no hands-on exercises could be shown and shared, which made the coaching process less stimulating for the students.

To guide the students through the design thinking process, teachers as well as coaches used Google Jamboard and Google Meet. Each week, the teams discussed an important aspect of the design thinking process, from the creation of a Persona to developing an idea, the sketching of their ideas, discussing and selecting ideas, etc.

The first assignment was to create a Persona who could benefit from a team’s proposed design solution. The Personas had to include a description of their personality, their interest and skills, and any struggles they experienced in the kitchen when making pasta, cutting meat, cooking vegetables, etc. Students had to observe and ask family members about their challenges. Eventually, from the information gathered, a design solution had to be developed taking into account a generic persona’s needs.

To keep the process light and manageable, homework assignments took little time to complete or were tackled and discussed with the teachers in class or online on days that there was no coaching.

Four weeks into the process, students presented their initial findings at a first Playback Session to an external jury of stakeholders from WDO, SoundWaters, SPE Foundation, and Penn State Behrend. The jury provided extensive feedback and suggestions to the students’ presentations and ultimately also on their designs.

The challenge concluded with a presentation of final projects by the 12 teams. All team members got an opportunity to share a component of their presentation. And in accordance with WDO’s Design Competition Guidelines, a jury comprising of members from WDO, SoundWaters and SPE Foundation deliberated all entries to select one project.

Throughout the design challenge, a Penn State University student provided insights on the molding process and helped determine the molding specifications for the final design. These university students created a product mold and worked on the production. In order to prepare for production, Ultra-Poly Corporation, an SPE Foundation partner, processed the bottle caps to produce the plastic pellets used to manufacture the students’ design.
Jury Selection

Each of the projects were scored on Creativity (50 points), Challenge Objectives (40 points), and Process (10 points) for a total of 100 points.

<table>
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<th>Creativity</th>
<th>Challenge objectives</th>
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<tr>
<td>• Originality of design</td>
<td>• Meets challenge objectives to design an object that can be upscaled using bottle caps</td>
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<td>• Visual appeal</td>
<td>• Resolves an issue or provides an opportunity related to the persona</td>
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<tr>
<td>• Ease of use</td>
<td>• Complies to molding specifications</td>
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<tr>
<td>• Attention to detail</td>
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Process

• Respects design thinking process

• Overall quality of final presentation

The final winner - a dish rack - designed by the ‘Distance Learners’ team was not selected automatically based on the highest score. Rather, the merits of all projects were discussed, as well as the technical feasibility of the concepts to be molded into an object.

The jury applauded the hard work the 12 teams put into the challenge and recognized that in their own way, all concepts were solution-driven and aimed to solve a persona’s problem encountered in the kitchen. The design concepts were creative, well-thought-out and fascinating designs showing that students were passionate about developing a product for use in a kitchen environment.

However, after careful deliberation, the jury eliminated eight concepts because they were too complicated to mold into an object or were made up of too many components. Other important considerations were to make sure that the selected product would be safe for use in a kitchen, and that it would actually be used and not immediately end up in a landfill. The recycled plastic bottle caps imposed their own limitations. Upcycled into an object, they cannot withstand heat and are not considered food-safe. This further eliminated some concepts.
The winning design - a plastic dish rack by ‘Distance Learners’ team
The winning design - a plastic dish rack by 'Distance Learners' team
Overall Conclusion

This design challenge created for K-12 students was a hands-on experience to teach students the positive impact of design in relation to the UN Sustainable Development Goals (UN SDGs). Our planet faces enormous challenges with climate change, and microplastic waste, burdening the environment. Collecting approximately 1.3 million plastic bottle caps to upcycle them into a product that doesn’t end up in landfills or contribute to marine pollution is an already important and meaningful contribution.

When taught to students captivatingly, design thinking can have a lasting imprint on young people to help them tackle personal and work-related issues. The international scope of the project, with design coaches coming from nine countries, turned it into an even more compelling encounter and cross-cultural exchange.

In conjunction with the SDGs, it can raise awareness about sustainability and instill new, conscious behaviours through the use of design.

Teaching students about the impact of our actions on the environment using design is an opportunity to, in this instance, critically examine the issue of plastic waste and to make fundamental connections with the SDGs. The design and design thinking practices used in the Million Bottle Caps Design Challenge are powerful tools to explain a serious topic in a fun and practical way. From the onset, the objective of this design challenge was to let students experiment with a new tool and framework they can add to their toolkit.
Challenges & Opportunities

Challenges

• The biggest challenge for all stakeholders directly involved were the virtual meetings imposed by the COVID-19 pandemic. For some students, it was difficult to stay focused during the meetings, as well as keep up an interest in what was happening. Other students made the most of it. Because of the volatile situation with COVID-19, teachers, and coaches sometimes had to tend to family and had to be replaced. Fortunately, the team spirit was great, allowing for an easy transition among them.

• Although the students received more than 100 hours of coaching, to be really impactful even more hours should have been dedicated to teaching them about design and design thinking.

• Due to the time constraints and virtual calls, the teams were not able to 3D print their designs, which would have allowed for the students to visualize their findings and increase the hands-on experience.
Opportunities

- Through simplified, fun and interactive exchanges, students were exposed to the problem-solving nature of design in a hands-on approach to a real-world challenge.

- The team work and presentation of design results allowed students to experiment and improve their leadership skills.

- An upside of the virtual calls, instead of organizing in-class coaching sessions, was that the design coaches could come from anywhere in the world. In total, 10 coaches from 9 different countries participated in the project and made it possible for the students to meet and exchange weekly with people from different cultures and backgrounds, enriching the design experience further.

- The eight-week challenge allowed WDO to experiment with a programme for students to learn about design and design thinking. It was an opportunity for WDO to create a framework for similar projects in the future that could be applied in a primary, high school, and even a university setting internationally.

- The Million Bottle Cap Design Challenge inspired students to take action, to use their collective voice and engage the local community in the first step of a solution by collecting two tonnes of plastic bottle caps, thereby ensuring that at least that plastic will never reach Long Island Sound. Through their opportunity to work with engineers and professional designers students, students were introduced to the next steps in an ultimate solution to our plastics problem.

Lessons Learned

- Virtual one-hour meetings with primary school students challenge their ability to stay focused. Coaches continually need to involve students to keep them engaged.

- In class presentations using tangible designs increase student engagement and learning.

- Limitations with online tools, such as Jamboard, put some constraints on what students, teachers, and coaches could present and develop. Other tools (Mural or Miro) were deemed too difficult for the K-12 students at this stage or were not readily available through the schools’ IT systems.

- Larger teams of students can be difficult to manage. Smaller groups of around 10-12 students create a more intimate environment, enhancing the learning experience.

- A combination that works well is teaming up a coach (designer) with a teacher who knows the students well and can assist them with their homework assignments.

- International engagement between the students, teachers, and coaches from 9 different nationalities is a rich experience. Students learn about other cultures and ways of seeing the world.

- This kind of project is a great tool to teach students about the power of design that can be used to tackle a major and delicate environmental issue like plastic waste and microplastics ending up in landfills or contributing to marine pollution.

- The programme is an opportunity for a very diverse set of organizations to partner and to build a novel experience.
Acknowledgements

WDO, SoundWaters and SPE Foundation would like to thank all the participants, coaches and collaborators who gathered remotely to promote the use of sustainable design practices to ensure a better future.

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Tyler Smith
About World Design Organization
World Design Organization (WDO)® is an international non-governmental organization and the international voice for industrial design. It advocates for Design for a Better World, promoting and sharing knowledge of industrial design-driven innovation that enhances the economic, social, cultural, and environmental quality of life. Today, WDO services over 185 member organizations, representing thousands of industrial designers around the world.

About SoundWaters
SoundWaters, founded in 1989, is the premier environmental education organization focused on the protection of Long Island Sound and its watershed. Annually, SoundWaters hosts shipboard and land-based programmes for 32,000 students. SoundWaters works in partnership with schools, communities, civic organizations, businesses and other environmental and educational organizations to develop experiences that foster a sense of responsibility for the environment and encourage actions that ensure the sustainable future of Long Island Sound. SoundWaters advances environmental justice and educational equity by creating broader access to Long Island Sound because our communities are stronger when we are connected to and learning from the Sound.

About SPE Foundation
The SPE Foundation supports the development of plastics professionals by funding quality educational programmes, grants and scholarships emphasizing science, engineering, sustainability, and manufacturing while working to create inclusive opportunities for students around the world. The PlastiVan® programme serves over 25,000 students a year changing the perception of plastics one classroom at a time by promoting sustainable practices, innovation and STEM careers in the plastics industry.

About YDC
World Design Organization’s Young Designers Circle programme harnesses the creativity and ambition of designers under-40, across multiple disciplines and regions. Aligned with the organization’s objective to promote the use of design to help meet the United Nations Sustainable Development Goals (UN SDGs), this initiative aims to strengthen the role of design leadership today, by planting seeds that will lead to large impact tomorrow.

Resources

- https://sdgs.un.org/goals
- https://www.condorferries.co.uk/plastic-in-the-ocean-statistics
- https://www.plasticpollutioncoalition.org/the-facts
- https://www.plasticsforchange.org/blog/doing-it-right
- https://sdgs.un.org/#goal_section
- https://emf.org/news/new-white-paper-on-a-un-treaty-to-address-plastic-pollution?mc_cid=2a23a3e496&mc_eid=d51b3dba04