THE MAKER MOVEMENT AND DESIGN AND TECHNOLOGY

Torben Steeg, D&T Consultant

Who are Makers?

Even if you haven't had any direct involvement with them, you've probably heard of folk who call themselves 'makers' or 'hackers', or of the 'Maker Movement', or of Fab Labs or hackspaces, or of open source hardware projects such as the Arduino and the RepRap 3D printer. All of these are aspects of maker activity.

'Maker' is a term used to describe people who like to make stuff; often using (and also designing and making) high technology tools (microcontrollers, laser cutters, 3D printers etc). To a large extent it is a largely self-defining term (if you call yourself a maker, you probably are one) and takes in a broad swathe of interests that includes crafting, Steampunk, heavy engineering, electronics, embedded control, programming, robotics and biotech amongst many other things. There is a strong bias towards open-source tools, both hardware and software, and a belief that the products you make (and those that you own] should be released with 'open' or Creative Commons licences, thus allowing them to be developed and modified (i.e. hacked) by others. This world view is summarised in the Maker's Bill of Rights.

The things that makers produce are often quirky and produced for themselves or their immediate community (rather than made with an immediate eye to mass production). Often they are a result of 'tinkering' or 'playing' with materials; see 'The Art of Tinkering' in Further Reading below. However there are also examples of things created by makers becoming the basis of a commercial company – many products on funding sites like Kickstarter have their origins with makers.

Roots of the Maker Movement

The desire to make stuff is hardly new. DIY has been around a long time and became more of a leisure pursuit and less a necessity during the second half of the last century. What is new is the coming together of this DIY mindset with a collection of tools and resources that have enabled the maker movement to do more and to communicate better. These include the rapidly dropping costs of digital manufacturing tools, the availability of powerful free software, the rise of open hardware, social networking and the growth of community spaces where makers can gather.

THE MAKER'S BILL OF RIGHTS

- Meaningful and specific parts lists shall be included.
- Cases shall be easy to open. ■ Batteries shall be replaceable. ■ Special tools are allowed only for darn good reasons. ■ Profiting by selling expensive special tools is wrong, and not making special tools available is even worse. ■ Torx is OK; tamperproof is rarely OK.
- Components, not entire subassemblies, shall be replaceable. ■ Consumables, like fuses and filters, shall be easy to access. ■ Circuit boards shall be commented.
- Power from USB is good; power from proprietary power adapters is bad. ■ Standard connectors shall have pinouts defined. ■ If it snaps shut, it shall snap open. ■ Screws better than glues. ■ Docs and drivers shall have permalinks and shall reside for all perpetuity at archive.org. ■ Ease of repair shall be a design ideal, not an afterthought. ■ Metric or standard, not both.
- Schematics shall be included.

Make: technology on your time

Drafted by Mister Jalopy, with assistance from Phillip Torrone and Simon Hill.

See http://makezine.com/2006/12/01/the-makers-bill-of-rights/ for a statement of use rights

Photo of the Amsterdam FabLab at the Waag Society

Two significant things happened in 2005: firstly Neil Gershenfeld published 'Fab'; a book that detailed the development of a making course at MIT open to all students and the subsequent creation, as a spinoff, of what he called a FabLab (Fabrication Laboratory), a workshop stocked with state-of-the-art but low cost digital designing and making tools with a focus on community use. There are now more than 400 FabLabs worldwide, including over 20 in the UK; one of the aims for a FabLab is that it should be able to make another one.

Also new in 2005 was the launch of Maker Media and the publishing of Make magazine and its associated website. The website has grown to include a shop (Maker Shed) of equipment and resources for makers as well a large and growing repository of step-by-step maker projects. In 2006 Maker Media ran the first ('Bay Area') Maker Faire (strap line; 'The Greatest Show (and Tell) on Earth') in San Francisco. In 2014 the 9th Bay Area Maker Faire hosted over 1,100 exhibits and there were 130,000 attendees. In 2013 there were 100 Maker Faires around the world, including seven in the UK, with a total of more than half a million visitors. And numbers have certainly grown again in 2014.

However, while FabLabs and MakerMedia are significant influences they also are just facets of the wider maker community, which is incredibly diverse. Across the world makers get together to hack and make in a wide range of settings from informal gatherings in cafes, through a wide range of 'makerspaces' and 'hackspaces' (there is a growing movement, mainly in the US, so far, to site makerspaces in libraries) to professionally run membership organisations such as TechShop – which is run a bit like a 'gym' for makers.

In the US (mainly; there is a scattering of affiliates across the world, including a couple in the UK), 100K Garages is an organisation that helps connect makers with each other and to those with fabrication facilities. On this side of the Atlantic, the UK Hackspace Foundation lists 49 affiliated hackspaces – and this certainly isn't the total; I know of a number of spaces that don't appear on this list.

The Maker Movement and Education.
When I read Gershenfeld's 'Fab' book, two things particularly struck me. Firstly he has some interesting and insightful things to say about how to organise a curriculum in which students are working on individual projects, based on very open and diverse starting points, using a wide range

Hackers

In everyday usage (especially by popular media) the term 'hacker' is generally used to describe those who illegally break into other people's computers. However, historically, such people were always called 'crackers'. Certainly, in maker culture, 'hacker' is used much more widely to describe folk who are clever programmers, adept at taking apart code and tweaking it for new purposes and, by extension, those who like to do the same with hardware.

of materials in a lab with a large number of digital fabrication tools available. However exploring that would be the subject of a different article.

Secondly it occurred to me that (even in 2005) many school D&T departments were at least as well equipped as the minimum specification for a FabLab (at that time the first schools were installing 3D printers, a technology that didn't, then, figure in the list of prescribed FabLab equipment). It seemed to me that here was a great opportunity to open up the school to the community – and open up the D&T curriculum to new ways of working. But discussions with schools at the time were not positive, partly because the idea of makerspaces was pretty new and few had heard of FabLabs and, probably more significantly, it was hard for schools to see past the barriers of things like insurance, health and safety and security.


In the US, the Obama administration has viewed the maker movement very favourably, referencing it in a number of key speeches and, last year, hosting the first White House Maker Faire. The result of this interest is that significant federal money, followed by substantial funds from industry, has been made available to set up the Maker Education Initiative ('MakerEd') with the aim of developing Makerspaces associated with schools. Because of the very diverse nature of the US education system this initiative is focused, at least to start with, on extracurricular activity. This is clearly a US-based Initiative, but they are very open to working with makers and educators across the world and four makerspaces in the UK are currently affiliated.

MakerEd is based firmly on a constructivist view of learning and sees engagement with making as a powerful lever to support learning. A number of US schools have embraced making as a core element of their curriculum. Most famous is High Tech High a network of 12 charter schools (roughly equivalent to a Multi Academy Trust in the UK) in San Diego. Even more radical is Brightworks, a private school where the whole curriculum is built around collaborative, mixed-age projects in which making is a core activity. Imagine: D&T as the central subject in the curriculum.

Two recent books, 'Invent to Learn' and 'Design, Make, Play' make the case for making as a core component of a rounded education and provide case studies from a range of schools as well as advice on how to get started.

You'll notice that most of the sources I'm referencing are from the US; this is a direct result of that being where the maker movement is most active (and it helps that the US administration is supportive, seeing a positive contribution to STEM education). However, I am convinced that STEM subjects in general and D&T in particular could benefit from the interest-driven, open-ended, constructivist approach to developing products that the maker movement embodies. This isn't to argue that all of D&T education should be given a maker flavour, but I do think it is a perspective that could enrich practice.

BRIGHTWORKS: AN EXTRAORDINARY SCHOOL

everything is interesting
we can create anything
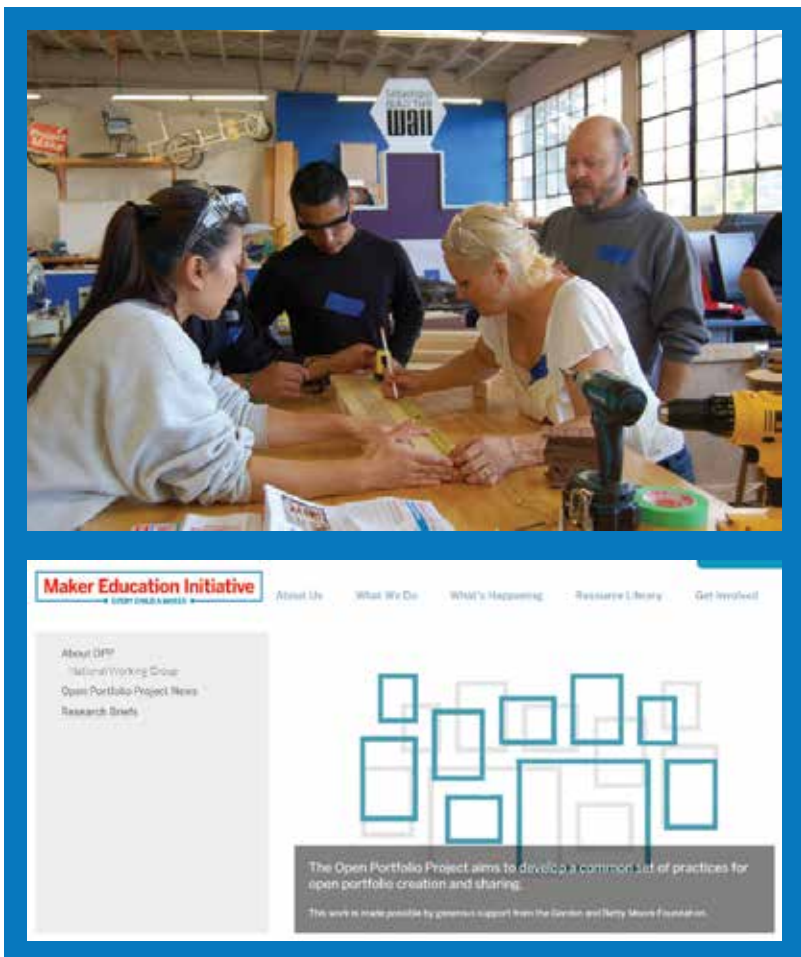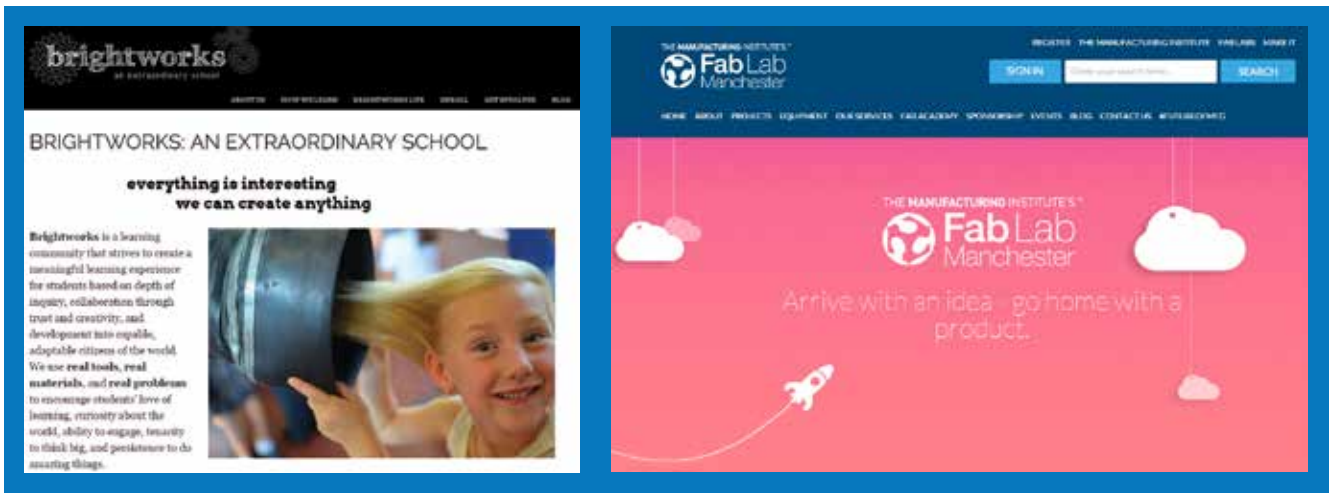
Some examples from the UK

I hope, having read this far, that you'll be pleased to hear that there are examples of education and makers working together in this country as well. At a strategic level the RSA, with NESTA and BIS, is exploring ways to support the maker movement and links to education are firmly in their sights; expect further announcements from them 'soon'. And the Government is certainly interested; in September this year the Cabinet Office, also with BIS, organised a round table conference, hosted at the Manchester FabLab, titled 'Maker spaces, digital fabrication and user-innovation' at which the education perspective was well represented.

It will take time for these initiatives to produce concrete outcomes. In the meantime, there are schools and makers already working together.

Cefn Holle is a maker based in Morecambe and the developer of 'Shrimping It', a low cost accessible microcontroller system based on the Arduino. Amongst the projects he has developed for schools is one based on persistence of vision. A full description is provided at the link at the end of this article. Cefn says of the work he does with schools:

"Generally there's a distinctive opportunity from working outside the assessed education system as well, giving us the freedom to allow kids to be driven by their own interest rather than steered towards creating a specific thing. They can fail and learn from that failure."

Mark Stroup is a maker and educator based in London. In a current activity he is working with a middle school advisor on a Saturday outreach program. The theme will be "This is my verse," an allusion to a line in The Dead Poets' Society. The focus of what he will be doing is geared to self-expression. Participants will be working with and learning about electronics - but this is seen clearly as a means to an end. Mark says:

"We all should practice art, literary criticism, and engineering if we feel like it, not because some outside agency says we are good at it …I was a lousy math student and a lousy woodshop student. But I still love those subjects, and I don't think I'm foolish for pursuing my interest in those subjects. I bring that perspective to people who are in one of my workshops and want to be makers."
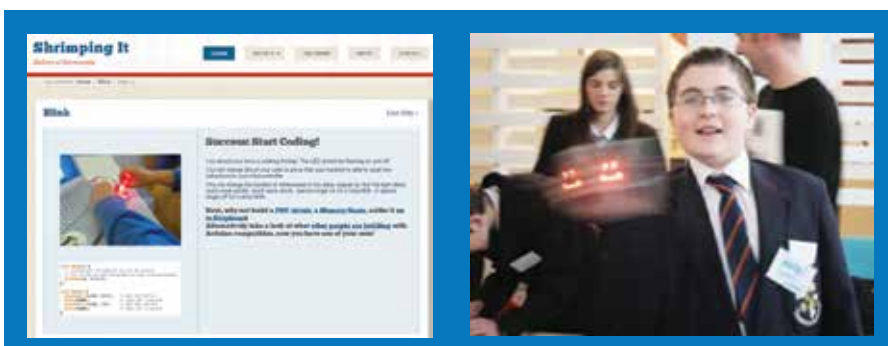
Try it yourself

The best way to get to understand the Maker Movement is from the inside. You can find your nearest hackspace or FabLab by searching, respectively, the UK Hackspace Foundation or the Fab Foundation websites. Get in touch with them and start to explore what you might be able to do together. It is very likely that they will be keen to develop links with local schools; the next best thing to making for most makers is sharing their maker knowledge. You can probably develop a reciprocal arrangement as it is probable that you and your school have capital, skill and intellectual resources that could be useful to local makers. You will probably start with some extra-curricular activity as you get to know each other, but a medium term aim could be to develop a unit of work to embed into your curriculum that is built from a maker perspective.

Don't forget to look up when and where the nearest Maker Faire will be. Not only is it a thoroughly entertaining way to spend a day (encourage your students to go as well) but it might well be that you have students (or members of staff) whose work would could be exhibited; most Maker Faires are very keen to include young people as exhibitors.

Finally, if you are working with makers in your curriculum (or you start to do so), please do let us know.

Links

100K Garages: www.100kgarages.com
Arduino: www.arduino.cc
Brightworks: www.sfbrightworks.org
Creative Commons: https://creativecommons.org
Fablabs: www.fabfoundation.org/fab-labs
High Tech High: www.hightechhigh.org
Kickstarter: www.kickstarter.com
Maker Education Initiative: http://makered.org
Maker Faire: http://makerfaire.com
Maker's Bill of Rights: www.misterjalopy.com/?page_id=219
Maker Shed: www.makershed.com
Make Magazine: http://makezine.com
Open source hardware: http://www.oshwa.org
Open source initiative: http://opensource.org
Open software licensing: www.fsf.org/licensing
RepRap: http://reprap.org
RSA: www.thersa.org
Shrimping It: www.shrimping.it
Techshop: www.techshop.ws
UK Hackspace Foundation: www.hackspace.org.uk

Further reading

Gershenfeld, N (2005). Fab: The Coming Revolution On Your Desktop – from Personal Computers To Personal Fabrication. New York, NY. Basic Books.

Honey, M and Kanter, DE (2013) Design, Make, Play: Growing the Next Generation of STEM Innovators. Routledge

Martinez, SL and Stager, GS (21013) Invent To Learn: Making, Tinkering, and Engineering in the Classroom. Constructing Modern Knowledge Press

Wilkinson, K and Petrich, M (2014) The Art of Tinkering: Meet 150 Makers Working at the Intersection of Art, Science & Technology. Weldon Owen