Duct-tape and dreams

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Abstract

The making and tinkering movement has become increasingly mainstream over the past decade, pioneered in part through the popularity of magazines like 'Make', events such as Maker Faire and DIY websites including 'Instructables'. Science centres and museums have been developing their own ideas, notably the Tinkering Studio at the Exploratorium. In this commentary piece, we reflect on why this movement has a strong appeal for the Life Science Centre in Newcastle upon Tyne and why we are in the process of developing a new making and tinkering space to help us enact our centre's vision to 'Enrich lives through science'.

Keywords

Informal learning; Public engagement with science and technology; Science centres and museums

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Background and context

Newcastle upon Tyne in the north-east of England is steeped in the history of the Industrial Revolution. From Stephenson's Rocket and safety lamp to Swan's lightbulb, through which the city's Mosley Street became the first street in the world to be lit by incandescent light, the region's history is full of inventors and makers who have long toyed and tinkered. This historical context explains, at least in part, the appeal of the maker movement for a science centre set in Newcastle.

The Centre for Life 'village', in the heart of the city, is a place where academia, industry, education and entertainment meet. Bars and a nightclub rub shoulders with university research laboratories and two NHS clinics. This melting pot of viewpoints renders 'Life' quite unlike other science centres and encourages an entrepreneurial spirit. This resonates well with the tinkering movement which often celebrates the whimsical and the wonderful.

The pioneers of the industrial revolution may seem like relics of the past but their approach to thinking outside the box has never been more relevant.

Malleable dreams

This reinvention is a particular imperative for us in the north-east. We have some hair-raising statistics [The Case for Culture for Children and Young People, 2017]:

- Almost a quarter of children in the region live in poverty.
- Over a fifth of children in the region are eligible for free school meals.
- There is a higher rate of children with special educational needs in our schools than the English average.
- We have a third more children in the care system than the English average.
- The region consistently has one of the highest unemployment rates of the U.K.

It's hardly surprising then that a report found that young people in the north-east were the least confident in the country about their futures, [City and Guilds, 2016]. In August 2016 one local newspaper reported with the front-page headline: 'North East teens' dreams are less ambitious.' Serious stuff.

It is time for us to consider that aspirations themselves can be nurtured and encouraged to grow. This is where we see much of the strength of the tinkering mindset.

Regardless of whether or not our young visitors go on to study science, technology, engineering or maths, the habits developed and practiced in making and tinkering can be seen as building positive skills for all our young people. For us, this is about encouraging young people to have a vision of what they'd like to achieve and support them in working towards that goal. It's about the state of flow they get drawn in to whilst working with their hands, trying to figure out how to bring to life what's in their head. It's about not accepting the world around them as unchangeable, but seeing it as malleable and crucially to see that they can be the agent of that change.

There is a saying amongst makers and tinkerers that there's little that can't be fixed with duct-tape. This may be true, but we also need a generation who know how to dream.

Influencers

In our Making Space we have been greatly influenced by the work done at the Tinkering Studio at the Exploratorium. Their 'Tinkering Tenets' include such pearls as 'create rather than consume' and 'go ahead, get stuck' [Wilkinson and Petrich, 2013]. Encouraging paying visitors to get stuck and find the road ahead challenging rather than smoothing their path isn't always an easy sell, but a true sense of achievement often requires a real chance of failure.

The research on the concept of science capital by Professor Louise Archer and her teams through ASPIRES and Enterprising Science [Archer, Dawson et al., 2015] has also had an impact on the development of the Making Space and other areas of the science centre. This research helped us to articulate what many of us have long felt, that there are many more facets that influence a young person's STEM identity than the knowledge gained from a subject at school.

Other influencers on our Making Space include Ignite! This organisation championing the creativity of young people introduced us to the "5 Rs of creativity": Resilience, Reflection, Relationship, Resourcefulness and Risk-taking [Hall, 2017]. Through discussions with those at Ignite! we began to think of these traits as skills that can be nurtured, but that are often not rewarded in formal educational environments. These 'Rs' were initially the work of two professors of learning, Guy Claxton and Bill Lucas, and although the definitions have evolved in different contexts we find this formulation of the 5 Rs stuck for us.

Inevitably, we learn most by the things we do ourselves, and that has also been true for our journey with the making and tinkering movement.

Life's journey

Over the last decade our interpretations of the making and tinkering movement have evolved. We first hosted Maker Faire U.K. in 2009 and brought our own philosophy of making and tinkering to exhibits and programming in the centre. We opened our current Making Space in 2015. Initially a temporary area, it proved popular with visitors and has remained a key part of the visitor experience.

Life's strategic direction is influenced by the regional challenges we face; the making and tinkering movement plays an important role in our future.

Like many science centres, Life is not solely focussed on STEM subjects as an academic pipeline. Inspiring a few extra graduates would be nice, of course, but the purpose of our centre goes further. We aim to play a part in building science capital across the region, inspiring people to explore and make sense of the world through STEM. For us, this is about showcasing science and technology as a cultural and lifestyle choice as much as it is a career choice. A science centre is a space where families spend quality leisure time, for fun.

We adopt a light touch, but whimsy does not fit well for everyone. For some, science should always be serious. The counterpoint to this seriousness, for some, is the arts. Blurring the boundaries between how the two are perceived is important to us.

A proportion of the visitors to our centre, notably children, see the arts and sciences as distinct worlds with different philosophies. It is telling that research found that children as young as ten are forming perceptions of themselves as 'not scientists'. Much of that is due to the way they view science and scientists [Archer, DeWitt et al., 2010].

Why tinkering?

We want to demonstrate that there are many shared skills and processes between these so-thought discrete worlds. These shared skills and processes lie in understanding and interpreting thoughts and ideas. A mechanical and material sympathy are essential, but so is the frame of mind it takes to build and create.

Tinkering can help build these layers of understanding.

The value of making and tinkering is greater than any end-product. The flat-packed dinosaur or duct-tape-scribblebot our visitors proudly carry home may

feel to them like the reason they spent time in the space, but the real value is in the *process* of creating.

Whilst we aim to inspire and enable visitors to see how accessible these styles of activities are, we also need to ensure our visitors feel the experience is worth the entry price. There's a fine line between 'I could do this at home', and 'I could have done that at home'. Some of this, in the case of tinkering, is about having familiar materials that they could access at home, but sparking ideas that might not be obvious.

We believe the processes involved in making and tinkering have value regardless of age or background of the participants, but we see that the majority of our visitors come with, and for, children.

Although process driven, the participants in making and tinkering activities often need to have an outcome in mind. When the hands cannot make what the mind can see, designs need iterating and prototyping along the way. In this way, thoughts and hands meander and the participant finds a fluency with materials that they might otherwise struggle to express. This sense of flow can render the participant completely absorbed by the activity, leaving the outcome of lesser importance than the process.

Having a vision of what they might like to achieve and working towards that goal can prove tremendously valuable. Again, it is about seeing the world as mouldable and recognising that they can be the agent of that change.

Creative play

It is easy to dismiss making and tinkering as mindless playing, but we mustn't devalue play so swiftly. Making and tinkering help us practice and build the skills needed for creative thinking. We often expect to be good at things we've not given ourselves enough time to practice. At Life, we consider creativity to be such a skill.

If skills are easy to master there is usually little fun to be had in mastering them. There is a powerful emotional driver in failure, failure, failure, success — that's why game designers spend millions in getting this balance right. We should embrace this 'hard fun' too. Tinkering is as much about the failure as it is about success, but it can be hard work to retrain ourselves to think that way.

In our current Making Space families engage with whatever the activity of the day is, building, modelling, printing. We love it when a child gets stuck in and creates something wonderful, high above their expectations.

Research shows us that engagement and encouragement in a home environment is as important, if not more important, than similar encouragement at school in raising a young person's science capital [Archer and DeWitt, 2016].

How families play together matters.

Levelling the field

We observe that tinkering is often a great leveller — of abilities and ages, but also of generations. We have seen parents stunned as their six-year-old child correctly

identified a painting by an artist of whom they had never heard. Other children confidently pick up glue guns or soldering irons, tools their parents weren't aware they'd ever used. Grandparents can enthral children by simply threading a needle. These spaces are at their best when generations work alongside each other or with the child in the position of authority and the older generation providing assistance. One of our challenges is how best to design spaces and activities that encourage adults to work with and not doing things for the child.

Some of our favourite interactions have parents watching their children engaged in something for a much longer time than they expect. When parents say: 'We could do more activities like this at home', we see new habits being made. Some parents are surprised that their children are engrossed in something other than a screen and are delighted to see them interacting so deeply with the real world.

To make, is to dream

It shouldn't come as a surprise to us that children like making. Recently, a cultural collaboration in the north-east surveyed a thousand young people to find out how to build a better region for those growing up here. The results were astonishing. 49% of those surveyed wanted to 'make things', [Dickinson, 2017]. This was higher than 'grow my talent', or 'learn things'. *What* they want to make will need a little more research, but it is already clear is their strong desire to be creators and not just consumers. They want to contribute and to build. A challenge for centres like ours is to work out how best to offer opportunities and constructively nurture this desire.

At Maker Faire U.K. a few years ago, a maker was reminiscing on their childhood tinkering in a relative's shed, dreaming up ideas. Their mentor had the time, the tools and the skills to help bring at least some of these dreams to life. A spark was kindled. The maker looked wistfully around and said, 'children can come to places like this to realise that they like these things'. With the decline of mentors with the skills, tools and workshops in sheds, this comment showed us that part of our contribution towards raising the science capital of the region is to be to be a destination where people can discover what science and STEM *are* beyond the school experience. Where they can come to feel like a scientist or engineer. Perhaps this is how we enact our vision to 'Enrich lives through science'.

The crucial idea for us is that the skills of creativity can be nurtured and practiced. They are useful habits of mind to develop. If we practice them, we arm ourselves with stronger abilities to think creatively. And thinking creatively is surely to be valued in our rapidly changing world.

The issue of scale

We must balance our idealism with reality, however. Life is an educational charity; a science centre with paying visitors who have expectations of access to our gallery spaces. On a busy day, our current Making Space accommodates three hundred visitors, on exceptional days over four hundred. It is sometimes difficult to balance our need to reach high numbers in the space with our aims for a high-quality visitor experience. To reach more visitors and allow more time for those engrossed in making and tinkering activities, Life Science Centre is in the process of redeveloping an exhibition space dedicated to creativity to open in 2019.

Creativity Studio

The working title of this new gallery is 'Creativity Studio'. It will encompass 450 square metres of our visitor centre (in contrast to the 20 of our existing Making Space). The main purpose of the area will be to support creative thinking through making and tinkering activities. Our current Making Space can seat around a dozen people at any one time. The Creativity Studio will have capacity for over sixty. Unlike the Making Space, which is entirely staff facilitated, there will also be exhibits in the new area. These exhibits are being designed to increase a visitor's confidence in their own creativity, encouraging them to engage further.

The exhibits are an attempt to counter some of our observations that the Making Space has a high 'bounce rate' — a proportion of visitors who approach the space but decide not to engage. There are several possible reasons for this. Perhaps the activity on that day doesn't appeal, or maybe the visitor feels that it might take more time than they have: both perfectly valid. We are keen to reduce the likelihood, however, that visitors don't engage because they feel intimidated, or feel 'not good enough', or 'too stupid'. We would like to believe that through careful considerations in the design process we can make our space more welcoming for all our visitors and encourage them to feel comfortable and confident in the space. More confidence, we hope, will lead to greater engagement.

We know through the research that many people have strong preconceptions of what is 'not for me' [Archer, DeWitt et al., 2010]. This is a clear risk to engagement, which we must take seriously. We must do what we can to identify barriers and work to dismantle them wherever we can. Yet we also want our spaces to be interesting and inviting to those who are already confident in the area. We, and other centres in similar positions, would like to have our cake and eat it.

Equity

Recent research has raised questions of the equity of accessibility to informal STEM learning [Dawson, 2017], and other researchers question how different environments can influence children's understanding of ownership over tools and materials [Sheridan et al., 2016]. This raises questions of whether we can address equity in opportunity of access to resources, at least in part, through the conscious design of the environment and the way we develop staff facilitation.

One of our greatest challenges in our future making and tinkering activities is to provide opportunities for our participants to be stretched, regardless of their background and experience. Our aim is to create experiences that are personal and meaningful. To do so, we need to push and be pushed out of our comfort zones, otherwise there is little of the emotional benefit of having overcome the adversity that builds resilience. In order for our visitors to put themselves in a vulnerable position where they might fail, we ought to offer them a place where they feel supported. To do so, they need to have trust in our gallery spaces, in our staff and in us as an organisation.

This difference in scale of us moving from our Making Space to the Creativity Studio will provide us with opportunities and challenges in reasonably equal measure.

And so, on the cusp of our gear-shift, we continue to tinker with our concept of tinkering; continuing to research and note how our visitors' behaviour changes

when we adapt the environment or shift our approach to instructions. Tinkering is often about the process more than the result. Producing something to be proud of is a great thing, but so is producing something where you have a strong idea of how you'd make it better 'next time'.

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