Feature Article

Printing in a pandemic: the makers response to COVID-19

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Abstract

uCreate Studio is the University of Edinburgh's Community Makerspace. The uCreate Studio team worked throughout the COVID-19 lockdown, collaborating with other local teams to produce personal protective equipment (PPE) for staff in the National Health Service locally. This paper describes the work of the uCreate Studio team and how they used their skills, knowledge, network of contacts, and the specialist equipment in the uCreate Studio in the production of PPE.

Key words: *makerspace; additive manufacture; 3D printing; Creative Commons.*

Introduction

I was delighted to be asked to write an article for *JEAHIL* on our efforts manufacturing emergency PPE, although I must confess, I feel a little out of my comfort zone too. I don't have a background in the medical sector and – like many other makers and makerspaces – the COVID-19 epidemic has resulted in the uCreate Studio Makerspace staff and myself working far more closely with the health sector than any of us ever expected to.

Edinburgh University's Makerspace

I manage the uCreate Studio (1) at the University of Edinburgh, a community Makerspace available to all staff and students. The makerspace houses a wide range of new and transformative technologies and provides training and support in their use. Technologies range from the traditional (such as hand tools and metal casting) to the cutting edge (including Digital Manufacture, 3D scanning and Virtual and Augmented Reality).

Situated in the Main Library, the services the makerspace provides are freely available to any University of Edinburgh library user; equally used by students (to apply the skills and theories they learn in their studies); teaching staff (for the provision of practical and skills development course components); academics and researchers (to access new research tools); student societies and start-ups (for meetings and project space); and inventors and makers (to explore new ideas, discover new technologies and indulge in their favourite pastimes). We are deliberately nonprescriptive – prioritising the acquisition of new digital skills; the testing of new ideas; and the promotion of interdisciplinary collaboration – and are proud to have membership from all schools within the University.

3D printing and PPE

In the early stages of the COVID-19 epidemic, the UK makerspace services took on a new role. It became apparent that personal protective equipment (PPE) supplies were low throughout the country, and that new PPE sources were needed urgently. Makers across the world were working on their own solutions to the problem and several designs were created for face shields that could be manufactured on consumer grade 3D printers.

3D printing has grown in prominence and captured imaginations all over the world as a tool to allow quick and easy home manufacture of an infinite number of objects. In the health sector they see use for applications as wide ranging as the manufacture of prosthetic arms (2), dental implants (3), tissue engineering scaffolds (4) and bespoke surgical guides (5). Their utility makes them an extremely popular tool in a maker's armoury, their affordability (reasonable quality consumer 3D printers can now be bought for

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well under £200) make them extremely common and widespread.

As with many makerspaces they are a critical technology in the uCreate Studio and so an area our staff have devoted significant time in developing expertise in over the past few years. Student demand has seen us build up a large stock of hardware and so, as it became apparent that 3D printing offered the best solution to plug the PPE gap quickly, we felt well placed to be able to contribute to the cause (*Figure 1*).

Fig. 1. *Makerspace Coordinator Anthony Middleton separating stacks after printing.*

Community response

By the time we returned to the Makerspace in early April, we were already plugged in to the community efforts in Edinburgh and the South of Scotland. Members of the Edinburgh Hacklab (6) – a private makerspace in the city – had been hard at work prototyping the various open source visor designs available. These had been submitted for review by the National Health Service (NHS) staff and feedback had led to the selection of the most popular and efficient designs. Other University, community and private facilities had dedicated their hardware to the cause and a print farm had been established in the city's Summer Hall. Printers had been modified to eject completed visors from the print bed and restart the printing process automatically. Allowing the machines to run 24 hours a day, 7 days a week, local charity organisations, such as Street Assist Edinburgh, had become delivery services: distributing face shields to hospitals on request (7).

We quickly transferred our suitable printers to the Summerhall print farm and kicked the rest into action. While organising safe return to the Makerspace was underway my colleagues and I had used our home 3D printing hardware to test and refine the existing design to allow the printing of visors in bulk, stacked one on top of another in batches 36 high, each separated by a hair width so they could be broken apart with little resistance.

At peak we were producing roughly 250 visor frames per day in the makerspace which were added to the greater stock being produced by Edinburgh Shield Force – the collective that had formed in the city. By 21 April 2020 - in little under a month since the crisis took hold-10,000 face shields had been produced and delivered to healthcare workers and hospitals throughout Scotland by the group (8).

These efforts, combined with hundreds of similar approaches across the United Kingdom, utilised the rapid speed of manufacture made possible by 3D printing to plug an emergency gap and ensure hospitals were provided with urgent supplies while mass production geared up and government sourced PPE began to re-enter the system. PPE supplies appear relatively stable for now, and our printers have since moved on to supporting the creation of bespoke hardware for the NHS and testing apparatus for medical research teams within the University but as with makers and makerspaces across the country, we're ready to ramp up PPE production again at a moments' notice.

Creative Commons for the common good

Key to the success of the project was the Creative Commons (10) and the internationally collaborative approach it facilitated. Designs were rapidly created, shared, prototyped, and improved on as an iterative process, pulling in expertise from across the globe.

The 3DVerkstan visor (11) manufactured in the uCreate Studio had been modified by Edinburgh Hacklab (an ingeniously practical change (12) to the design shifting the mounting pins for the protective transparent front by a few mm, allowing for a standard UK hole punch to be used for manufacturing transparent fronts). In turn we altered the design further to allow it to print successfully in stacks. As

with the optimised designs before ours, the modified model has since been shared with print settings, project files and tips for post processing (13). Making reuse of our work easy for other teams across the world. Our design has no doubt been improved upon since, modified further to suit the needs local to its producers.

Since it was enacted in 1998 Creative Commons has proved a powerful tool for collaborative, community, and common good work activities. With the development of the designs for PPE it provided a mechanism for hundreds of makers and experts from a variety of fields to work simultaneously on a problem in which time was of the essence. It ensured that the fruits of their labours were available to everyone as quickly and freely as possible. A massive, global community effort in which the mechanisms were in place to allow experts from every required field to contribute freely to the project to ensure all makers could manufacture PPE quickly, efficiently and to a shared standard.

The wider community

"It was great being able to contribute to EdinburghEMS where everyone has different skills and is working towards the same goal. Whether we needed a custom database set up for tracking PPE orders or an injection mould to be designed and optimised, there was someone on the team that had experience with it or knew someone that did!"

Miron Zadora, Director, Edinburgh Hacklab (14)

Throughout the pandemic, we have been in contact with uCreate Studio makers manufacturing PPE in their own projects:

The Edinburgh Hacklab – the driving force in drawing together Edinburgh's maker community to form Shield Force has Miron Zadora among its directors, previously a student technician at the uCreate Studio. Miron and his colleagues have since gone on to form the PPE Collective (15) dedicated to producing and developing PPE in the UK using ethical and sustainable practices.

In Canterbury uCreate Studio maker and University of Edinburgh undergraduate Edward Shapcott co-formed his own team of PPE producers. The team crowdfunded their production, supplying thousands of face shields to carers and charitable organisations across the city.

In London, University of Edinburgh student start up and uCreate makers Augment Bionics (16) had established their own 3D print workshop. As a medical tech start up focused on affordable bionic prosthetics, the team would move quickly from 3D printing into injection moulding for mass production. To date, they have produced and donated almost 120,000 face shields, sending them as far afield as Armenia, Uganda, Zimbabwe, Somalia, and Somaliland (17).

Seeing students and staff who had developed their maker skills in the uCreate Studio form their own bases of manufacture has been an immense source of pride for us as a service, but also provide evidence of the importance of library makerspaces and the skills they develop. Since first opening to Makers in January 2017, the uCreate Studio has seen a diverse range of outputs and projects carried out by its makers (18). As an experimental space, these have typically been initial low risk, prototypes. By design, projects will tend to mature to more advanced facilities before their true impact is felt and so directly measuring and communicating this impact has proved tricky in the past. In providing skills development opportunities to students that have since allowed them to support the NHS in a time of critical need. The importance of the digital skills developed in makerspaces and the impact they can have has never been clearer.

Conclusion

Makerspaces foster a range of practical, creative, and professional skills. They promote collaboration, innovation, and action. They can be used to surface new technologies quickly, to democratise access to tools and technologies with demonstrable potential to change the world for the better; and to empower people with the ability to have a direct material impact on the world around them.

In Libraries their access and availability can be maximised (19). They are treated as a resource that is useful to everyone. For centuries libraries have provided and promoted access to knowledge and ideas which pave the way for progress and innovation.

Library makerspaces let us do the same with digital skills and new technologies. The greater the prevalence and the wider the access, the more positive impact the new industrial revolution is likely to have on how we live, work and play.

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