Connecting Students and Seniors to Solve Real-World Challenges using 3D Printing

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Abstract
Public engagement has been a core focus of the MakerLAB at Cornell Tech since its inception in the Fall of 2016. In this poster we share the process and findings from a pilot workshop offered in Spring 2018 where 6 senior community members were paired up with 6 Cornell Tech graduate students and 6 Weill Cornell Medicine Clinical Translational Science Center (WCM CTSC) students to work together to design and create a real-world product that could address a challenge posted by the senior community using 3D printing technology. The teams applied Design Thinking to empathize and define their challenges, and learned to design, print, test their prototypes, and integrate constructive feedback from users. By week 6, students learned to take an idea from conception to prototyping and each team presented their final projects at a community showcase.

Background
Cornell Tech is located on Roosevelt Island, in the East River between Manhattan and Queens in NYC. It is a residential community of approximately 14,000 people with a significant older adult population, including two active senior organizations: The Carter Burden Roosevelt Island Senior Center, and the Roosevelt Island Senior Association (RISA). To design and implement this workshop, the MakerLAB at Cornell Tech coordinated with these two organizations to solicit design challenges as understood by this community, and that could be addressed using digital fabrication techniques - in particular, 3D printing. The WCM CTSC has sought to encourage adoption of 3D printing in biomedical and clinical research by acquiring 3D printers and establishing a 3D printing lab in 2014. This workshop grew out of an awareness of the opportunities for innovation and creativity to address the needs of the aging population by leveraging 3D printing’s application in health and medicine.

Why 3D Printing
Unlike conventional prototypes which may take a skilled artisan weeks or months to produce, rapid prototyping tools like Fused Deposition Modelling (FDM) machines can make parts in a few days or less with little human intervention. Therefore, the designer may prototype the part as often as necessary to check for appearance and function. Changes may then be easily incorporated into the model and another prototype generated [1].

Workshop Format and Learning Environment Design
Future innovation is likely to come from both familiar forms of professional design and engineering, as well as from non-professional networks of people “hacking together.” This includes rapidly prototyping their own designs, developing and building bespoke inventions, and making adaptations to existing technologies [2].

The workshop schedule:
Week 1: Sourcing Challenges & Meeting Teams
Week 2: Empathize & Define your challenge
Week 3: Ideate to Prototype
Week 4: Prototype to Test
Week 5: Test to Use
Week 6: Final Project Showcase

A. Sourcing Challenges & Meeting Teams
Three focus groups conducted with our two partner organizations allowed us to gather 30+ everyday challenges from senior citizens. Also, through these sessions we were able to identify individuals from these communities who were intrigued by the idea of using 3D printing to create solutions for everyday life activities. They eagerly signed up for the 6 week workshop, along with six graduate students from Cornell Tech with a technology background, and six graduate students from WCM CTSC with a focus on health and medicine.

Areas of Research, Major and Profession of Workshop Participants (N=18)

<table>
<thead>
<tr>
<th>Participating Team</th>
<th>Senior Citizen</th>
<th>Cornell Tech Graduate Student</th>
<th>WCM CTSC Graduate Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Geriatric Care Manager</td>
<td>Computer Science</td>
<td>Occupational Therapy</td>
</tr>
<tr>
<td>2</td>
<td>Economist (Retired)</td>
<td>Computer Science</td>
<td>Pathology and Laboratory Medicine</td>
</tr>
</tbody>
</table>
Summary of challenges presented to teams: “How might we create products for consumers which will…”

1. Help to remember everyday tasks
2. Help with getting dressed
3. Help with limited strength/dexterity to use household products
4. Create, modify, or augment existing products to improve accessibility i.e. grasping, holding, twisting, opening, lifting, identifying
5. Create a product that enhances the ability to carry essentials outside of the home
6. Help to enhance physical activity with limited mobility

The first session included a course overview and meetings with student mentors (Ph.D. and Masters students at Cornell Tech with expertise in product design and 3D printing) and teaching staff. The teams were also introduced to Tinkercad software, a simple, easy to learn, online 3D design and 3D printing app, that they would use to develop their projects.

A. Empathize & Define your Challenge
The teams developed an avatar based on knowledge of the user population. Using this model, they developed likely scenarios for how these personas might benefit from custom-designed solutions.

For example: One team’s persona named, ‘Betty,’ is a sociable 80 year old woman who lives alone with advanced arthritis, but wants to be independent. She has hand weakness, stiff joints, and overall limited hand mobility and dexterity. Her medication makes her thirsty, she drinks water throughout the day, and carries a water bottle that she struggles to open.

B. Idea to Prototype
Teams were given materials such as clay, paper, cardboard, wire, fabric, different types of stretchable materials, recycled tubes, etc. to build their first rough physical model. They were encouraged to use props to support their scenario (i.e. folding walker, jars and bottles, clothing, etc.).

Teams also received 3D printing training and by the end of the workshop were able to design using Tinkercad, prepare printing files using a slicing software, Cura, and printed their prototypes using Ultimaker printers. During the next 3 weeks, the teams met with student mentors and teaching staff to refine their initial prototype. In some cases, students found that their designs replicated already existing products. In these cases, teams customized the existing designs using 3D printed parts.

C. Final Project Showcase
Teams had a chance to demonstrate their final prototype and get constructive feedback from potential users and industry experts during the final showcase. The audience for this showcase included the Roosevelt Island community, Cornell Tech and Weill Cornell Medicine students, staff, and faculty.

Project Outcomes

A. Graduate Student experiences
The feedback from WCM CTSC students was overwhelmingly positive. Students completed a course evaluation at the end of the term (N=6, 100% response rate), and the majority of students “strongly agree” that the course objectives were clear (4.33), and students rated the overall course quality a 4.0 (based on a 5 point Likert scale, where 5 was the highest score). Moreover, students unanimously agreed that they would recommend this course to their colleagues (N=6, 100%). One student’s comment perfectly encapsulated the benefit of this type of experiential learning environment from a physician scientist’s perspective: “It’s an enlightening break from the traditional lecture course format and teaches first hand how to engage in diverse team problem solving and ideation.” One student submitted a 3D printed hand prosthesis project to the Weill Cornell Medicine CTSC Health Innovation Hackathon (May 18-20) and was awarded a Novel Technology Team Award. An idea proposed by a senior resident on Roosevelt Island--to create a solution to help seniors experiencing choking while living alone--was also adapted for the WCM CTSC Hackathon.

B. Senior Citizen experiences
The older adults were thoroughly engaged every step of the way, forming tight bonds with and providing life experience and guidance to the younger students, in some instances serving as an informal career mentors. The older adults found the experience fulfilling and educational. A course survey elicited enthusiastic responses. “I loved it! The challenge, in terms of what older people might need to make their everyday tasks easier, is a very meaningful topic. Another older adult remarked on the intergenerational component: “Was novel, almost interdisciplinary. Seniors had practical knowledge, graduate students had technical savvy. Was a constructive collaboration.”
References
