Impact of Digital Fabrication on Refugee Youth

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ABSTRACT

I work in a for-profit start-up that mainly seeks to lower barriers of access to 3D printing technology. We do this by building the machines from recycled electronic waste parts and other locally available materials. We believe in leveraging the power of technology for good and we also believe that the world's youth should learn and take advantage of this 21st century skill in order to solve the world's complex problems and prepare for tomorrow's jobs. As such we teach how to make with a focus on 3D printing and digital fabrication coupled with human centered design in order to nurture the next generation of problems solvers. We conduct workshops and training sessions depending on each context and mostly in partnership with like-minded organizations. This paper is focused on a workshop we conducted in Athens, Greece this year in collaboration with MIT d-lab and Faros (local NGO) and funded by UNHCR. The workshop, dubbed the 'Digital Design Fabrication Workshop' taught digital fabrication skills to unaccompanied refugee youth aged between 9 and 17 years old. The youth were taught basic computing, basic CAD, design thinking, 3D printing and 3D printer fabrication.

Our biggest takeaway from this experience is the immediate transformation we noticed in the kids. The refugees were initially very apprehensive and generally had a foul attitude towards learning 'difficult' things or taking on new challenges. Given their tumultuous past, they generally shunned circumstances where failure was an option. After imparting just a few skills and showing the youth that they are indeed able and capable, the transformation was profound.

Keywords

"Unaccompanied refugee minors", "capacity building", "digital fabrication", "youth empowerment", "resilience"

2. DESCRIPTION

2.1 Description of your setting

We are a hardware start-up based in Nairobi, Kenya and our overarching goal is to lower the barriers of access to 3D printing. We do this by building quality and affordable 3D printers from recycled electronic waste parts and other locally available materials. We believe in teaching this relevant 21st Century skill to the youth in order to better prepare them for tomorrow's jobs. But 3D printing is not enough in itself. As such, we combine concepts of making and digital fabrication, coupled with design thinking in order to impart youth with sufficient skills with which they can tackle some of the world's complex problems. In general, we primarily target children aged between ages 10 and 19 and we cater each session for each audience.

The session of interest however was a two week workshop run in Athens, Greece for unaccompanied refugee minors aged between 9 and 17 years old. The youth, all boys, were from the conflict regions of Syria, Afghanistan, Iran, Iraq and Pakistan. They had not only not been in a classroom in over 3 years but also lacked confidence and expressed a myriad of psychological problems. Faros, the local NGO that accommodates some of the refugees strives to not only offer food and shelter but also equip the youth with skills that would help them realize pathways that would improve their livelihoods now and in future. As they work to resettle some of the refugees in Europe, Faros offers training on vocational skills such as basic circuitry, tailoring and languages such as Greek and English. We partnered on a workshop, in collaboration with MIT's D-lab, to introduce design thinking and aspects of making and digital fabrication and equip the refugees with skills that could ideally directly help them in future.

2.2 Description of the educational experience

The sessions were intended to be 7 hours a day each day for 10 days and the focus was supposed to be on 3D printing core competency skills. But an initial assessment showed that some of the students had never interacted with a computer before, let alone a 3D printer. And so because of this there was a need to introduce basic computing skills. After three days, the kids would show up before sessions, refuse to take breaks and stay after hours. The structure of the sessions then involved a 3 hour morning session where we taught design thinking and basics of computing such as the Microsoft packages as well as basic programming, 2D and 3D design software. For programming we introduced the students to Scratch and the basics of Arduino. We tinkered with Blender while teaching the students 3D design and modeling and Repetier-Host to teach them how to operate the 3D printers. The general format involved sometimes having the some participants share computers which encouraged peer-to-peer learning.

The general structure of the session, however, involved introducing concepts to the entire class using a projector and then letting the students tinker with that tool and explore other concepts as well. This method was especially necessary when teaching the design cycle. There were always three facilitators moving around and answering any and all of the students' specific questions and challenging them to explore more tools and functions once they completed the tasks at hand. This allowed for the different rates of learning and understanding of the students and also allowed some of the less confident students to express themselves more, even as they worked in teams.

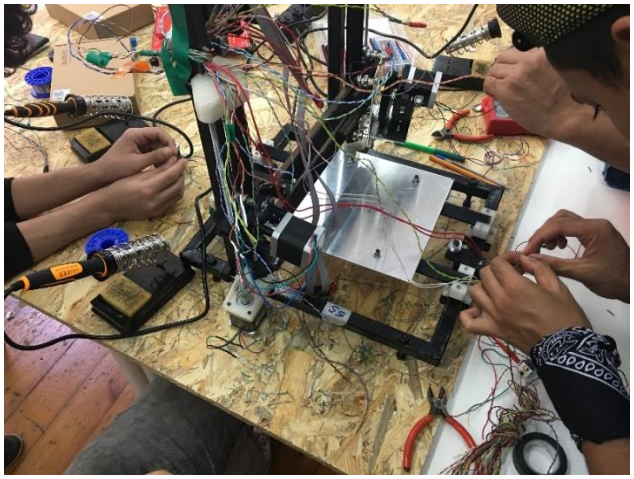
In the afternoon sessions, it was all about building the 3D printers. The focus of the afternoon sessions was learning the skills rather than the product they were building. We emphasized learning skills such as soldering, working with hand tools and troubleshooting a 3D printer. The students worked in different teams to build different parts that later on came together to build this one, cool machine. The refugees took turns operating different tools in turn learning different skills. They were encouraged to rotate and ensure that they all learn to use the different tools and understand the different tasks and processes.

3. CONCLUSION

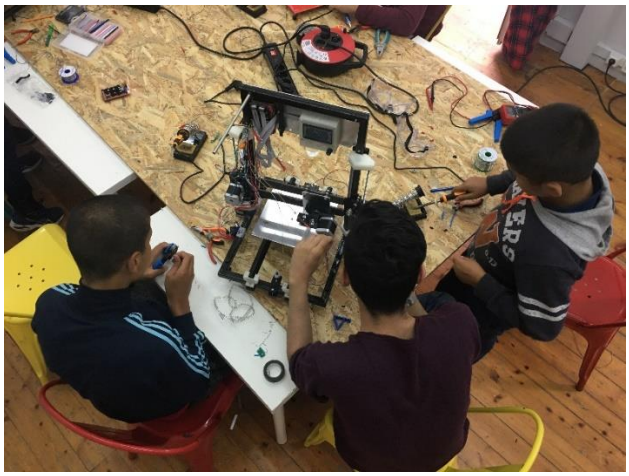
3.1 Results

Initially, we relied on translation as the refugees did not understand much of English. We had two sets of concurrent translation; to Urdu and Farsi. After two days however, we somehow did not need the translation. We found a way to communicate even with the language barrier. The kids got a chance to explore without necessarily being told what to do. We as instructors were reduced to only a guiding role and the students used the curiosity and creativity to explore and learn new things. The students challenges us as facilitators, constantly asking for new challenges or for help with doing more difficult tasks.

We noticed changes in confidence, resilience, and general attitude from the refugees. Many times the refugee students went out of their way to teach their peers, especially since the facilitators sometimes struggled to explain certain concepts given the language barrier. They applied the skills they learnt directly to some of the challenges they were facing. For example, one child with broken spectacle frames went ahead to design and print samples of fixtures that would help him repair his broken frames. He took ownership of the entire design and fabrication process of his solutions from idea to actual development and this, for us, was powerful. There were other similar examples with exciting outcomes of how the refugees saw themselves and other things they wanted to develop in future. In another instance, one of the refugee students managed to get his hands on a tablet which had internet and would go to YouTube and learn new tools, functions and tricks and then instantly practice them on the laptop he was using. This showed a lot of curiosity and self-drive.



Picture 1: Refugee children working in teams to build a 3D printer



Picture 2: Refugee children working in teams to build a 3D printer

Picture 3: One of the participants designing a solution for themselves

Link to video of the summary of the experience: https://www.youtube.com/watch?v=cv0zzXjteOY&t=20s

3.2 Broader Value

I think our approach of guiding the learning process rather that leading it was of significant value. The learning was guided by the students' curiosity especially when it came to deciding what to design and make. It also helped the refugees to see us as peers that they could relate to and this helped overcome the apparent trust and intimacy issues as well as other psychological issues the unaccompanied minors might have been facing. This was due to the fact that, we as facilitators, are all relatively young compared to the conventional teachers or the personnel that run the NGO and shelter. It was also powerful to let the youth make mistakes and learn from the mistakes as they think through troubleshooting options. Before the workshop, many lacked resilience as their experience had beaten them down. But we noticed that during the workshop, with a little guidance, correction, and encouragement, the refugees became more resilient and consequently more confident. There was pride for the solutions they developed even to seemingly insignificant tasks or challenges. Some of our key takeaways are:

- The need to be patient with such troubled youth.
- The need to be supportive rather than instructive.
- Designing solutions *with* rather than designing solutions *for* the youth.

On a personal level, we learnt that when we open up and allow ourselves to be vulnerable even with our students then there is a greater sense of trust and they become more open to learning and changing their attitude and bias.

3.3 Relevance to Theme

This experience plugs in directly with the conference theme of how understanding the role that Maker Education plays in a world of growing social and environmental challenges. We witness the powerful transformation that resulted from two weeks of training and capacity building of refugee youth. The experience restored hope and reignited their zeal for life as they saw themselves as more able and capable.

4. BIOS

Roy (Presenter)

Roy has a mechanical engineering background and is affiliated to the Nairobi Fablab. He is passionate about technology, making and innovation especially when geared towards social impact and development. Roy is a Stanford Fablearn Fellow having cofounded the Nairobi Fablab Robotics Outreach Program aimed at teaching making to underprivileged children in Nairobi's slum settlements. Roy is an alumnus of MIT D-lab's International Development Design Summit (IDDS) having participated in 2013 in Zambia and helped organized the summits in 2014 (Tanzania), 2016 (Pakistan) and 2018 (Kenya). Currently, Roy is the founder at AB3D (African Born 3D Printing LTD), a hardware social enterprise that lowers barriers of access to 3D printing technology by manufacturing quality and affordable 3D printers from recycled electronic waste parts and other locally available materials. This was inspired by his project, 'Happy Feet' which aimed at creating custom and bespoke shoes for people with deformed feet. Roy was named among Africa's Top 20 Young Entrepreneurs in 2018 and one of Impact Design Hub's Top 40 Under 40.

Justine Boudreau

Justine received her bachelor's degree in mechanical engineering at the University of Ottawa and is currently pursuing her Masters in Electronics Business Technologies. Over the last three years, Justine spent her time playing with new technology and diversifying her knowledge, especially with the uOttawa Maker Mobile. With the Maker Mobile, she was delivering workshops and integrating new curriculum for robotics and women in science and engineering. Since then, she has been working with the uOttawa's Richard L'Abbe Makerspace, where she also teaches first and second year engineering design courses through the Makerlab. In her spare time, Justine practices Kung Fu and loves crafting. Her research will be looking into the intersection of Makerspaces and engineering education.

Heewon Lee

Heewon is a designer trained in human-centered and participatory design approaches to develop services and products in both the public and private sectors. He is a candidate for a doctorate in Industrial Design with extensive experience in product design, interaction design, graphic design, and international development design. Experience in teaching the design process and methods in formats including academic coursework and short/long term workshops around the world. Heewon is skilled in tailoring design research tools and methodologies for diverse users, stakeholders, and contexts. Currently, Heewon is working as a deisnger and instructor at Massachusetts Institute of Technology (MIT).