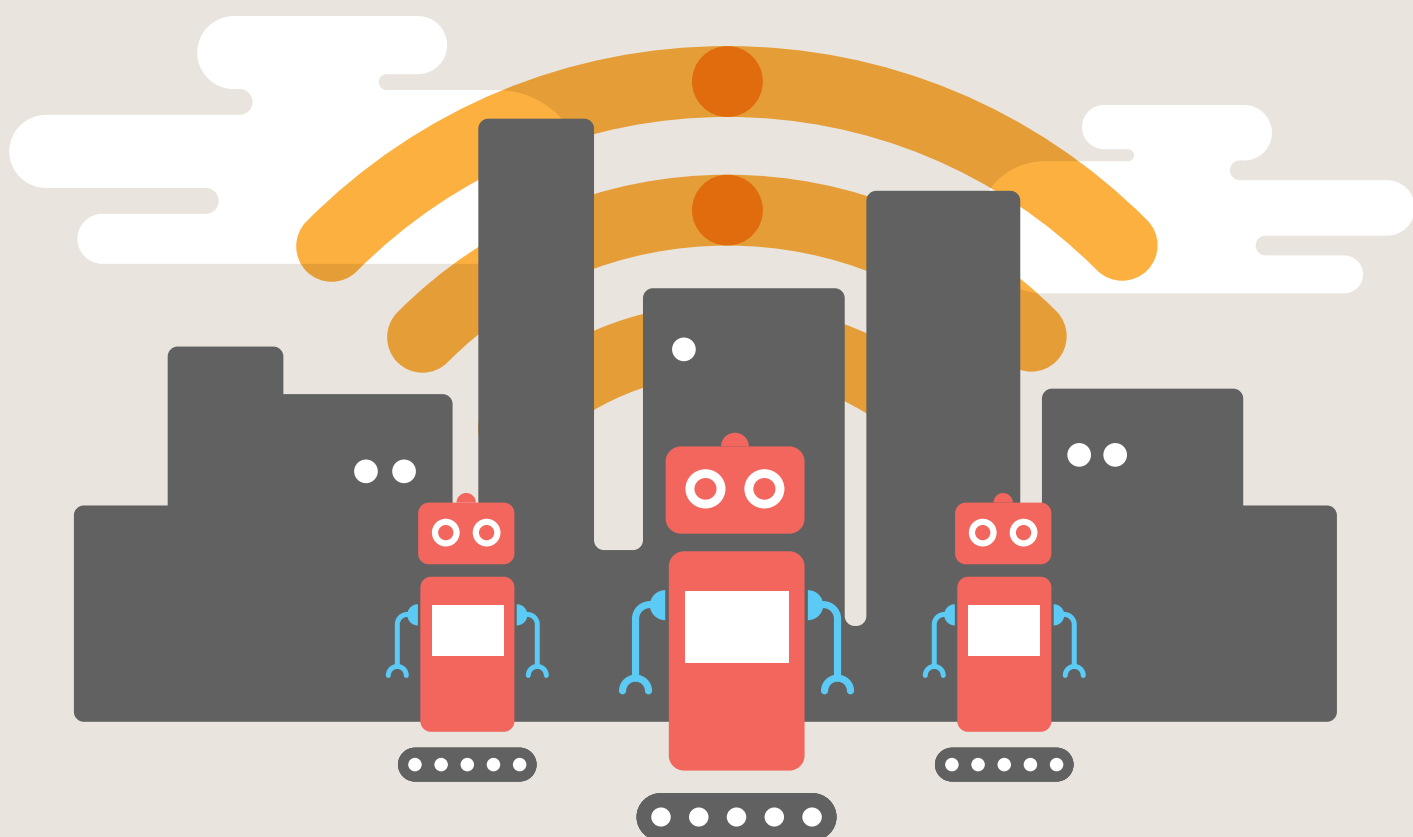


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Young Digital Makers

Surveying attitudes and opportunities
for digital creativity across the UK

Oliver Quinlan
March 2015



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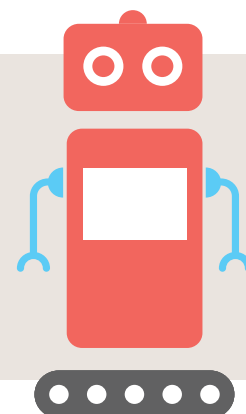
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Young Digital Makers

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Foreword

Martha Lane Fox, Baroness Lane-Fox of Soho

Digital technologies pervade every part of our lives. They offer us rapid social and economic change as well as complex ethical questions. We need to understand how they work in order to make the world work better. But as this report shows, we risk another generation growing up as passive digital consumers rather than confident digital makers.

The internet now contributes roughly 8 per cent of the UK's GDP – the highest of the G20 countries. But ten million of the UK's population lack basic digital skills and seven million have never used the internet. Only 30 per cent of small businesses make effective use of the internet for marketing and sales, despite the UK being home to the highest percentage of online shoppers in Europe. Only one of the world's top 100 websites – the BBC – is British (despite the web being invented by a Brit). And 90 per cent of new jobs require digital know-how.

The lack of digital skills in the UK needs addressing as soon as possible. This report reveals just how much is already happening, from the work of coding clubs to activities in the school curriculum to developments in online tools. But the gaps are more striking than the successes, amplifying existing inequalities and hierarchies rather than empowering more people. London has the best provision, but rural areas are being left behind. Many girls are defying stereotypes – but far too many are not engaging, and the gap in confidence between boys and girls is widening. Without radical steps, we won't change the woeful numbers of women working in the tech sector, which currently stands at 17 per cent.

Eighty-three per cent of young people surveyed by Nesta have made something online. That's a great starting point, but we need to ensure that this interest is nurtured. It's vital that our education systems catch up with the tools young people are using in the rest of their lives.

Like Nesta, I support the broad notion of digital making which is about harnessing the digital world to tell stories, creatively solve problems and create innovative new businesses (as well as the usual coding, computational thinking and algorithms). It's fun, motivating and beyond traditional subject limits, inspiring collaboration across the arts and sciences and between people – essential skills in the face of rapidly blurring boundaries. Knowing how digital products are made should also encourage more critical usage of the digital infrastructure in our daily lives – from online security to data protection.

We need to move quickly to fill in the gaps revealed in this report, apparent across all aspects of society. Hopefully many of the most confident digital makers can help their parents and grandparents to also participate – something that Go ON UK¹ has been championing. A heartening feature of this report is the extent of public support, with parents learning alongside their children, supported by both volunteers and industry. That's probably the best way to ensure that digital confidence really does become part of our culture.

Foreword

Tony Hall, Director-General, BBC

Britain is renowned for its creativity. And I'm proud of the contribution the BBC makes every day, as we have done since our first programmes were broadcast in 1922. And just like our very own *Doctor Who*, we have evolved and innovated through the years. We have consistently broken new ground with world-class programmes like *Life Story* and *Wolf Hall*, as well as the game-changing BBC iPlayer.

Great ideas can, and do, come from anywhere – moments of inspiration, concerted efforts to address audience needs, or even throw-away suggestions. But ideas in and of themselves are not enough. They need to be turned into reality. They need to be made.

Digital technology has fundamentally changed our lives for the better and we've had countless British success stories, but I'm struck by the huge potential we're yet to tap into. Nesta's report clearly proves young people are eager to make things digitally, but it also highlights a concerning gap between interest and action.

Bridging that gap matters. It matters to Britain's place on the world stage, to our creative economy, and to individuals as an outlet for their ideas. We need to make sure the next Tim Berners-Lee – and the digital equivalents of Steven Moffat, David Attenborough, Hilary Mantel – have the tools, confidence and know-how to express themselves.

This report helps further our understanding of the state of the nation and it shows we're making good progress. There are a wide range of organisations committed to helping young people unlock their digital creativity, and they are doing fantastic work. It also backs up what we intuitively knew – that parents and teachers are overwhelmingly supportive.

But there's still work to be done. The industry, teachers and parents have all repeatedly told us – and these findings support their view – that many people simply aren't aware of the resources and local clubs available to them.

This BBC is in a unique position to make a difference. We are the only public service that everyone uses and also provides a wider social benefit. Through our Make it Digital initiative, we plan to raise awareness of coding and digital creativity among all audiences, and amplify the vibrant ecosystem that already exists.

We are giving digital creativity a platform on a scale it's never had before, using our hugely popular and much-loved brands to create new TV programmes, radio shows and digital content. This will enable all audiences to see how Britain has helped shape the digital world, why digital skills matter and their growing importance to our future. And we hope it will inspire people – young and old – to take their first steps in moving from digital consumers to digital creators.

But raising awareness is only part of the solution. The BBC plays a crucial role as a catalyst and hub in the creative industries, creating £8 billion of economic value for the UK. We want to extend that approach to digital creativity. We can bring together organisations already making a difference, help the next generation of pioneers navigate these opportunities, and enable them to take their learning journeys further.

This isn't a challenge just for the BBC, or just for the digital and creative communities, it's a challenge for the nation. A huge part of the BBC Micro's success in the 80s was the collective drive and support from enthusiasts, hobbyists and those keen to explore their own potential.

It's precisely that spirit we need to capture for the digital age. We all have an opportunity to help digital creativity become as familiar and fundamental as writing, and I'm truly excited by what Britain, and future great Britons, can achieve.

Executive Summary

This report explores the emerging field of digital making for young people in the UK. Based upon research Nesta has carried out, it charts the organisations providing opportunities for young people to make things with technology; looks at how these opportunities relate to what young people learn in school; and explores the attitudes of young people, parents and teachers towards digital making.

For most young people digital technology is an everyday part of life. Many are avid consumers of digital media. However, they often don't understand how to manipulate the underlying technology, let alone how to create it for themselves.

As technology shapes our world, young people need to be able to shape it too. As skills and work become increasingly technologically mediated, the need for digital skills is paramount with some calculating a potential £2 billion loss to the UK economy from unfilled roles requiring such skills.²

What is digital making?

Digital skills, digital literacies, digital creativity; there are many terms used by different people in different ways in this area.³ Since 2012, Nesta and others have been emphasising digital making as distinct from simply using digital devices, and as the best way of understanding how technology works. Our work to date has focused on helping young people to 'look under the hood' of technology while they are making.

From programming entirely on a computer to designing and 3D printing physical objects, digital making represents a diverse range of activities. It doesn't include checking emails or browsing a website (clearly digital, but not making). It isn't the array of making activities young people take part in without technology (worthwhile that they are). Between the technical and the creative is an intersection where young people make useful projects while learning about technology.

Other groups of people refer to digital making more broadly. They include activities such as producing electronic music or editing a video in a way that may not involve understanding how the fundamental technology works. As we can see, digital making is not just about nurturing an interest in technology for its own sake or as a specialism.

Our definition of digital making

For this report we have taken a broad look at digital making. The term is used to represent a continuum of skills and understanding. In our surveys of young people, parents and teachers we defined digital making as 'learning about technology through making with it'. However, we also asked these groups about interests and activities that might be seen as more broadly digitally creative such as editing photos or making music, many of which were very popular.

In talking to organisations we sought those who self-identified as being involved in digital making, seeking to understand what kinds of activities they provide. In such a complex field we will not have picked up everything. Much digital making is happening informally between peer groups and in communities without any organisations coordinating this.

Face-to-face interaction with others is a vital part of developing learning in practical activities such as digital making, and so we have focused on those organisations that create opportunities for this kind of activity.⁴

The current digital making landscape

In the UK there is currently a lack of skills in making with technology, with the recent House of Lords report on digital skills warning that change is so rapid the UK could be left behind in terms of our digital capabilities.⁵ However, action is being taken to address this. For example, from September 2014 school children in England as young as five and six will be taught to create and debug simple computer programmes. Outside of school, many organisations across the UK are supporting young people in learning to create with as well as consume technology – to become digital makers. Alongside this we have some creative and high-profile industry activity lead activities such as Barclays' Digital Eagles programme and Samsung's Digital Academies. As our research found, young people across the UK are having their first experiences of digital making.

Nesta has been working with partners to make this happen for some time. In 2011, we published the *Next Gen* skills review with Ian Livingstone and Alex Hope that called for changes to the National Curriculum. Since 2012 our Digital Makers Fund, set up with our partners Mozilla and Nominet Trust, has funded organisations across the UK providing opportunities for young people to learn about technology through making.

In 2010 computing became part of the curriculum in Scottish schools. September 2014 saw computing become a new subject in the National Curriculum for England, with aspects of programming and computer science in lessons for all young people aged six to 14. Many teachers in Wales and Northern Ireland are integrating aspects of digital making into their ICT lessons. However, nearly a third of UK teachers in our survey reported that their students do not currently receive enough teaching time to reach the level expected of their age group in these subjects. It is early days for computing as a compulsory subject, but the demands of studying it are becoming greater. Extra-curricular activities should play a role in achieving these high ambitions.

Enabling digital making to grow

Far too few young people have regular opportunities to engage in digital making. Half of those we questioned make things less than once a week, or never. We estimate that over 80 per cent of the ten million school age children and young people in the UK are interested in digital making, yet in 2014 there were only 130,000 face-to-face places offered by the making organisations we identified.⁶ These organisations are doing a terrific job, but their impact is currently limited.

A huge expansion is needed if we are to grow a nation of digital creators who can manipulate and build the technology that both society and industry are increasingly reliant on. This expansion cannot be left exclusively to professionals, however, as we simply don't have enough of them. It will require the mobilisation of enthusiasts and interested amateurs, from parents and non-expert teachers, to those working in the tech industry, working and learning alongside young people to help meet this demand. Encouragingly, almost two-thirds of parents and carers say they are interested in participating in digital making.

As well as greater quantity of activity, the field needs to grow by providing activity that is compelling for new and different groups of young people. They need to be engaged in digital making in a way that is relevant to them and their hobbies and interests, alongside discovering new avenues for creativity and self-expression. What children learn through this process may contribute to a skillset for future employment in a technology-related job, but these skills will also lend themselves to creative roles, which our research found is likely to become increasingly important.⁷

Making all of the above happen is a creative challenge, and Nesta calls upon organisations from media to tech companies and grassroots organisations to rise to this, so that digital making becomes part of the national psyche for the next generation. This will require innovative approaches to engaging new groups of young people through developing experiences that are rewarding. We need to convert dabbling with technology into embedded habits and normalise digital making as part of youth culture.

We cover this in the report through the following three areas:

1. What and where do young people make?

- **Participation:** To understand uptake, we examine who is currently taking part in digital making and how often.
- **Provision:** Exploring the infrastructure of a growing sector of organisations in the UK providing opportunities for digital making for young people. We describe the kinds of activities these organisations are providing, where these activities are available, and how these organisations are structured and growing.

2. What do people think about digital making?

- **Perceptions:** Discovering the attitudes, interests and awareness of young people, parents and teachers towards making with technology.
- **Ambitions:** Looking at what young people would like to make, how their parents think it fits into their future and the development of skills in school.

3. Conclusions, key findings and recommendations

- Information about organisations providing face-to-face digital making experiences.
- A summary of the findings from our surveys of young people, parents or carers and teachers.
- Identifying the directions that those involved in different aspects of digital making might take to increase participation and further develop skills.

How we conducted our research

Research was gathered through representative surveys across the UK of young people aged eight to 18, their parents and carers, and teachers. Our researchers collected information about informal learning organisations through analysis of online media, surveys, case studies and interviews. Any statistical comparisons quoted have been tested for significance.

Recommendations

- 1. The high levels of interest in digital making amongst young people and parents need to be capitalised on further.** The digital making movement has had a strong start, but there is a clear need to increase action, and address the current lack of awareness of parents and teachers, if the demand for digital making amongst young people the across the country is to be met.

We would like to see: existing digital making activity given more support to grow, through the scaling up of existing work and the creation of new digital making organisations. We would also like to see more staff and volunteers to run activities and help for parents, and teachers to navigate the digital making opportunities available for children and young people ([See point 1 of Summary of research findings on page 52.](#))

- 2. Young people need to be supported as digital makers across the UK, not just in London and areas that have high provision.** There is a strong interest from young people and parents across the country that is not yet met by the scale of current provision. All areas have potential for growth, but the creative and high-tech economies are disproportionately based in London and the South East,⁸ and there is a danger of educational opportunities reinforcing this.

We would like to see: digital making opportunities for young people increase across the whole of the UK, but particularly in the East and South East (where provision is especially low). We would also like digital making organisations to focus their work on geographical areas that are less well provided for ([See point 2 of Summary of research findings on page 53.](#))

- 3. Non-professionals – such as volunteers, parents, teachers, and young people themselves – need to be mobilised.** Face-to-face interaction with others is a vital part of developing learning in practical activities such as digital making.⁹ We simply don't have enough technology professionals to work with young people at scale, but there are many examples demonstrating that non-professionals can facilitate digital making with the right resources and support. Rather than see the process as tackling a deficit, we see it as an opportunity to support enthusiasts and interested amateurs to learn alongside young people.

We would like to see: resources and support targeted at skilling up non-experts in order to engage new groups of young people in digital making, beyond tech enthusiasts. The potential of peer-to-peer learning should also be tapped into. Many online resources, such as Scratch, are also already designed for young people to access independently as a tool or to supplement learning face-to-face, while Code Club supports volunteers to teach programming to children in schools. These should set an example for future development ([See point 3 of Summary of research findings on page 53.](#))

- 4. There needs to be greater access to a variety of making opportunities catering for a wider variety of young people and their different interests, ages and genders.** For instance, our survey showed girls are interested in digital making, but less interested in learning about technology for its own sake. Much of the public discourse has been around programming and fostering an interest in technology, and these are the most common activities provided by organisations. However, the demand from young people is to make things that are a culturally relevant part of their lives.

We would like to see: opportunities for engaging with digital making targeted at a broader range of young people's passions (for instance, music or fashion), rather than simply an interest in technology itself ([See point 4 of Summary of research findings on page 53.](#))

- 5. Clear pathways to excellence should be built to grow young people's ambitions as digital makers and help them fulfil their potential, in and out of school.** Many young people and their parents report confidence in computing, but some teachers do not think young people are reaching their expectations.

We would like to see: digital making opportunities that take account of young people's prior learning and aim to deepen their skills, providing regular activity and not just first-time experiences. Accredited informal learning with Open Badges would allow providers to build on this for progression. Achieving these ambitions will require joined-up informal learning activities and resources, some linked to the curriculum ([See point 5 of Summary of research findings on page 54.](#))

- 6. Schools must exploit their potential as a hub for digital making opportunities, work with informal learning organisations, raise parents' awareness and recruit volunteers.** Three-quarters of digital making organisations are already working in schools, but with very low teacher awareness of their activities there is enormous room for growth.

We would like to see: teachers supported at all levels to provide digital making activities across the curriculum; extracurricular opportunities in schools expanded; and the provision of the space and resources young people need to collaborate. The continued expansion of professional development is also needed to ease this transition ([See point 6 of Summary of research findings on page 54.](#))

- 7. Digital making organisations need to be supported to grow sustainably through new and existing partnerships with grassroots organisations and private companies.** Most digital making organisations are early-stage but promising, with huge opportunities for growth. They and their public and private sector partners have so far worked closely together with great success. As new organisations emerge, efforts must be made to sustain this collaborative approach.

We would like to see: an increase in industry support – through finance, through sharing expertise and providing volunteers. Scaling the collaboration between digital making organisations and the wider industry will ensure that young people have a range of opportunities that are diverse but complimentary. (See point 7 of Summary of research findings on page 55.)

Introduction

Most of us have already accepted digital technology as an everyday presence in our lives and those of our children. Young people are avid consumers of media such as websites, and apps, and enthusiastic users of gadgets and electronics. They use technology to communicate, to manage their social lives and to experience entertainment and culture. Increasingly schools, colleges and universities are integrating online platforms and digital communication into the way they organise and deliver learning to young people. As they get older young people will use digital media to find job opportunities, to work flexibly and to mediate their relationships.

Our society has become adept at using and consuming digital media. The adoption of now commonplace technologies such as text messaging, social networking and music streaming often shows young people leading the way.

When it comes to manipulating and making things with this technology, the story is rather different. While the competent consumption of digital technologies has become near ubiquitous, confident creators using these technologies are harder to find.

The need for this is political, social and economic. As technology shapes our world, young people need to be able to shape it too. As skills and work become increasingly technologically mediated the need for digital skills is paramount, some calculating a potential £2 billion loss to the UK economy from unfilled roles requiring such skills.¹⁰ In 2012 Microsoft claimed one in four IT-related jobs worldwide were unfilled.¹¹

Technology is becoming more user-friendly but also more complex. Early home computers came as kits that their owners needed to understand and put together in order to use. Now they come in ultra-thin sealed boxes. Our cars contain increasing numbers of computers to customise our experience of driving. Yet, open the bonnet and the exposed workings that enthusiasts have spent lifetimes tinkering with have been replaced with a plastic shield and the increasingly familiar words: 'Qualified personnel only'. As our world becomes increasingly shaped by digital technology it seems most of us are further from being able to shape it.

Despite this, user-friendly tools and techniques for creating and making with digital technology have developed hugely since the days when schools were given a BBC Micro and encouraged to get children programming in BASIC.¹² Visual programming languages such as Scratch (from the Massachusetts Institute of Technology in the US) teach programming by dragging and dropping coloured blocks. The cost and learning curve for complex computer controlled electronics such as the Arduino and Raspberry Pi have plummeted. Mozilla's Webmaker tools allow anyone with a web browser to explore the code the web is made of. Children can even learn programming concepts through playing video games such as Kodu, Hakitzu and Erase All Kittens.

With these possibilities an ecosystem has developed to support and empower young people to learn how to make and shape digital technology. A wide range of organisations have been founded and developed by technology enthusiasts and social innovators to engage young people in the world of digital technology. Some of them make physical tools, others online resources, and many enable face-to-face activities for young people to discover and explore what it means to create rather than simply consume technology.

They do so for many reasons, but underpinning them all is the importance of agency. When our world is increasingly digital, it is those who can manipulate and create technology who will be able to shape it. The movement around digital making is based on the belief that making gives us access to the powerful ideas that help us to understand the world we live in, and to shape it.

Nesta has been working in digital making for some time. Our 2011 report *Next Gen* highlighted the enormous gap for technical and creative digital skills in the UK games and visual effect industries.¹³ This became part of the public discussion that caused ICT to be removed from the National Curriculum in England and replaced with computing. Our continuing work on the UK's Creative Economy has shown that there is a need for skilled people who can work across the technical and creative spheres.¹⁴

The UK is a global leader in terms of our Creative Economy. There are over 2.5 million jobs in this area, more than in financial services or construction.¹⁵ We predict there will be an additional million creative jobs created over the next ten years, jobs that will require the creative manipulation of technology across many fields.¹⁶ Increasing numbers of jobs are being automated out of existence by developments in technology. Creative jobs, whether in the creative economy or those more broadly using creative skills, are less susceptible to this phenomenon.¹⁷

Since 2012, our Digital Makers Fund (with Mozilla and Nominet Trust) has funded organisations across the UK providing opportunities for young people to learn about technology through making. Our partnership Make Things Do Stuff (again, in partnership with Mozilla, Nominet Trust and 50 other organisations) brought projects and opportunities directly to young people, families and teachers, enabling them to get involved with the movement to make digital projects.¹⁸

After several years of positive progress, we feel the digital making movement in the UK is entering a new phase. In September 2014 computing became a compulsory subject in English schools, having been a part of the Scottish Curriculum for Excellence since 2010. The importance of learning programming has become a part of the national discourse, and 3D printers are becoming a common sight in schools. It can't be long before we will be seeing them in homes as well.

There are signs of increasing corporate engagement with digital making. O2 have had a digital making component of their Think Big Schools programme for two years and are issuing Open Badges for a number of skills. Barclays have recently started to build on their Digital Eagles programme with activity aimed at a younger audience. Resources such as their Code Playground and the Upload events, run in conjunction with Freeformers, are additional routes to creating mainstream awareness of digital making.

Of the promising ideas we have funded and supported, many have gone on to huge success. Code Club, which supports volunteers to teach programming to young children, aims to be in half of all UK primary schools by 2018.¹⁹ Apps for Good last year engaged 17,000 young people with their programme designing technological solutions to challenges in their local communities.²⁰ Throughout 2015, the BBC will shine a spotlight on opportunities, like these, for young people to develop their digital creativity. Digital making is about to go mainstream.

At this important stage we wanted to take stock. As with the early stage of any field, digital making has been driven by enthusiasm, opportunity, and in large part by individuals spotting gaps and challenges in their own contexts. To move forward and scale up to meet increasing demand driven by the likes of the BBC, we need to have a clear sense of what is happening already.

This report explores the shape of the digital making ecosystem in the UK. **'What and where are young people making?'** begins by looking through the eyes of young people. It maps the organisations providing opportunities for young people, the kinds of learning that are

happening and the ways these work. It also looks at the roles schools play in this kind of learning and how the teaching of computing is developing.

‘What do people think about digital making?’ explores attitudes, perceptions and ambitions. We asked young people what they are interested in, what they would like to make and how. Parents and carers are an important part of the ecosystem and we explore their attitudes towards and support for digital making. Schools are also a strong influence on the experience of young people, so we asked teachers about their attitudes and work in this area.

Finally, we look to the future and the directions this growing field might take. There is much to celebrate in what has been achieved already, but a huge need for growth in terms of both numbers and types of opportunities. Growing the numbers of opportunities to engage with digital making is one part of the story. The other part is attracting a wider audience through appealing to different interests, and building progression and depth into the learning. Our work has identified the gaps and needs that could be filled.

Eighty-two per cent of the ten million school age children and young people in the UK say they are interested in digital making, yet in 2014 there were only 130,000 face-to-face experiences provided by the organisations identified in our mapping. These organisations have made a great start on offering digital making experiences to young people, but their numbers are small compared to potential demand.

A huge expansion of activity is needed if we are to grow a nation of digital creators who can manipulate and build the technology so much of our society is reliant on. This requires scaling existing infrastructure and starting new opportunities. There is a creative challenge across the board to develop opportunities that engage interest, reward and deepen aptitude for all young people.

This report explores what is happening already and how we can meet the need to achieve our ambition.

What we mean by ‘digital making’

Digital skills, digital literacies, digital creativity; there are many terms used by different people in different ways in this area.²¹ Since 2012, Nesta and others have been emphasising digital making as distinct from simply using digital devices. From programming entirely on a computer to designing and 3D printing physical objects, digital making represents a diverse range of activities. It doesn’t include checking your email or browsing a website (clearly digital, but not making). It isn’t the array of making activities young people take part in without technology.

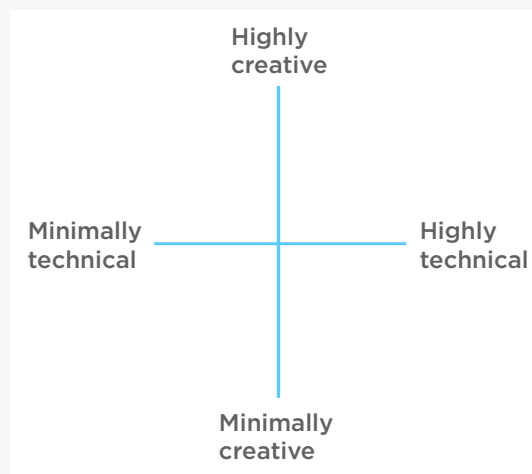
Our Digital Makers Fund focused on learning through making an end product in such a way that young people learn about the underlying technologies they use and how they work. We supported organisations that encourage young people to ‘look under the hood’ of technology while they are making. Other groups refer to digital making more broadly. They would include activities such as producing your own electronic music or editing a video. These activities may not involve understanding how the fundamental technology works, but do involve manipulating it using existing tools in creative ways.

There is debate and discussion over the array of activities that come under the broad umbrella term of ‘digital making’. We feel it is helpful for organisations to clearly describe what they mean by the term, but it may be less productive to try to distil it into a universal definition. As tools advance some tasks become more possible without needing to manipulate the underlying technology, whilst the possibilities that can be achieved with technical skills expand. Some young people may come to digital making through an initially creative and

less technology-focused avenue such as music making. As their ambitions for their finished products grow, they may begin programming their own instruments or effects, and delving into the technology to achieve the ends they have in mind. To limit the definition of digital making runs the risk of shutting out such avenues, and also the possibility that making activities will shift between different levels of creativity and different levels of technical skill.

We could conceptualise digital making projects as relating to two axes; one for the level of creativity and one for the level of technical understanding and skill required.²²

All digital making projects will sit somewhere within these axes. Young people may start in one quadrant, but move to others depending on the particular project they are making. Any project may have different elements or phases that sit in different parts of this diagram. Some children will be motivated by the sense of achievement that technical skills give them, and perhaps begin digital making in the lower right quadrant. Others will be enticed by the creative possibilities of using existing tools and begin in the top left. What is important is that there are multiple entry points for different groups of young people, and that there is a potential for moving into different areas. Even activities in the bottom left, representing minimally creative and minimally technical projects, can play a role in introducing young people to the possibilities of digital making in a way that has a low barrier to entry and could build confidence.



Although we think it is useful to consider these distinctions, for this work we have taken a broad look at digital making. We recognise that the term is used to represent a continuum of skills and understanding. As Sefton-Green and Brown's recent research into learning journeys in digital creativity demonstrated, the pathways young people take are often nuanced, sometimes messy and always individual,²³ just like the most authentic learning.

For the purposes of our surveys of young people, parents and carers and teachers we defined digital making as learning about technology through making with it. However, we also asked them about interests and activities that might be seen as more broadly digitally creative, many of which were very popular. In selecting which organisations to talk to, we sought those who self-identified as being involved in digital making, without strictly judging whether their activities fitted our preconceptions. This growing field is defining itself, so we sought to understand what kinds of activities that those self-identifying with digital making provide.

In such a complex space we will not have picked up everything. Much digital making is happening informally between peer groups and in communities without any formal coordination. There may be some organisations that we have not found yet through our methods.

Research methods and scope

We ran a nationally representative online survey with TNS Global with a sample size of 1,000 young people and their parents and carers. This explored what they made and their attitudes and ambitions towards digital making.

A survey of teachers was carried out by YouGov Plc to understand how digital making and the subject of computing are happening in schools. The total sample size was 750 teachers. Fieldwork was undertaken between 6 and 16 January 2015. The survey was carried out online. The figures have been weighted and are representative of all UK primary and secondary teachers.

We also draw on similar surveys we have run with young people and teachers in previous years. Some questions were repeated to draw comparisons, some were new to explore more recently emerging themes. Only where sample sizes and statistical significance testing make it possible have we drawn out differences in the data by region, gender and other categories.

A research team from BOP Consulting gathered data on the field of organisations providing opportunities for informal learning in this area and interviewed some of the people making this happen. We worked with BOP Consulting and Professor Julian Sefton-Green to explore definitions of organisations in this field. We categorised activity into three areas: online resources and tools, physical kits and equipment for making and face-to-face educational experiences. For our survey of provider organisations we chose to focus on the latter as these organisations represent an interlinked field in the UK focusing particularly on the development of digital making skills. The experiences of young people will, of course, also be shaped by the online and physical resources they have access to. Some organisations also work in several of these areas.

Sefton-Green and Brown's recent work has shown the importance of face-to-face experiences and mentoring for young people to be successful in digital making.²⁴ In their case studies some kind of face-to-face influence from an expert, enthusiastic adult or more experienced peer were key to the learning journeys of many successful digital makers. Online resources are available to any child with access to the internet, which Ofcom have found to be 87 per cent of those in the UK.²⁵ Although this is still not all children and young people, they are geographically independent and we would support the efforts that are happening to bring this access to all, regardless of geography or social factors. Physical kits are available to all of those with the financial resources to purchase them and awareness of their existence. Hence they are largely independent of geography. Access to face-to-face activities, however, is limited by provision and geography.

Gaining a complete picture of all the complex influences on young people in digital making would be a beneficial area for further research, but for the scope of this research we have focused on the face-to-face experiences provided by organisations in the UK.

To do this, BOP researchers used the Quid web analysis tool to uncover public discourse, news stories and organisations' websites related to digital making.²⁶ Building on the contacts gathered as part of the Nesta Digital Makers Fund and Make Things Do Stuff programme, they built a database of organisations that self-identify as promoting digital making and provide face-to-face educational experiences.

This data collection was followed up by surveys and telephone interviews with representatives from many of the organisations to gather more detailed information about them, including their locations, types of activities and details of their business structures. Case studies of a range of organisations were collected through interviews.

This is an emerging sector and there is much still to be understood in terms of how we promote learning in young people. The scope of this work was defined in order to productively contribute to this understanding, but we do not claim it to be the final or complete picture.

What and where are young people making?

What is happening already? As tools for digital making become more ubiquitous and toolmakers explore the possibilities of opening up technology, many young people are discovering on their own what they can achieve through making. Parents and carers are encouraging them, sometimes sharing their interests and sometimes encouraging what their children discover themselves.

An exciting, growing field of organisations have been creating resources, running workshops and teaching skills to get them there. Schools have a part to play and teachers are supporting digital making both formally and informally.

Here we seek to uncover what is taking place, what young people are making, where this happens, and who is supporting them.

What and where young people make

What young people make



It is clear that a large proportion of young people have made some kind of digital projects already. Eighty-three per cent of respondents to our survey said they made something with digital technology. We asked them about a range of such projects that they might make. This covered some projects that require more creative than technical skills, such as pictures and music. It also included those requiring increasing technical skill levels, such as animation and websites. At the more complex end were those involving learning about the underlying technology while making, such as apps, robots and computer software.

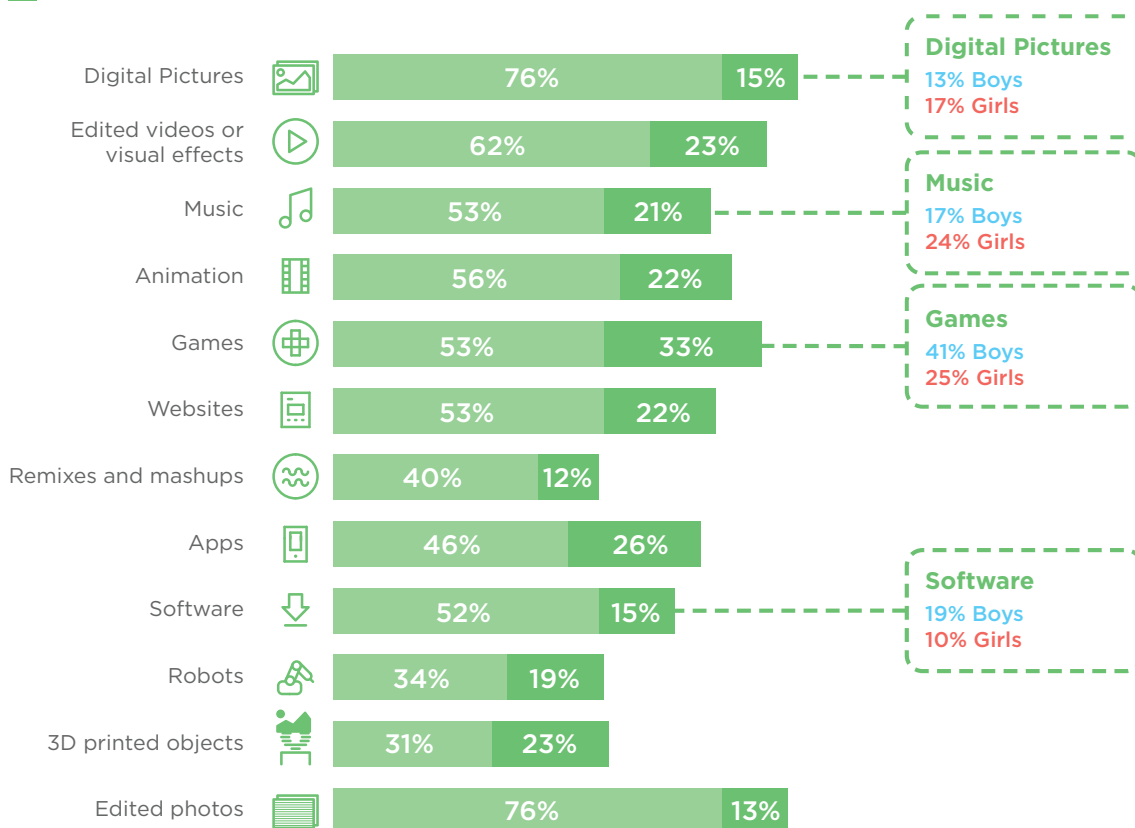
It is no surprise that the less technical projects have more young people making them, including those involving photos or pictures. Software and even mobile apps are widely available for drawing, and mobile devices are almost always equipped with cameras. Many popular apps feature 'filters' or editing capabilities, and the days when only family pictures taken by professional photographers were manipulated are long behind.



Ninety-six per cent of young people said they had used such **mobile devices**, and these are used every day by 10 per cent more than those who use a laptop or desktop computer daily. Clearly accessibility of technology is a key factor in what young people are able to make; the more specialist the software and equipment required for certain projects the less likely they are to make them. Video editing is a similar picture, with most mobile devices now equipped with editing facilities.

What young people make

 Already making
 Want to make more of



Over half of young people also said they had made their own **music** with technology in some way (53 per cent). The role of digital technology in music making could span many activities. A traditional performance could be recorded, or a computer or tablet connected to a musical keyboard could be used to play sampled instruments or synthesisers. The activity moves towards the more technical end of digital making as music production is explored, and young people can create their own sounds by combining virtual devices or event programming their own digital audio manipulation.



Websites (53 per cent), visuals or infographics (52 per cent) have been made by just over half of children. This has most often taken place in school (28 per cent websites and 30 per cent infographics). Such numbers suggest that making a website to convey information about a topic could for many be the new 'school project'.



Games and software are reported as having been made by around half of children (53 per cent and 52 per cent), with apps a little less common at 46 per cent. Where these things are made varies, with software much more likely to be made in school, and apps (17 per cent) and games (20 per cent) more likely to be made at home with friends (14 per cent). Software is a broad category, but one that carries more utilitarian connotations compared to games and apps. Young people may classify the focused work they do in school as 'creating software', whereas their interests and pursuit of fun are more of an influence on what they make at home.



Perhaps unsurprisingly, the **projects requiring specialist hardware** have been made by smaller numbers of young people. Thirty-four per cent say they have made something relating to robots, and 31 per cent 3D printed objects. Given that 3D printers are seen as emerging technology, this figure seems high. Looking into the data shows the majority of this making happening in schools. Schools are quickly acquiring such technology, with the Department for Education running pilot in 21 schools in 2012–13²⁷ It should also be remembered that this may be a one-off activity, with some organisations bringing equipment such as 3D printers into school to give a taste of new technology.

Young people are increasingly coming into contact with specialist technologies in the course of their education, with 20 per cent of them reporting using robotics equipment every week and 20 per cent programming languages on a weekly basis. Over half (55 per cent) reported having used a programming language at some point.

Where young people make

The prevalence of schools as spaces for digital making is shown when examining where young people say they make things. Across all of the types of projects 'in class at school' was the most frequently chosen location in 2015 (66 per cent), although was a decrease (from 78 per cent) when we surveyed in 2013.

Where have you learned to make things with digital technologies?

	2013	2015
In class at school	78%	66%
By myself	35%	40%
With friends	35%	34%
With parents and carers or guardians	29%	27%
In activities or clubs at school during lunch times or after school	20%	15%
With brothers or sisters	17%	15%
In activities or clubs outside of school	14%	11%
In private classes or with a tutor	8%	6%
I haven't done this	–	2%
Online/internet	–	1%

There is much making taking place across all of these situations, and some types of making such as music, games and apps are reported as happening more at home.

It should be remembered that these are based on the perceptions and reported behaviour of young people and may not accurately represent the number of activities happening in these different places. What they do represent is the perception of how important different situations are for young people's experience of digital making. What is clear here is a significant shift in 12 months – from school as by far the strongest perceived situation for making, to an increased influence from making at home. However, in general schools continue to be a key influence in exposing young people to new types of making and experiences.

As we will see, a proportion of young people describe digital making as solitary, so efforts may need to be made to position it as a sociable activity for some groups of young people.

Organisations supporting digital making

If the types of projects young people make are diverse, the growing field of organisations, suppliers and supporters surrounding this is equally so. Some focus on providing a first experience to beginners, some on deepening skills with those who have caught the making bug.

While we have explored the making experiences of young people broadly, when considering organisations we decided to focus in on face-to-face experiences of digital making as opposed to online resources or physical kits.

Online resources, software and apps for digital making are prevalent, and many young people indicated they use tools such as the Scratch programming language or the Webmaker tools, associated learning programmes and community from Mozilla (who are headquartered in the US and active across the world). The very nature of online resources means that they are available to young people in the UK regardless of where these are created or designed. In a more limited sense, the same is true for physical products; kits such as 'Makey Makey' self-assembled game controllers, Arduino microcontrollers, or even basic electronics parts.

Although online resources have a tremendous reach, the level of engagement is very different from face-to-face. Online resources can provide an initial taste of an activity or allow a motivated individual to develop their skills. However, they do require high levels of motivation and engagement for successful sustained learning. Massive reach does not necessarily equal deep learning. Currently there is much debate about the high dropout rates being seen in Massive Open Online Courses developed by many universities.²⁸ The jury is out in terms of what this means long term, but in the short term it is important to engage young people in doing more than just having a taste of digital making.

For the scope of this report we focused on those organisations providing face-to-face learning experiences. Some of the organisations we identified such as the Raspberry Pi Foundation and Technology Will Save Us are also associated with hardware and kits. Some such as Appshed and Drum Roll also provide online resources accessible to children across the world. What ties them together is their relationships in a field of organisations identifying as being part of the digital making movement and running face-to-face sessions with young people in the UK.

As discussed in the research methods section, research by Sefton-Green and Brown has underlined the importance of face-to-face activities in the learning journeys of young digital makers.²⁹ While online resources are available to any young person with internet access, as well as physical kits to those with the financial resources to purchase them, access to face-to-face activities are limited by provision and geography.

One organisation that sits in between the online resources and face-to-face activity is Mozilla. It is an international organisation that makes several of the most prevalent tools for getting young people involved in the web-based programming aspects of digital making, such as X-ray Goggles and Thimble.³⁰ Despite their track record for creating powerful online tools, they are also committed to the importance of face-to-face activity for the development of skills. They do this by leveraging local communities to run events to ‘teach the web’, including an annual push on such events known as Maker Party.³¹ Some of these events are run by organisations such as those involved in our study, others are self-organised by parents and community groups. This highly-distributed approach to encouraging digital making is undoubtedly making a strong contribution to the field of digital making in the UK. It is likely that much future activity will contain elements of such an approach.

As well as the smaller organisations we have focused on in our analysis, there has been notable corporate support for this sector. A number of large corporations such as Google, Facebook and Intel have supported these organisations. Some of this support has been financial, some in-kind support such as the use of venues. It is hard to tell from the available data what support is funding and what other contributions, but it is clear that the corporate sector is involved in many ways.

O2 have had a digital making component of their Think Big Schools programme for over two years and are issuing Open Badges for a number of skills. Barclays has recently started to build on their Digital Eagles programme with activity aimed at a younger audience. Barclays has offered the use of their branch network to CoderDojo, but without additional volunteers CoderDojo are unable to take full advantage of the offer.

Some large corporates are becoming involved in the space directly, by running branded activities. Barclays Code Playground initiative aims to get young people engaged with the programming technology that fundamentally underlies many of their activities as a business.³² Samsung Digital Academies involves vocational training and qualifications for young people to take steps into employed roles creating with and manipulating technology.³³

Industry has a big role to play in supporting the development of digital making, and digital skills more broadly. This needs to continue to develop and grow to enable digital making and the associated learning to scale. As well as funding, industry can contribute volunteers, venues and equipment. With the gap in awareness that digital making currently faces, the power of brands and the communications channels corporates have to the public can play an important role.

Types of opportunities to engage with making

The survey of organisations uncovered 66 UK organisations that self-identified as offering digital making opportunities to young people. With initiatives such as Hour of Code from the US, the changes to the curriculum in Scotland and then England to include elements of Computer Science, and the public discourse on the need for software engineers, it is of no surprise that programming is the most prevalent form of digital making amongst organisations in this research. Ninety per cent of the organisations that provided this level of information described themselves as providing opportunities to engage with programming or coding.

Other forms of making with technology were not far behind. Thirty of the organisations provide activities with electronics or robots, 25 animation and games, 21 app development and 18 additive manufacturing or 3D printing. Many organisations provide a combination of these, showing the joined-up nature of many digital making projects. For example, it is more than likely that app development will involve programming, and 3D printing can be combined with electronics to create usable end products.

Types of activities provided

Activity type	Number of organisations
Programming/Coding	39
Electronics/Robotics	30
Animation/Games	25
App Development	21
Additive Manufacturing (3D Printing)	18
Design	4
Prototyping	2

The format and regularity of opportunities provided varies a lot. A third of the 30 organisations who provided us with this information run one-off events, a third weekly activity, and almost a third daily activity. Many provide activities which are accessed on an ad-hoc basis, and three run competitions. Many organisations also combine the types of experiences they provide.

Types of services delivered

Activity type	Number of organisations
Face-to-face educational activity	37
Online resources	29
Access to facility, workshop or studio	23
Provide physical kit	17

Many of the organisations have their headquarters in London, but there is a spread of organisation HQs across the country with strong networks around Manchester, Wales and Scotland. However, the reach of experiences, or 'places available', provided to young people is concentrated far more highly in London. This is reflected by the fact that nearly all the organisations are small, if not micro-businesses, with some having no paid employees at all.

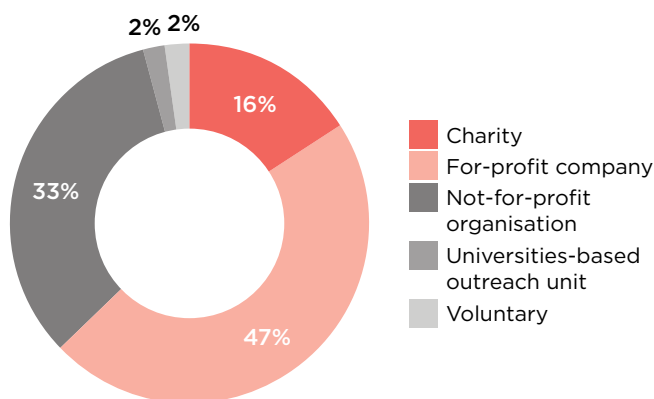
There are a range of legal structures for organisations, but a fairly even split between those that are set up as not-for-profit and those with commercial structures. Earned income is a funding source for 44 per cent of the organisations and 27 per cent rely on a single source of funding. Public funding (29 per cent) and donations (15 per cent) are also an important source.

The prevalence of earned income suggests that there are business models that can be used to develop commercially sustainable activity in digital making for young people. However, even the development of these at scale will require substantial investment. If we are to grow the activity as much as is needed to cater for the ten million school age children and young people in the UK, then more funding to develop activities and support them to scale will be paramount.

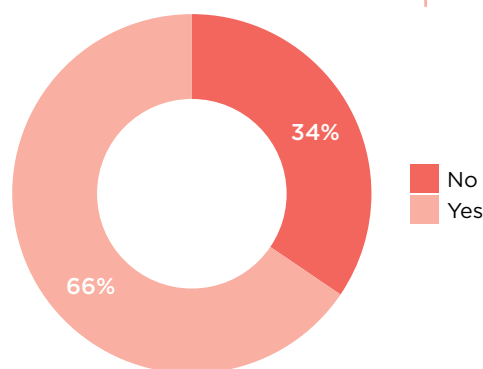
Funding currently comes from a wide network of organisations across the public, private and third sectors. Support for digital making activity from such organisations is strong. Around half (51 per cent) of the organisations listed as funders, sponsors or supporters are from the private field, with government, public funders and charities making up 34 per cent of these.

Overview of delivery organisations

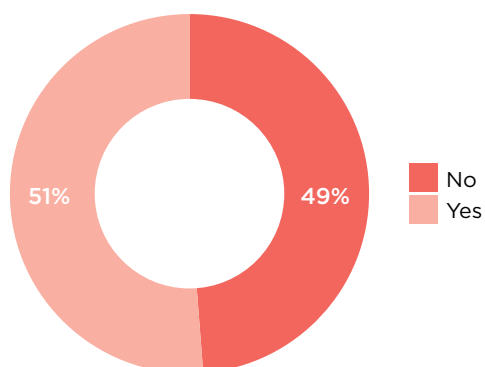
Organisation types



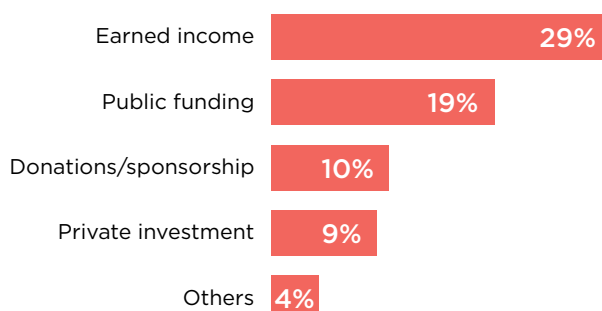
Uses volunteers



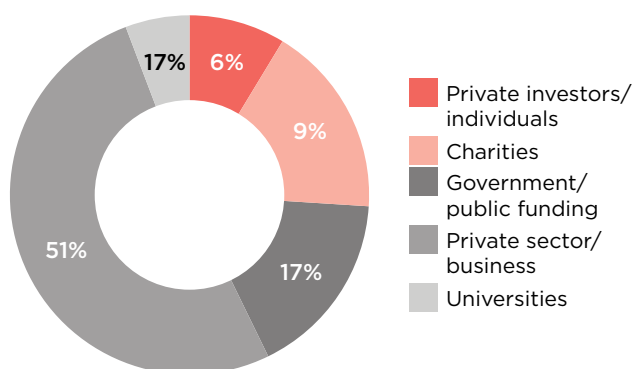
Conducted impact survey



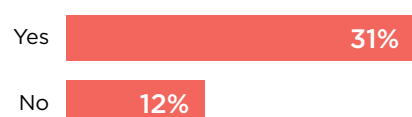
Sources of funding



Types of supporters, funders and sponsors



Work with schools



Not all of this support is funding, although it is hard to ascertain who is providing money and who is providing other types of support. Digital making is supported by a wide network of organisations. There is much overlap, with some funding or supporting multiple organisations and a high level of collaboration across the field.

Although digital making organisations are mostly small, they are conscientious. Almost half (49 per cent) of them have conducted some kind of study into their impact. Such studies could be persuasive to external funders, and may be particularly important to those structured as charities or social enterprises in attracting the funding they need to continue to sustain their activities.

How they are evaluating their activities is currently less clear, and moving forward it will be important to continue to develop the use of evaluation. We need to be confident that young people are engaging and learning in the most effective ways. Organisations need to ensure they are not just showing high numbers of young people engaged, but also that they are reaching diverse social and cultural groups. Only by ensuring this broad reach can organisations realise the ambitions many of them hold to bring digital making opportunities to all young people

Volunteers

The digital making field is powered not just by money but also by volunteers. Two-thirds of the organisations identified said they rely on volunteers to do their work. The numbers of these per organisation vary greatly, from four to 2,700 per organisation. Most, in keeping with their small size, work with between 20 and 50.

Volunteers may be used for a range of reasons, from expertise to requiring numbers to engage with many young people at a low cost. Some organisations seek to use expert volunteers from industry to provide knowledge and skills they identify are needed to facilitate certain types of digital making. Others recruit enthusiasts and interested amateurs who can learn alongside the young people.

When using volunteers, organisations will often create benefits beyond the core aims of digital making for young people. Role models of professionals from industry, or older and more experienced people from outside their school and family lives can impact young people's aspirations and confidence. Parents and community members volunteering in schools can strengthen links between what happens in class and at home. Volunteers themselves also gain satisfaction and experience from their interactions, often learning about digital making themselves. When volunteers come from the communities in which the young people live, it can also encourage community cohesion.

Such effects are evident in Northern Ireland where FabLabs have been used to develop peace-building activities and bring together communities that have historically experienced tensions. FabLabs provide spaces and practical programmes where young people can come together to realise their ideas through advanced manufacturing techniques such as 3D printing and laser cutting.³⁴

For some years Nesta has been working on supporting and developing projects based on volunteering. People Powered Health showed us that harnessing the power of volunteers could make an impact on health care services, predicting the NHS could save £4.4 billion from these approaches.³⁵ We are currently seeing social impact from volunteering across a range of areas addressed by organisations in our Centre for Social Action Innovation Fund.³⁶ Such volunteer activity is a key aspect of the field of digital making and much could be learned from existing initiatives in other areas as to how best to grow this.

There is a correlation between organisations that work with schools and those that work with volunteers. Although some organisations work with volunteers in a non-school setting and some work with schools and do not use volunteers, many more work with both.

It appears that organisations working with volunteers have particular approaches towards funding. Of those working with volunteers, many more rely on sponsorship, donations or public funding. A higher proportion of those who do not work with volunteers rely on earned income and are less likely to rely on sponsorship, donations and public funding. They are also less likely to rely on private investment.

Volunteering has fuelled the early growth of many digital making organisations and the recruitment and retention of volunteers is of critical importance to continued impact. For such activity to scale, the pool of volunteers will need to expand by an order of magnitude.

Sources of volunteers could include those from the tech industry and commercial partners to provide experience, expertise and act as role models. It could be adults from other industries where digital creation is becoming increasingly important such as design, fashion or music. Nesta's work on supporting volunteering also suggests that enthusiastic volunteers from the local community such as parents and hobbyists who have a commitment to young people in their area should also be capitalised on, with the appropriate structures and safeguards in place.

The geography of digital making

Digital making is taking place in many locations across the UK. Young people from right across the UK said they made things with digital technologies, with over three-quarters in each region reporting they had made something with digital technology.

Provider organisations reported to us the opportunities for engagement that they had seen over the past year and the locations of this engagement. Different organisations offer different types of engagement (see above) ranging from single workshop sessions to a longer course of making over several sessions. With no standard model it is difficult to quantify the level of engagement, however, this picture goes some way to illustrating how activity is spread across the UK.³⁷ It must be remembered that there are many digital making experiences taking place that are not mediated by organisations, and are supported by parents and carers, family members or peers. We consider here those experiences offered by the organisations we identified, providing structured opportunities for face-to-face learning in informal settings.

In the last year, the organisations surveyed estimate they provided a total of 130,800 opportunities for engagement with digital making. Each opportunity may be a single workshop for a child or a course of sessions depending on how that organisation has chosen to achieve their goals. We define an 'opportunity' as the completion of the intended experience an organisation provides. These will differ depending on the organisation and the way they have defined the learning. If they intend a young person to reach an outcome in a single session then this is counted as an opportunity. If they are working on a more complex set of skills that takes several sessions to master, then the completion of these sessions has been counted as an opportunity. This gives some idea of the provision of digital making across the country, although the opportunities we have identified are diverse and will not be equivalent in terms of what has been learned. This supports the need for the collection of data about the impact of such activities and the potential of accrediting learning with a system such as Open Badges.

Eight of the 37 organisations providing face-to-face experiences work across the UK and provided 72,500 of the opportunities for engagement last year. For example, Teen Tech runs a programme of events across the country, bringing together young people from the local area

to each event. The 12 per cent of organisations (eight) that work in a nationwide way such as these provide 55 per cent of all opportunities to engage with digital making, although the touring nature of some of them inherently means they are providing time-limited experiences that could also inspire further engagement through other channels. Some such organisations provide online resources or links to expertise to allow young people to continue their engagement, for example Apps for Good.

Next we look at the opportunities provided by those organisations focusing on particular areas of the UK. Eighteen per cent of opportunities to engage with digital making last year were locally delivered in London, 10 per cent in the North West of England and 8 per cent in Scotland. Wales and Northern Ireland represent the next band of engagement with 3 per cent and 2 per cent of all opportunities. The remaining regions of England show far fewer opportunities, with each region seeing less than half a per cent of all opportunities engage.

As well as proportions, it is worth considering the numbers. While London has around 23,750 local opportunities to engage with digital making for a population of 1.4 million school age children, the 1.3 million in the South East of England have only 381.³⁸

Distribution of opportunities to engage with digital making in 2014

Region	% school age children	Number of opportunities localised to this	% of all opportunities	No organisations
Spread across UK	72500	55.5		8
London	14	23750	18.1	7
North West England	11	13360	10.2	7
Scotland	7	11520	8.8	5
Wales	7	4200	3.2	3
Northern Ireland	3	3000	2.3	1
North East England	4	450	0.3	1
Yorkshire	8	450	0.3	1
West Midlands	9	450	0.3	1
East Midlands	7	450	0.3	1
South East England	13	381	0.3	3
South West England	8	320	0.2	2
East of England	9	0	0	
Total		130731		

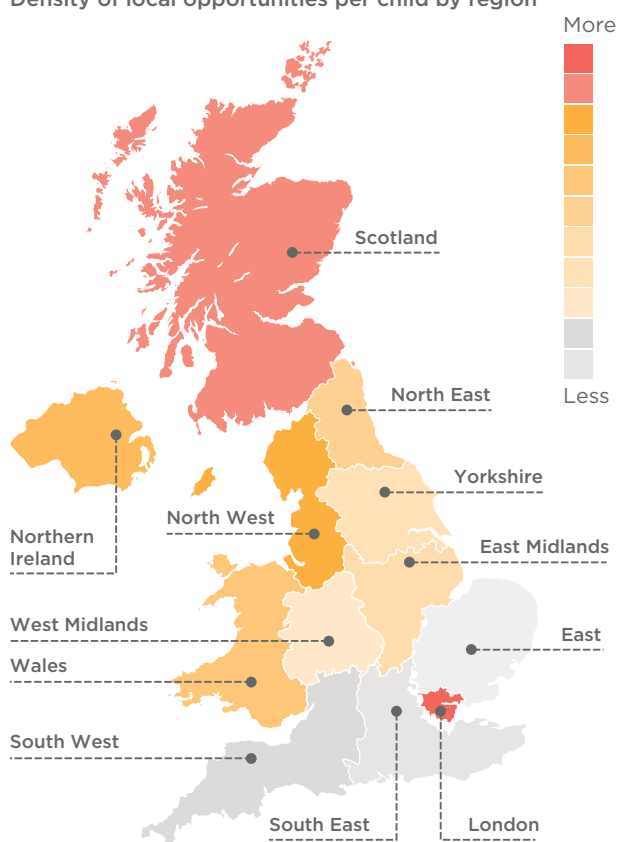
It is clear from comparing the numbers of opportunities with the numbers of young people that there is a massive need for growth in this activity. This need is across the nations, but particularly acute in some areas where there are currently very low numbers of opportunities in proportion to the population. This is particularly notable in several of the regions of England such as the East and the South East of England. As organisations and supporters grow and scale opportunities, they should aim to address this imbalance as well as growing overall numbers.

Nesta research has shown that the creative and high-tech economies are disproportionately based on London and the South East.³⁹ Although interest in digital making is spread across the country, there is a concern that educational opportunities could reinforce the current

geographically-limited reach of these opportunities for employment. As a part of efforts to open up creative and high-tech employment across the country, efforts should be made to balance digital making opportunities across the UK.

Opportunities for engaging with digital making face-to-face

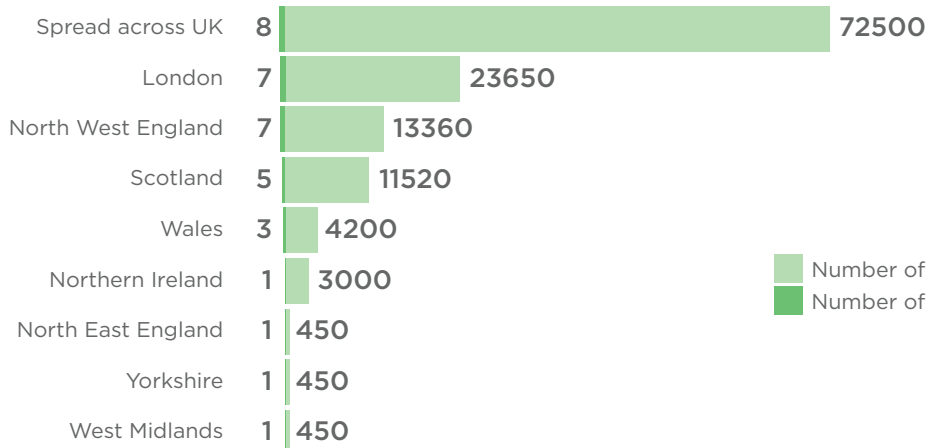
Density of local opportunities per child by region



Locations of organisation/headquarters



Locations of opportunities for engagement



Number of opportunities
Number of organisations providing

Provision in schools

Digital making represents a diverse set of activities, skills and understanding. Some projects use elements of many different types of technology and techniques. The context of their use may also touch on many traditional school subjects, from science and maths to art and music. Digital making organisations often promote the ‘cross-curricular’ nature of their activities, seeing the links such activities draw between technical and creative subjects as a positive benefit.

This makes analysing how digital making takes place in schools a complex question. Often our conceptions of school are framed around particular traditional subjects. The links with some types of digital making and some subjects are clear: programming links directly with computing and contains many elements of mathematics; robotics links with an understanding of electronics in science; and the process of designing and making finished products links closely with design technology. In many schools however, these subjects are taught by different teachers in different times and locations, making the joined up nature of digital making projects hard to place.

When it comes to qualifications, the picture is similarly complex. The public discourse on learning ‘coding’, alongside computing being made a compulsory subject in England, has focused consideration of digital making on the part of this subject that covers programming. In reality the diverse types of digital making touch many subjects, and as subjects develop this becomes even more the case. Core understanding of scientific and mathematical concepts is developed through electronics and programming. At the same time art and music are becoming increasingly digital in their practice. A survey of the subjects offered to school age students by exam boards revealed many subjects with potential links to digital making – from traditional school subjects to electronic products, music technology and interactive media.

The subject of computing is undoubtedly closely linked to digital making. However, there are many other subjects that would benefit from the skills learned in such projects, or could utilise digital making as a means of learning in their own lessons. If current school subjects are often viewed as silos, digital making is a field of activity that can provide a vehicle for interdisciplinary and cross-curricular learning. It can result in working across these barriers and bringing authenticity and tangible purpose to academic learning.

In school, off timetable

As a niche interest or as a moment to learn without restrictions, clubs outside of the normal timetable are often a space in which digital making takes place. A fifth of UK teachers said their school had a club after school relating to this activity, and 18 per cent said there was a similar club during lunch times. One organisation, Code Club, provide resources and volunteers to enable such clubs to take place and it seems this kind of activity is growing quickly. Code Club has ambitious plans to be in half of all primary schools by July 2018.

Links to industry are another chance for young people to engage with the realities of digital making in the world of work. Ten per cent of teachers said their school organised trips to industry locations, such as businesses, and 8 per cent said they had organisations or guest speakers come in to school to work with young people.

However, a third (34 per cent) of teachers said their school was not currently providing any extra-curricular opportunities of these kinds, and 27 per cent said they did not know whether these activities happened or not. Whether in formal classroom hours or not, schools are potential hubs for young people to work together on digital projects, and they have a symbiotic relationship with many of the organisations we surveyed. Sometimes they

are needed to provide the specialist equipment required (such as laptops, Wi-Fi, tools, software and kits like Raspberry Pi), but they can also provide the venue for young people to productively collaborate on realising their ideas. As channels of communication to parents and carers they can also play a role in engaging potential volunteers.

Devonport High School for Boys in Plymouth is one example of such activity. An interest by a pair of pupils in creating an app after school with the encouragement of their teachers has led to the establishment of a software development initiative in the school.⁴⁰ In this case the school provided the venue for collaboration. It seems from our survey that such initiatives are not yet widespread, or at least they are not widely known about by teachers.

There are huge opportunities for growth in extra-curricular provision in schools for digital making. The numbers of after school clubs are encouraging but still low, particularly when accounting for the fact they can only be accessed by a small number of children in each school. Digital making organisations need to significantly raise their awareness amongst teachers and to increase their collaborative provision with schools. This provides mutual benefits, such as an avenue for organisations to scale and support schools in developing their offer for students.

Schools represent a central hub in the lives of young people. They can provide access to resources for digital making, but perhaps more importantly safe and collaborative spaces for young people to come together to work on their making projects. Without utilising such spaces we run the risk of digital making being largely a solitary activity in front of a screen at home. Such activity will only ever capture the imagination of a narrow section of young people.

Computing in schools

Digital making can be a part of many subjects and it influences learning in many more. Despite this, the discourse around making with digital technology in schools has, in the last few years, focused on the subjects of ICT and computing.

In Wales, students study ICT currently focusing on how technology can be used. In Northern Ireland ICT is one of the core strands running across the curriculum. Computer science contexts have featured for all learners from the age of three in Scotland since 2010, as part of the technologies outcomes and experiences of Curriculum for Excellence, although computing qualifications have been taught in the majority of Scottish secondary schools since the 1980s and 90s.

In England, the content of the curriculum for ICT was removed in 2010 (although it was still a compulsory subject). It was replaced in September 2014 with computing, a subject containing aspects of programming and computer science that relate closely to many aspects of digital making.

In recent years the public discourse around the curriculum change in England has had a strong theme of creating as well as consuming with technology. Given this link to the ethos of making and the fact computing is arguably the compulsory subject most closely related to digital making, we explored how digital making is being implemented in schools. It is very early days for the subject in England, but a snapshot at this time helps to understand the UK-wide picture of digital making.

We asked teachers about the approach of ‘learning through making’, which underpins the activity we have been considering. We defined ‘learning through making’ as young people learning new skills by making a product or working on a project that can be shared with or used by someone else. This approach represents learning ‘just in time’ when needed for a purpose, rather than the ‘just in case’ teaching of abstract subjects. Around half of schools

(51 per cent) said there was some kind of 'learning through making' involved in how they delivered ICT or computing, with 2 per cent reporting this approach was always used and 17 per cent saying it was often used.

Schools are free to decide how much time the students spent studying particular subjects. The time spent could indicate the perceived importance of a subject, although it should be recognised that schools face many competing priorities. Almost half of teachers (45 per cent) said that their students were spending an hour a week studying computing. However, in some schools it appears there is no compulsory time for the teaching of computing, with 10 per cent of teachers in primary schools and 6 per cent in secondary schools saying this was the case.

Time spent may not equate how much has been learned. Almost a fifth of teachers (21 per cent) reported that their students were not currently at the expected level for their age in computing. Given that it has only been a compulsory subject in England for five months, at the time of writing, it is not surprising that many teachers may feel their students need to catch up. However, when asked whether the time dedicated to computing is sufficient for students to reach their age-related expectations only 39 per cent agreed. This should be considered alongside the fact that 77 per cent of teachers agreed that their students were actually confident users of technology. The demands of the new subject may be ambitious, but the general digital skills perceived by teachers is more encouraging, and 41 per cent even agreed their students were capable in digital making.

Looking specifically at Scotland, the picture is similar. Computer science is regularly allocated less than one period per week in secondary levels S1-S3. A 2012 survey, conducted by Computing At School, looked at how many periods were spent on computer science. A period can vary between 30 to 60 minutes. The average class time for computing in S1 was 0.6 of a period, and in S2 it was 1.1 period, the lowest amount of time spent on any subject in many schools. This very limited time is sometimes shared with ICT training, which does not develop computing science skills and understanding.

As a relatively new subject, teacher-training programmes have also been developing, and there have been a variety of programmes to prepare existing teachers for new developments. Notably, Computing At School has built strong networks across the UK. In Wales computing is not explicitly in the schools' curriculum, although the fact that CAS is active here shows the importance that many place on such learning in schools. CAS has 17,000 members and 142 regional hubs across the country, providing centres for teachers to build support networks amongst themselves for developing the teaching of computing.

In Scotland, a collaboration between Nesta and Computing At School has instigated a teacher support network which is currently operating across Edinburgh and Glasgow – a geographic network of teachers at both primary and secondary level who meet on a weekly basis to peer-support and share professional development opportunities and educational resources.

An inherent aspect of this context is the variety of qualifications and experience that teachers of computing have. This variation exists within schools as well across them. Secondary school teachers would normally hold a first degree in the subject they are teaching or a closely related subject. Forty per cent of UK secondary teachers identified someone in their school with a computing or computer science degree delivering the subject, whilst 46 per cent of them identified someone with an ICT degree.

In primary schools the picture is very different. Only 3 per cent of teachers identified the subject as being taught by someone with a computing or computer science qualification and 3 per cent a teacher with an ICT qualification. Primary teachers typically cover a wide range of subjects and regularly teach those they have not studied to degree level. However, such a

low percentage suggests it is very rare to have anyone in the school with such a qualification who could lead the establishment of this new subject. More than a fifth (23 per cent) of primary teachers said computing was taught by a class regular teacher as part of their general teaching, and almost as many (18 per cent) that it was taught by a cover teacher when the class teacher was taking time out for planning, lesson preparation and assessment (PPA).

Given that the subject of computing has not been compulsory until very recently in Scotland and England, it is no surprise that there is little specialist expertise in the primary field. However, it is likely to be a challenge to roll it out successfully, alongside addressing the lack of confidence teachers have in young people's current attainment. Initiatives are in place to tackle this, and the English Department for Education has invested £3.5 million in supporting teachers with implementation of the new curriculum.⁴¹ This may be a considerable sum, but commentators have noted that shared between the 24,000 schools in England this runs to only around £150 per school.⁴² Computing At School's Barefoot Computing programme have run workshops for 3,000 teachers from close to 900 primary schools in the five months since computing became a compulsory subject. In the academic year 2013-14 the Network of Teaching Excellence supported 17,000 teachers in developing their computing skills and teaching approaches.

Although interesting, stating the qualifications of primary teachers does not paint a fair picture of these capabilities. Realistically, training and networked support is likely to be of more benefit to the learning experiences of children than an aim of increasing the number of primary teachers with degrees in the subject. Teaching computing in primary schools does not require degree-level knowledge. However, it does require sound understanding of the more basic subject knowledge required for this age group, as well as a range of teaching approaches than can engage young children and develop their understanding.

Perhaps a clearer picture comes from exploring how confident teachers feel in delivering the curriculum. Nesta's previous survey of teachers in England found around two-thirds did not feel confident in teaching computing.⁴³ For this report we looked specifically at the confidence of teachers across the UK who would be teaching ICT or computing, either in secondary schools as subject teachers or in primary schools teaching across all subjects. Fifty per cent of these teachers reported they felt confident in teaching the subject. If we look only at England where the new computing curriculum has recently been implemented, a similar 49 per cent of teachers say they are confident in teaching the subject.

The picture was quite different for primary and secondary teachers. Of UK secondary teachers who teach these subjects 70 per cent reported being confident, only 46 per cent of UK primary teachers said they felt the same.

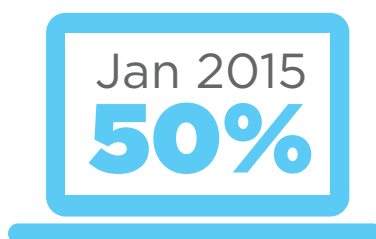
It must be remembered that secondary teachers usually have a focus on one or two subjects. For those who teach computing, the new curriculum will almost undoubtedly have been the most pressing professional development matter for their attention for some time. Primary teachers have had a new curriculum to implement for all 11 statutory subjects since September 2014. With such competing priorities it will take time to develop a new subject that the majority of teachers have never studied in school themselves.

There is some way to go, but such a shift in these early days is very encouraging and testament to the work done by CAS, UKforCE and the many other computing advocate groups. Commercial publishers have also moved quickly to provide resources. However, more importantly it is down to the teachers. Many of them have had to adapt quickly to update their skills. They have done so by seeking out resources, sharing their experience online and informally between schools, and getting down to the hard work of updating their knowledge of a new subject and the complex ways of engaging young people and developing their understanding.

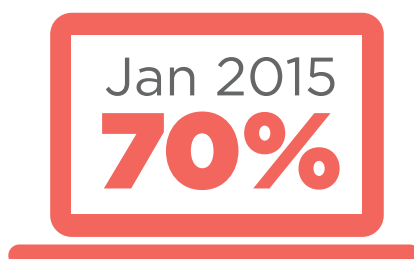
Computing in school has been fast moving and challenging. As shown in the previous section covering where young people learn, teachers in school are a hugely important influence. They need to be commended and supported as they implement this ambitious new subject. Increasing confidence and effective teaching in this subject will require continued investment in professional development for teachers. Scotland is further down the line with this subject, but our work there suggests that several years after introduction, professional development is still much needed. An ambitious curriculum with elements of computer science should be applauded. However, preparing teachers to effectively teach an academic subject most have never studied themselves needs sustained investment over the long term for success.

Teacher confidence in teaching computing

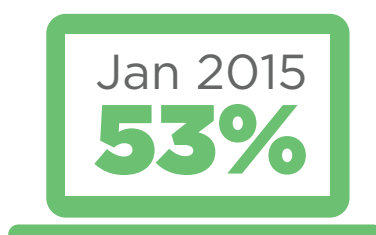
Confident (Overall)



Confident Secondary Teachers



Confident Primary Teachers



Case studies

Freeformers

Mission: Digital progress for anyone and everyone. For every business person we train, we train young people free through our one_for1 model.

Digital making

At Freeformers the term 'digital creativity' is progressively replacing the notion of 'digital making' as it seems to best represent the idea that technology helps you achieve your goals and brings ideas to life.

Main challenges

We are a business of two halves. We don't have any challenges in helping business people grasp the potential of technology. But we would like our partners to move faster in helping us train young people. The demand for digital skills evolves constantly. The digital skills field is expanding as demand is increasing in line with evolving technologies. It is competitive but this ensure that companies like Freeformers continue to innovate and put the needs of

those we're helping to progress at the heart of what we do.

Opportunities

Freeformers is focused on the digital transformation space and the opportunities are endless based on the results we are achieving with both corporates and young people. We believe there are lots of opportunities to create high-impact partnerships. The digital skills and services needed are constantly changing so those who innovate will do well, those who don't will get left behind

Influence of public perceptions:

Particular attention has been addressed to coding so far, sometimes the obsession with coding can turn off people who think it's an academic pursuit. Politicians need to better understand the range of digital skills as only then will they be able to talk about the full range of opportunities open to everyone.

Roundhouse

Mission: To encourage young people to explore digital making, with an experimental and creative approach.

Digital making:

At Roundhouse the term 'digital making' is used to define new media and technology, such as coding, films, radio or creating digital instruments.

Challenges:

There is a lack of a shared definition of digital making which makes conversations difficult. Accessing specific technologies

represents a key challenge for many young people. The educational system also lacks of sufficient resources to cope with the curriculum change.

Opportunities:

There are increasing opportunities to engage with young people and it is a fascinating time for them to influence the field as national data, key statistics and information can be used to take strategic decisions. Digital making organisations are characterised by a number of potential partnerships and collaborations.

Computing At School Scotland (Scotland)

cas.scot

Mission: Digital Creativity in Scottish Schools

Digital making

We've worked on various digital making topics with young people such as 3D printing, Arduino, processing, Scratch, animation, and mobile app making. More recently we have been establishing digital creativity hubs for teachers to come together and learn concepts through 'unplugged' activities – fun practical activities without computers.

Challenges

Our main challenges have been letting teachers know about the opportunities and persuading them that this would benefit them and their pupils. Curricular change is tough on teachers' workload, so teachers need to see a clear benefit.

Opportunities

We have been working with teachers and academics to think about how to update the Computing Science curriculum in Scotland, which has led to some extremely interesting and thought-provoking questions about what concepts can young people grasp at what age.

Public perceptions

There is a lot of work still to be done educating everyone about the differences between computer science and ICT and about how beneficial it is for all students, not just those who will go on to become software engineers. We also need to not lose sight of the importance of the creation process. It is far more important that students understand core concepts than have a polished perfect finished artefact.

Decoded (UK wide and international)

decoded.com

Mission: Transform people through understanding of technology.

Digital making

At Decoded the term 'digital making' is intended as the process of exploiting technology to be creative.

Challenges

Budget and the costs of delivering digital services represent a key challenge. Government funding is not sufficient to satisfy the field and delivering face-to-face services is challenging because it is based on individual needs and expectations, requiring tailored services.

Opportunities

The field is big enough to accommodate all businesses, especially if they are capable of interacting with foreign markets. Organisations like Decoded are an integral part of the rapid social change and they contribute to accelerate it.

Public perceptions

The debate about the importance of digital making increases people's awareness but should be ideally followed by significant investments in the field, ensuring enough funding and resources.

MadLab (North West)**MadLab.org.uk**

Mission: Unique community space for people 'who do and make interesting stuff'.

Digital making

For us, the term is mostly used externally as it is an effective and widely known label that people understand and a useful notion for funding applications. However, for the purpose of internal communication the concept lacks specificity.

Challenges

The education system and the way it is currently organised is not able to keep up with the rapid evolution of technology.

Opportunities

The recession has made clear that there are a lot of people that need help and this

is an opportunity for the digital making organisations to contribute to the well-being of society. It is not just for business' sake.

Volunteering is an essential component of digital making and it has a lot of potential. In addition the potential of current developments in crowdfunding are a useful way to raise capital to finance innovative ideas.

Public perceptions

The discussion of digital making by politicians has stimulated the debate and active engagement in digital but the field should not be driven by the political agenda.

CoderDojo Scotland (Scotland)**coderdojoscotland.com**

Mission: Supporting the next generation of Scottish digital makers

Digital making

At our clubs young people learn digital making skills from volunteer technology mentors. It makes learning to code a fun and social experience.

Opportunities

We have established a great network of volunteers with technology skills who are keen to share that knowledge. Finding new ways to make the most of this resource is an interesting opportunity.

Challenges

Our clubs are run by talented and enthusiastic volunteers. As the network of Dojos continues to grow we must ensure

our volunteers feel supported and confident about running their own Dojos. In order to achieve a greater geographical reach for our clubs, we must continue to support and train our existing volunteers while attracting more to grow new clubs.

Public perception

Coding is not just something that should be seen as an option for only a certain type of young person. Digital skills and more generally an appreciation of what is possible using technology will be essential to the future success of many young people in the UK. We need to look at how we can engage with those who face barriers to taking part in digital making opportunities – be that perceived gender barriers, or access to equipment – and find new ways to work with those groups.

The Digital Makers fund (UK wide)nesta.org.uk/project/digital-makers

The Digital Makers fund was set up to mobilise a generation of young people with the drive, confidence and know-how to create, rather than just consume, technology.

Nesta and Nominet Trust partnered with Mozilla and Autodesk to fund 14 organisations developing work in this area. The fund has run rounds awarding grants in 2013 and 2014. Successful organisations have received grants of up to £50,000 and non-financial support to scale their projects and reach more young people.

First cohort: Code Club, Printcraft, Technology Will Save Us, Hack to the Future and Raspberry Jam, Technocamps, Coder Dojo Scotland, Imagination.

Second cohort: Black Country Atelier, Codasign, #FabLabDevon, Kide, Makerversity, The Princes Trust (in partnership with Technology Will Save Us), Sheffield City Council.

Scouts (UK wide and international)scouts.org.uk/nesta

Digital making may be relatively new, but the importance of creating with technology has been picked up by one of the longest established youth organisations in the world. Nesta, Linda Sandvik (one of the original founders of Code Club) and a team of volunteers have been helping the Scouts to develop the digital area of the Scout programme through new Digital Maker and Digital Citizen activity badges.

These badges are achieved by Scouts of all ages, by completing activities delivered by Scout leaders from resources on making

digital projects as well as contributing and keeping safe online. Learning happens face to face and with friends. Some activities involve prototyping projects on paper and others working on computers with Mozilla's Webmaker tools.

They match up to the time-tested high standards of the Scouts, adding digital achievements to the range of skills and aptitudes young people can develop. This is a great example of digital making being incorporated into the existing habits and hobbies of young people.

What do people think about digital making?

With all this activity, there are clearly many young people who are enthusiastic about digital making, and many supporting them to develop this interest. Building on the good work that is already happening needs to be informed by the attitudes and motivations of the different audiences of young people, their parents, carers and teachers. If we want digital making to be experienced en masse, new opportunities need to appeal to a wide range of young people, and not just those who are already involved. We need to understand how all the young people in the UK see digital making, how they might engage with it, and how those who support them see it.

Parents and carers play a key role in influencing informal learning, and we need to understand what they think of digital making and what they might encourage their children to take part in. In the more formal setting of schools, the way teachers perceive digital making and the capabilities of their students is a big influence on the choices young people make.

Here we explore the attitudes and perceptions that young people, their parents, carers and teachers have towards digital making, and the interests and support that the field could tap into to fuel growth.

Young people's perceptions of digital making

Interest and confidence of young people

Eighty-two per cent of young people surveyed said they were interested in digital making. Thirty per cent of these were 'very interested' and 52 per cent 'quite interested'. Only 4 per cent said they were not at all interested. Despite this high level of interest, half of young people (49 per cent) said they made things with digital technology less than once a week, or never. There is a clear space for growth in the opportunities for young people to make with technology.

Despite the current higher level of opportunities focusing on London, the interest is higher in the North compared to the midlands (85 per cent compared to 80 per cent). The level of interest is also different for girls and boys. Eighty-seven per cent of boys and 76 per cent of girls said they were interested. Although this is a marked difference, both percentages show there is a high level of interest in both groups. There is a difference in interest between the age groups, with more interest amongst children aged eight to 11 years (86 per cent interested), compared with 16 to 18-year-olds (76 per cent interested). Again, despite the difference, both proportions are high.

Young people's interest in digital making

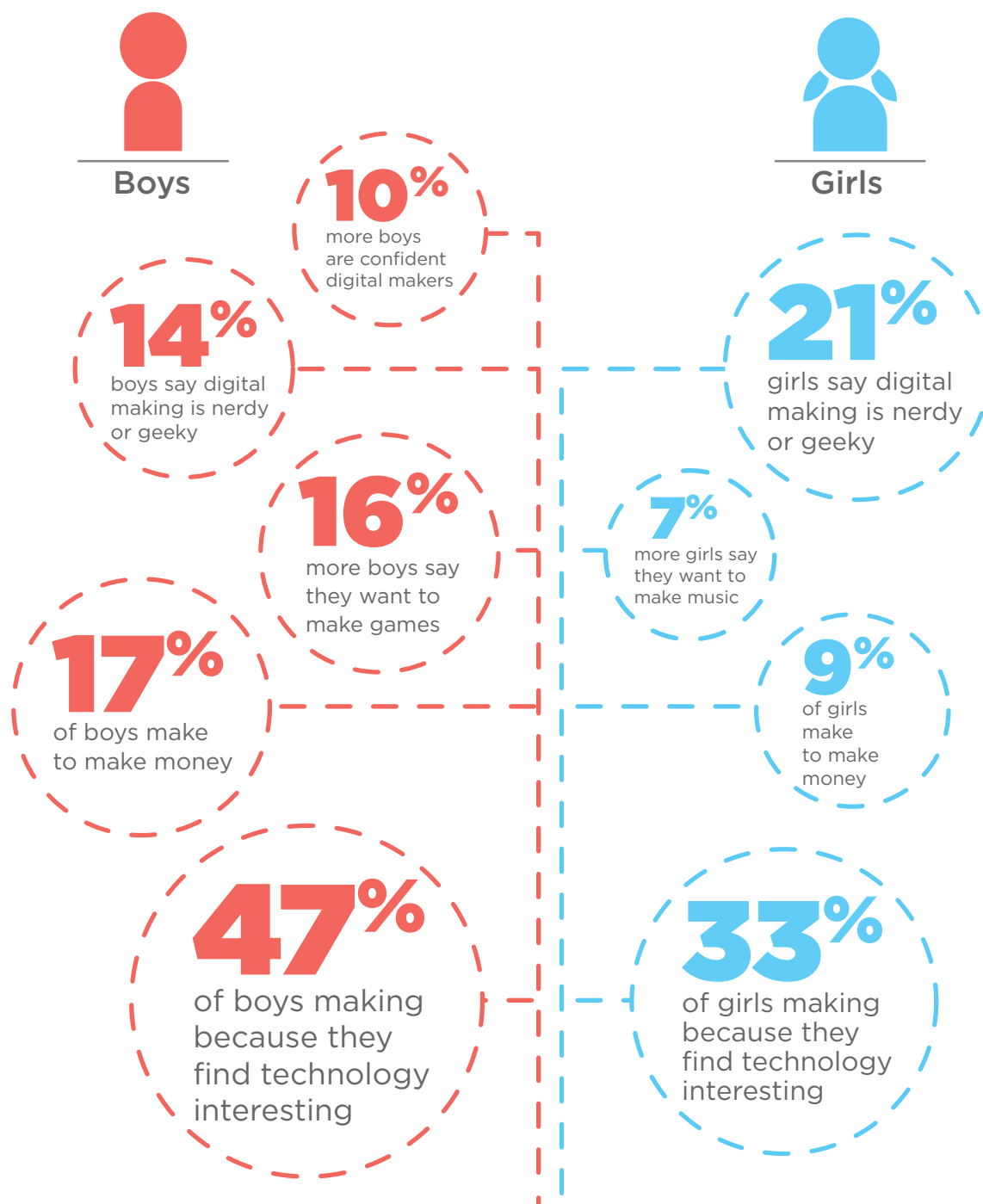
	Gender			Age			Region		
	Total	Boy	Girl	8-11	12-15	16-18	North	Midlands	South
Very interested	30%	36%	24%	37%	29%	22%	31%	28%	30%
Quite interested	52%	51%	52%	49%	53%	54%	54%	52%	50%
Not very interested	14%	11%	18%	12%	14%	18%	11%	16%	16%
Not at all interested	4%	3%	6%	3%	4%	7%	4%	5%	4%
NET: Interested	82%	87%	76%	86%	82%	76%	85%	80%	80%
NET: Not interested	18%	13%	24%	14%	18%	24%	15%	20%	20%

Confidence is high, with 68 per cent of young people surveyed saying they are confident in digital making compared to the 82 per cent who are interested in it. The figure is 10 per cent higher in boys than girls (73 per cent to 63 per cent), but in this case there is little difference between the age groups. This difference in confidence between boys and girls is 4 per cent higher than in our previous survey in 2014. There is little difference in confidence when looking across the different regions of the UK, despite the difference we have seen in provision.

	Gender			Age			Region		
	Total	Boy	Girl	8-11	12-15	16-18	North	Midlands	South
Very confident	15%	20%	11%	17%	15%	13%	16%	15%	15%
Quite confident	53%	53%	52%	51%	54%	53%	52%	54%	52%
Not very confident	26%	22%	29%	27%	24%	27%	26%	25%	27%
Not at all confident	6%	5%	8%	5%	7%	8%	6%	6%	7%
NET: Confident	68%	73%	63%	68%	70%	66%	68%	69%	66%
NET: Not confident	32%	27%	37%	32%	30%	34%	32%	31%	34%

Young people's confidence has grown a little since our previous survey in 2013, moving from 62 per cent to 68 per cent. The previous survey in 2013 also showed a slightly larger difference between boys' and girls' confidence (13 per cent difference in 2014, 10 per cent in 2015).

Gender differences



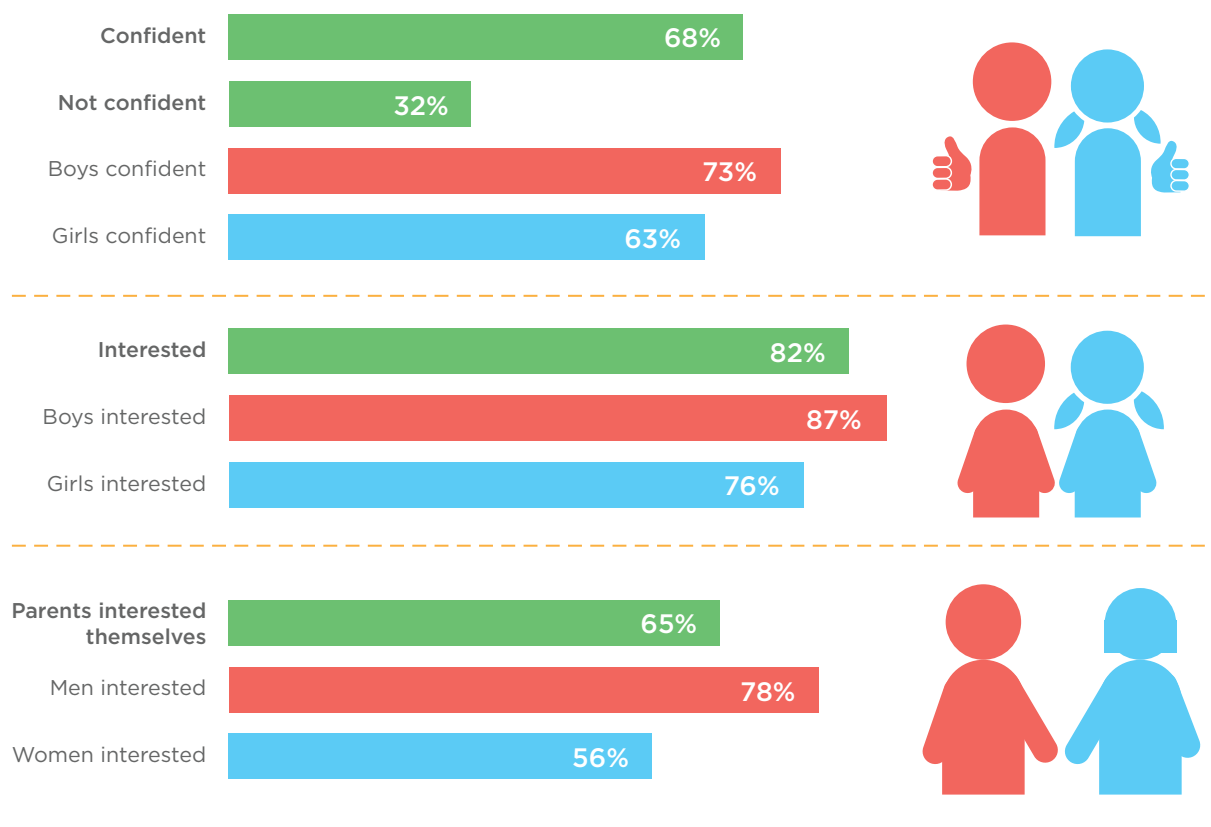
Parents and carers are aware of this, with 86 per cent recognising the interest of their children. More parents seem to feel their children are confident than the children do themselves, with 82 per cent of parents saying their children were confident, including 30 per cent who thought they were very confident.

Teachers see things a little differently, with 77 per cent of them saying the young people they teach are confident consumers of technology, but only 41 per cent agreeing that they are capable in digital making. As shown above, teachers are also less optimistic of the current capabilities of their students when asked whether they think young people will achieve the age-related expectations in ICT and computing by the end of their current key stage in school, just over half (51 per cent) agree.

The expectations of the school curriculum and those associated with the digital making activities children take part in outside school are quite different, so these results should not be seen as a direct comparison. What they do show is that there is a high level of interest and confidence amongst young people, despite a relative lack of frequency of engagement in digital making activity.

The results show that parents and carers recognise this interest and, understandably, slightly overestimate the confidence of their children. They also reinforce the ambition of the curriculum in schools, and more opportunities for digital making outside of the curriculum may well support young people to develop beyond the current assessment of their teachers and towards these high ambitions.

Confidence and interest



More broadly, the results show a high interest in digital making that would support increasing the supply of resources and opportunities for experiences such as those provided by the organisations considered here. The 130,800 opportunities to experience digital making provided by these organisations is a long way from catering for the 82 per cent of the ten million school age children and young people in the UK who say they are confident with digital making.⁴⁴

We need to scale-up activity and provide many more opportunities so that the large percentage of young people interested in digital making are catered for. The current number of opportunities is lacking when compared to the levels of interest this survey shows.

What young people want to make

We know already what young people say they make. In itself that tells us much about their interests in digital making. Finding out what they want to make, but as yet haven't, tells us about their aspirations and where those aspirations could take them, given the opportunity.

The most wanted type of project is games, with almost a third (33 per cent) of young people surveyed saying they have not made a game but would like to. This was followed by apps with over a quarter (26 per cent) indicating they would like to make a programme for their mobile device. This shows the demand from young people to make the things that are a part of their lives and culturally relevant to them. Almost two-thirds (65 per cent) said they use a mobile device daily, more than desktop and laptop computers (53 per cent).

The interest in games is much stronger in younger children, with 43 per cent of eight to 11-year-olds identifying them as something they want to make, dropping to 24 per cent of 16 to 18-year-olds. A similar decline in the interest of older age groups is apparent for animations and digital pictures or drawings.

Many of the projects we asked about were wanted by around a fifth of young people, with a mix between more technical projects, such as robots and 3D printed objects, and less technical but creative projects, such as animations and music. This shows the broad and varied interests young people have. Looking into the different groups surveyed only serves to reinforce this.

There are some clear differences between the interests of boys and girls in the young people surveyed. Games may come out top overall as something young people want to make, but this is influenced by 41 per cent of boys identifying this as of interest relative to only 25 per cent of girls. Significantly more boys than girls said they were interested in making websites (25 per cent to 19 per cent) and software or computer programs (19 per cent to 10 per cent).

Girls have stronger interests in other areas. Nearly a quarter of girls (24 per cent) identified their own music as something they would like to make, compared to only 17 per cent of boys. More girls than boys also identified digital pictures and drawings as a future interest (17 per cent to 13 per cent), and editing photographs came out as being slightly more appealing for girls than boys (15 per cent to 11 per cent). However, more girls also stated that there was nothing they had not made that they would like to make.

It is worth noting that when we asked young people to identify whether they had used resources from various organisations there was one leader by a large margin: 66 per cent of children and young people said they had used Minecraft, 31 per cent of them saying they did so frequently. This resource has captured the attention of a large proportion of young people with its combination of construction, gaming and collaborative or competitive social features. With such a high level of engagement, Minecraft should provide an important example of how we can tap into the interests of young people with future resources and activities.

Why do young people make?

Nearly half of young people say they make things with technology because it is fun (48 per cent). Joint second as a reason for digital making is because they find technology interesting (40 per cent) and because they have to at school (40 per cent).

The older age groups emphasise digital making as developing future skills for jobs more strongly than the younger age groups (24 per cent to 35 per cent), and the 16 to 18-year-olds we surveyed almost equally prioritised fun and finding technology as interesting (fun was 45 per cent and finding technology interesting 46 per cent).

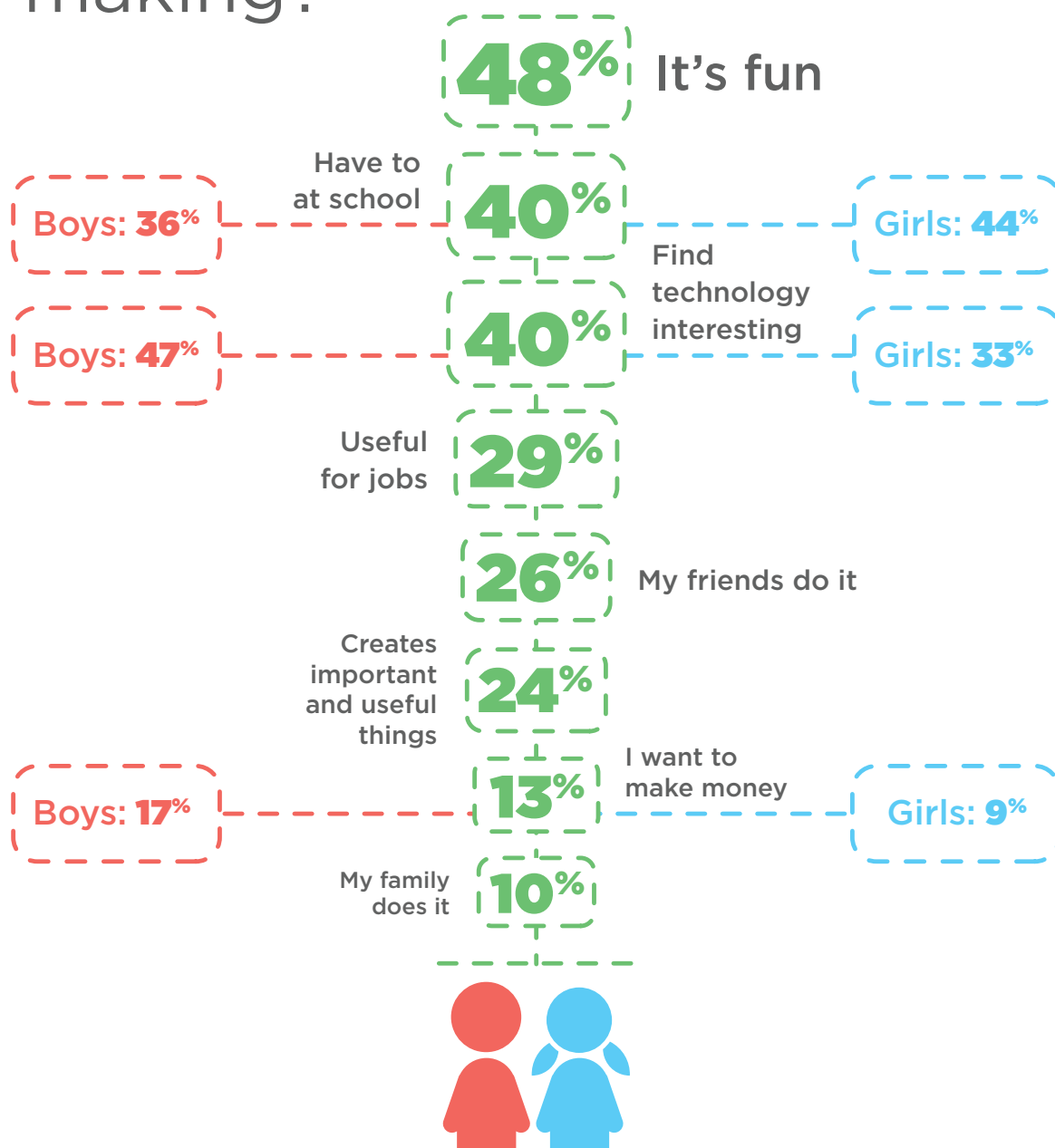
When asked why they make things, more boys said it was because they find technology interesting than because they had to at school. The same was not true for girls. Forty-four per cent of girls said they made things because they had to at school, whereas 33 per cent said it was because they find technology interesting. Fourteen per cent fewer girls said finding technology interesting is a motivation for making.

There was also a notable gender difference in the numbers saying they made things with technology because they want to make money. Almost a fifth (17 per cent) of boys selected this reason, whereas only 9 per cent of girls did.

As organisations and schools seek to grow the number of opportunities and engage increasing numbers of young people in digital making they need to develop approaches that cater for different interests and different motivations. Much activity to date has been characterised by appealing to an interest in technology. This is a very effective message for a proportion of the population, and our survey suggests more so for boys. Activity now needs to grow beyond the technologically-motivated young people who might be characterised as 'early adopters'. The majority will require hooks into activity based on interests, such as music, and projects that tap into motivations other than a love of technology.

There is a creative challenge here for all involved to develop engaging activities targeted at different groups and interests, building on previous learning and rewarding activities young people return to in order to deepen their understanding. If we can achieve this, we stand a chance of digital making moving beyond a niche interest and becoming a normal part of youth culture.

Why do young people take part in digital making?



Identifying as digital makers

As well as understanding what young people do and want to do, it is important to consider how they see people who take part in digital making and whether they would identify with this concept. They may be interested in certain activities or techniques, but whether they choose to spend time taking part in them and developing their skills is also influenced by whether they identify with the attributes and roles they perceive digital makers to have.

A fifth of children in our survey would identify with the description we provided of being a digital maker:

“A ‘digital maker’ is someone who makes or re-mixes something new using digital technologies – such as making their own websites, apps, games, 3D animation, or even physical objects or robots controlled using electronics.”

A further third said they would ‘sort of’ identify with the description of being a digital maker. A similar percentage of girls and boys felt the same way regarding the above descriptions. Significantly more girls than boys said they would definitely not identify with this label, with 33 per cent of boys and 42 per cent of girls saying so. Lower numbers of the older groups identified with the term, particularly so for girls. The percentage of those identifying with being a digital maker is less in the older children surveyed, and it is less for older girls than for older boys.

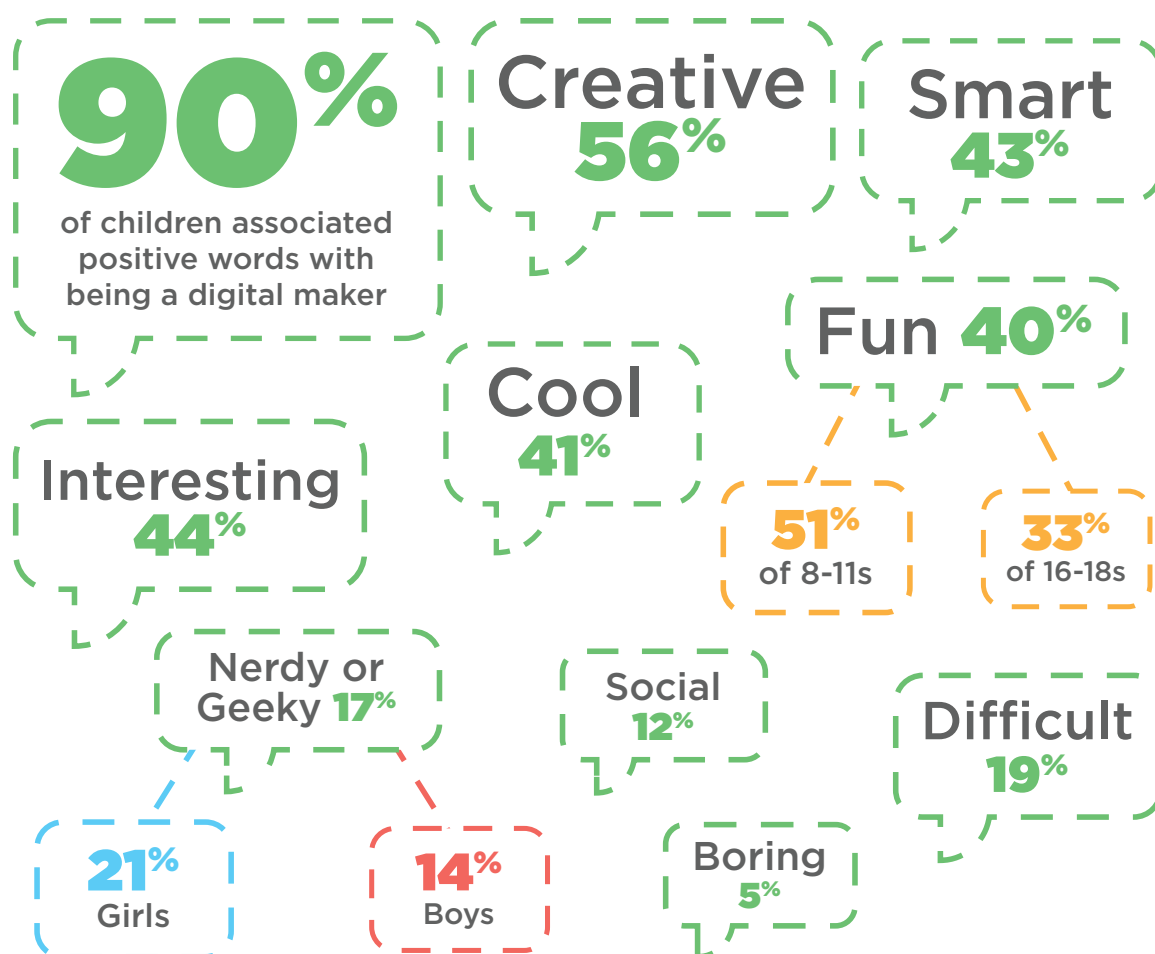
So what are these digital makers like? Over half of the young people surveyed said they would use the word ‘creative’ to describe themselves. ‘Interesting’ and ‘smart’ were the words chosen by 44 per cent and 43 per cent, and ‘cool’ and ‘fun’ by 41 per cent and 40 per cent. Given a choice of words they would associate with digital makers, 90 per cent of the young people surveyed chose terms that suggest they have a positive view of the identity.

Around a third of young people have mixed feelings regarding digital makers and 35 per cent of them also chose terms that are more negative, indicating some choosing both positive and negative terms. A fifth (19 per cent) of children associated the word ‘difficult’ with digital making, 17 per cent felt it was ‘nerdy or geeky’, and 5 per cent chose the words ‘solitary’ and ‘boring’. These are encouragingly low percentages, but there is a danger that young people could come to see digital making as an activity that is not sociable, missing the potential for developing collaborative skills that it contains. To guard against this we need to encourage team-making activities, promote digital making as a sociable activity, and provide spaces for young people to come together to make, as we recommend above for schools.

Boys chose more positive terms than girls (94 per cent to 86 per cent), with more girls choosing ‘nerdy or geeky’ and ‘boring’. A small number of girls also chose ‘solitary’ (7 per cent compared to 4 per cent of boys).

There is also some difference between age groups, with older groups more often choosing the words ‘nerdy or geeky’ (25 per cent of 16 to 18-year-olds, compared to 19 per cent of eight to 11-year-olds and 13 per cent of 12 to 15-year-olds). Sixteen to 18-year-olds also chose ‘solitary’ and ‘lonely’ more than the younger age groups. The number associating the word ‘cool’ with digital making was also lower for older young people, with 35 per cent of 16 to 18-year-olds choosing it compared to nearly half of eight to 11-year-olds (49 per cent). However, they also chose ‘expert’ more than eight- to 11-year-olds, and the choice of many positive terms such as ‘interesting’ and ‘smart’ was similar across age groups.

Words young people associate with digital making



Parents and carers' attitudes to digital making

Young people are interested in making things with technology, but developing that interest into an aptitude often requires a network of support. One important avenue for this is through their parents and carers, so we asked parents and carers about their attitudes to and awareness of digital making.

We found parents and carers to be almost overwhelmingly supportive of digital making. Eighty-nine per cent of our sample said they thought digital making was a worthwhile activity for their children, 67 per cent of them agreeing with this and 21 per cent agreeing strongly. It may be

easy to answer positively when asked this question, but 73 per cent of parents and carers said they actually encourage their children to make things with technology, and 53 per cent said they had purchased hardware or software of some kind to support their child with this.

It seems that the importance of developing creators of technology is an ambition that a great many parents and carers share. Eighty-four per cent of them agreed that the skills associated with digital making activity are important for jobs or careers for their children.

The link between this activity and the teaching of computing in school is complex, but for parents and carers the trend towards teaching this subject is welcome. Ninety-nine per cent of parents and carers surveyed said they thought computing was an important subject to be taught in schools.

Although there is much support amongst parents and carers for the importance of digital making for their children, this does not necessarily match their own interests. Almost two-thirds of parents and carers (65 per cent) said they were interested in making with technology themselves.

	Agree	Disagree
I encourage my child to make things with digital technology	73%	27%
I have purchased hardware or software to support my child to make things with digital technology	53%	47%
Digital making is a worthwhile activity for my child	89%	11%
Digital making skills are important for the jobs or careers my child may have	84%	16%
I would encourage my child to aim for a job or career related to Digital making	74%	26%

There is a marked difference in personal interest between male and female parents and carers. Seventy-eight per cent of men said they were interested in digital making themselves compared to 56 per cent of women. Different age groups also rate their interest differently, with 79 per cent of 25 to 34-year-old parents and carers interested in digital making themselves, compared to only 56 per cent of 45 to 54-year-olds. It is worth noting that although these figures are greater than half, it seems interest in digital making is lower in parents and carers than in children, but as part of a broad field of activities it does have the potential to be more than a niche interest within both groups.

The UK Digital Skills Taskforce recently reported that 23 per cent of parents believe digital skills are irrelevant to their children's future career success.⁴⁵ In the source of this research it was concluded that a problem may be that parents do not know enough about digital skills, with 38 per cent of their sample saying they did not know enough about the digital economy to advise their children on careers.⁴⁶ Although framed differently from our findings, this suggests 77 per cent of parents do think digital skills, when framed as making have some relevance for careers.

Our research suggests there is huge parental support for digital making organisations to capitalise on as they continue to grow. Parents can be encouraged to support their children by getting them involved in activities, but also using their personal interests in digital making to work on projects with their children using resources designed for this purpose. It must be remembered that a proportion of parents do not see the relevance of digital skills for themselves, and care needs to be taken to communicate this and make clear that children and young people are taking part in activities that are worthwhile.

Parent attitudes



89%

think it's a worthwhile activity

84%

think it's important for careers and jobs

74%

would specifically encourage a career in digital making

99%

think computing is important to be taught in schools

53%

bought something to help the children do digital making

only 12%

able to signpost children to online or face-to-face resources

Awareness of digital making opportunities

In order for young people to take advantage of the opportunities to make things with technology they need to be aware of them. They also often need those who support them, such as parents, carers and teachers, to be aware enough to signpost opportunities, or to get involved alongside them at home or in classes.

Much of Nesta's recent work has been focused on organisations that provide young people with face-to-face experiences outside of the formal curriculum, but our survey also explored the awareness of online resources for digital making, such as Scratch and Webmaker, and the growing number of physical products, such as Raspberry Pi, computers and robotics kits. Parents and carers surveyed had a low awareness of any of these kinds of opportunities for young people. They were most aware of the existence of online resources for making with 31 per cent saying they had heard of these. This was closely followed by kits at 28 per cent, and trailed by face-to-face activities at 22 per cent.

Although adults may have some awareness, this does not always translate into young people being supported to access resources. Only 12 per cent of parents and carers said they were informed enough of online resources and face-to-face activities to signpost their children to them, and 14 per cent for physical kits. The numbers of parents and carers saying they were actually using resources was similar for online resources and kits (11 per cent and 10 per cent), but much lower for face-to-face opportunities at only 5 per cent.

The picture of awareness of teachers is similar, with many teachers saying they are aware of these resources but do not know much about them. Eighteen per cent of ICT or computing teachers say they are using online digital making resources already, but only 5 per cent say they are taking advantage of face-to-face opportunities provided by organisations such as those in our research in schools. Overall, 71 per cent of teachers have not even heard of face-to-face clubs and activities for digital making.

Parents and carers' awareness

	Not aware of	Aware of	Could signpost students to	Are using already
Online resources (such as code academy, Mozilla Webmaker or Scratch)	46%	31%	12%	11%
Face-to-face clubs and activities (such as Code Club, Young Rewired State or Teen Tech)	46%	31%	12%	11%
DIY digital making kits available from retailers (such as Raspberry Pi, Makey Makey and Lego Mindstorms)	49%	28%	14%	10%

Teachers' awareness

	Not aware of	Aware of	Could signpost students to	Are using already
Online resources (such as code academy, Mozilla Webmaker or Scratch)	47%	27%	15%	9%
Face-to-face clubs and activities (such as Code Club, Young Rewired State or Teen Tech)	71%	18%	9%	3%
DIY digital making kits available from retailers (such as Raspberry Pi, Makey Makey and Lego Mindstorms)	43%	41%	13%	3%

Awareness is an obvious prerequisite for participation in activities to grow. Although interest in digital making is very high, awareness is low. As organisations scale up and provide opportunities for larger numbers of young people they will also need to plan for awareness-raising activity so that the interested young people can be converted into active participants. There is a challenge here for media companies, broadcasters and big brands to help spread the message and grow awareness of the opportunities as they scale.

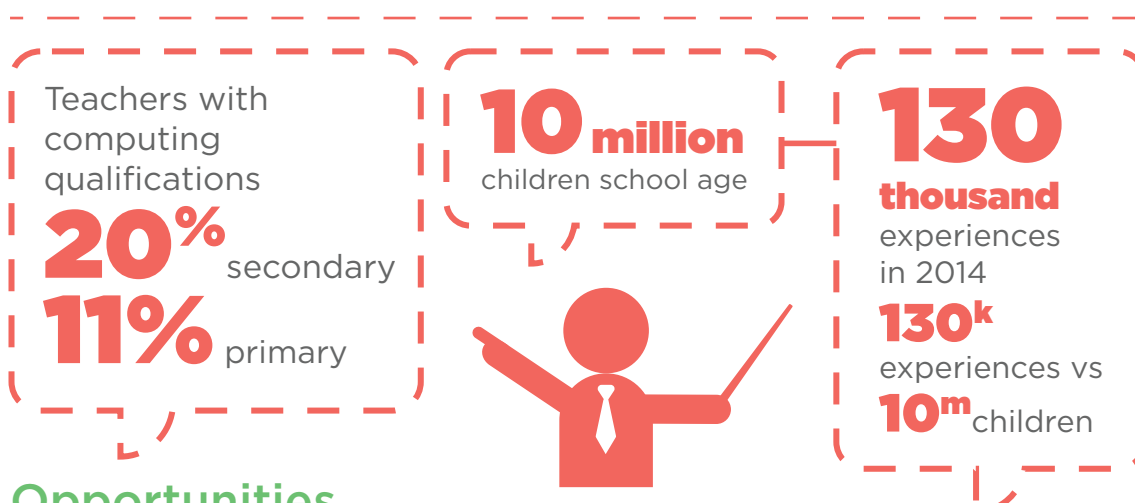
Scaling provision without raising specific awareness is a risk to the sustainability of activity. Awareness in young people themselves is important, but many of their experiences are facilitated or encouraged by parents and teachers so they should also be targeted.

Conclusion

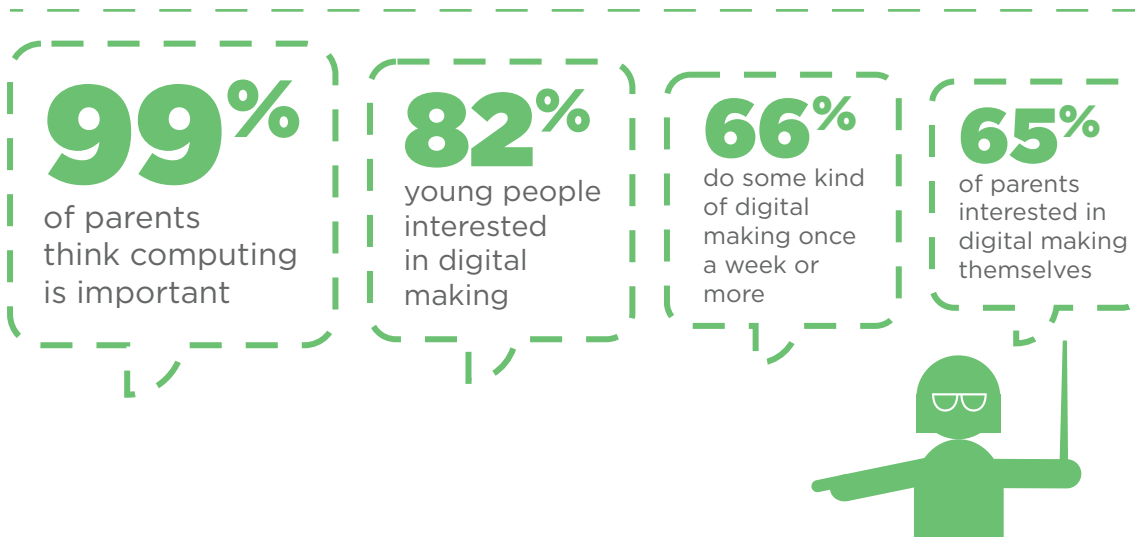
In this report we have explored the growing movement to empower young people to create and not just consume with technology. Young people also have broad interests in digital making, trying and developing a great many skills and capabilities, and their parents and carers are hugely supportive of the importance of this.

Opportunities for growth

Needs



Opportunities



Organisations are also springing up to tap into this interest, often carrying out innovative and effective work. However, there simply aren't enough of them to meet the growing demand from young people. Many organisations are also small in size, and there are still areas of the country that have very little provision.

But these organisations have huge potential to grow, if they can mobilise the resources, volunteers and non-professionals they need to capitalise on demand. Many are also supplemented by corporates, acting directly to fund or facilitate the development of opportunities – something that demonstrates a solid level commitment from the private sector.

However, our research has shown that enabling young people to become digital makers is about much more than simply growing an interest in technology – despite the fact many organisations focus on this. With the right support, digital making can move beyond a niche interest for budding technologists and become a means of expression for a vast range of hobbies and interests. As tools become more diverse and powerful we envision young people getting involved in digital making in order to make things happen in other fields they are passionate about and to develop their careers.

There is a creative challenge to open up the power of technology in order to normalise digital making as a part of youth culture. Scaling existing activity and growing new activity to engage larger groups of young people and their wider interests will require the help of corporate partners, volunteers, schools and parents.

Following is a summary of findings and our seven recommendations for seizing current opportunities and normalising digital making for all young people.

Summary of research findings

1. Young people's interest in digital making

- Eighty-two per cent of young people say they are interested in digital making. However, half of young people make things with digital technology less than once a week or never.
- Parents are overwhelmingly supportive of digital making. Eighty-nine per cent think it is a worthwhile activity for their children. Seventy-three per cent encourage their children to make things with technology. Acting on these feelings, 53 per cent have purchased hardware or software to support their child in digital making. Many also see possibilities for the future: 84 per cent agree that the skills associated with digital making are important for jobs or careers for their children. This is echoed by corporate engagement with the sector, with many large companies such as Google, Samsung and Virgin Media listed as supporters by the organisations surveyed.
- Only 12 per cent of parents felt informed enough of face-to-face digital making activities to signpost their children to them. A similar number said the same was true of online resources. Less than a third were aware of the existence of online resources, kits or face-to-face activities. Similarly, 71 per cent of teachers said they are not yet aware of the face-to-face opportunities to experience digital making available outside of the formal curriculum. So far only 8 per cent are using face-to-face opportunities provided by organisations, such as those in our research.

2. Geographical provision of digital making opportunities

- We identified 130,800 opportunities to experience digital making provided by the organisations surveyed. This is a long way from providing for the interest shown by 82 per cent of our survey, which represents a possible 8.2 million⁴⁷ school age children and young people in the UK.
- The high demand from parents and young people for digital making is consistent across the UK. London currently accounts for 18 per cent of the face-to-face opportunities available. All areas have potential for growth, but regions of England other than London and the North West are proportionally very undersupplied for the numbers of young people who live there.

3. The mobilisation of volunteers and non-experts

- Digital making is powered not just by money, but also by volunteers. Two-thirds of the organisations identified said they relied on volunteers to do their work. With such high levels of interest from large numbers of young people, the comparatively small number of professionals will not be enough to meet demand.
- Rather than see the above as a deficit, it is an opportunity to create resources to support enthusiasts and interested amateurs to meet demand and learn alongside the young people. Many resources are already designed for non-experts to access. Online resources such as Scratch are designed for young people to access independently. Code Club's resources support volunteers to teach programming to children in their local schools. These should set the example for future development.
- With 65 per cent of parents interested in making with technology themselves, there is an opportunity to provide parents with resources and opportunities to engage children in digital making. There is also potential to explore how young people can support their peers in developing new skills and volunteers can support in their communities.

4. Tapping into young people's different interests

- Young people are already engaging in a wide range of digital making activities from music to producing 3D printed objects, but the activity is concentrated around the less technical projects. Just over half of the young people surveyed have made a website, suggesting it could be the new 'school project'. Over half (55 per cent) reported having used a programming language.
- There are some differences between the interests of boys and girls. Boys are more interested in digital making than girls (an 11 per cent difference), feel more confident (a 10 per cent gap that has grown by 4 per cent since 2014) and are more likely to identify themselves as a 'digital maker'. Boys are more interested in making games, websites and software or computer programmes, whereas girls favour music, digital pictures and drawings.
- There are different motivations for doing digital making too. 'Fun' comes first, but the second most common reason differs according to gender. For girls it is because they 'have to at school'. For boys it is because they 'find technology interesting'. There was also a notable gender difference in the numbers of young people saying they made things with technology because they want to make money (14 per cent of boys and 9 per cent of girls). The numbers of girls expressing negative perceptions of digital making such as it being 'nerdy or geeky' was higher. The answer to this is not the creation of activities exclusively focused on girls; there is evidence to suggest such a focus can be counterproductive.⁴⁸ It is about catering for a broad and diverse range of interests that can be furthered through the means of digital making.

- Girls showed a strong interest in making digital music, which is less well catered for by the organisations we looked at which tended to focus on programming, electronics and app development. Music is not a gendered activity, but more opportunities based on this area would engage groups who are currently less interested.

5. Digital making, computing and education

- Only 56 per cent of ICT and computing teachers agreed that their students would reach age-related expectations in computing, despite 95 per cent agreeing that their students were confident users of technology. This gap is concerning and suggests that the demands of the new subject are ambitious. Extra-curricular activities can play a part in achieving these high ambitions.
- Young people are somewhat more confident in their own digital making abilities than their teachers (68 per cent of young people felt confident). When looking at things young people want to make, the more technically ambitious projects are evident, demonstrating young people's ambition.
- Achieving young people's ambitions will require joining up informal learning activities and resources with the curriculum, to both support and extend the learning in schools. Compulsory learning is both an important introduction and a springboard for further interest-driven activity. We also need more work on designing learning pathways and skills progression for young people.

6. Schools as digital making hubs

- Schools continue to be a key influence in exposing young people to new types of making and experiences. They are the most frequently reported location for digital making activity. Sixty-six per cent of young people surveyed said they did digital making in class at school.
- Only half of teachers who teach ICT or computing report being confident in teaching the curriculum. Reported confidence is considerably higher in secondary schools (70 per cent) than primary schools (46 per cent). It is still early days for the subject of computing in England and Scotland, and teachers have to adapt fast so are taking advantage of the supportive work done by Computing At School and other advocacy groups. Much more funding for support for teachers is needed.
- As well as the core computing or ICT curriculum, the diverse types of digital making have the potential to touch, or be touched upon, in many subjects. Core understanding of scientific and mathematical concepts is developed through electronics and programming, while art and music are increasingly incorporating digital into their practice. We have identified over 50 subjects with potential links to digital making,⁴⁹ suggesting digital making embodies interdisciplinary work and cross-curricular learning.
- In primary schools only 3 per cent of teachers identified computing as being taught by a teacher with a computing, computer science or ICT qualification. This suggests it is very rare to have an expert in the school with such qualifications to establish the new subject.
- Teacher awareness of digital making resources for young people outside of the school curriculum is low. For example 71 per cent were not aware of the existence of face-to-face clubs and activities and only a fifth of teachers say their school has an afterschool or lunchtime club related to digital making.

7. Growing digital making organisations

- Funding for the digital making organisations we surveyed came from a wide network across the public, private and third sector. A healthy 44 per cent of the organisations we surveyed had earned income as a funding source, suggesting there are financially sustainable business models that could be replicated and scaled, although 27 per cent rely on a single source of income.
- With high interest in the field, but 71 per cent of teachers and 61 per cent of parents unaware of the existence of face-to-face opportunities, huge potential exists for growing existing digital making organisations and new entrants. This is particularly needed to service demand in parts of the country where few opportunities currently exist.
- Although digital making organisations are small, they are conscientious. 49 per cent have conducted some kind of study into their social impact. Currently organisations are measuring different things, and there is a need to come together as a sector and define what measures of learning are important and how impact is assessed. This needs to be beyond simple measures such as numbers of people reached. Evaluation should be used to support the growth of new interests and new groups of young people. It should be shared as a sector to promote effective practice and encourage the 'joining up' of experiences provided for young people.
- The tech industry is an important source of support for face-to-face digital making activities, and a number of the organisations we surveyed listed large companies such as Google, Samsung and Virgin Media as supporters.

Recommendations

- 1. The high levels of interest in digital making amongst young people and parents need to be capitalised on further.** The digital making movement has had a strong start, but there is a clear need to increase action, and address the current lack of awareness of parents and teachers, if the demand for digital making amongst young people the across the country is to be met.

We would like to see: existing digital making activity given more support to grow, through the scaling up of existing work and the creation of new digital making organisations. We would also like to see more staff and volunteers to run activities and help for parents, and teachers to navigate the digital making opportunities available for children and young people ([See point 1 of Summary of research findings on page 52.](#))

- 2. Young people need to be supported as digital makers across the UK, not just in London and areas that have high provision.** There is a strong interest from young people and parents across the country that is not yet met by the scale of current provision. All areas have potential for growth, but the creative and high-tech economies are disproportionately based in London and the South East,⁵⁰ and there is a danger of educational opportunities reinforcing this.

We would like to see: digital making opportunities for young people increase across the whole of the UK, but particularly in the East and South East (where provision is especially low). We would also like digital making organisations to focus their work on geographical areas that are less well provided for ([See point 2 of Summary of research findings on page 53.](#))

- 3. Non-professionals – such as volunteers, parents, teachers, and young people themselves – need to be mobilised.** Face-to-face interaction with others is a vital part of developing learning in practical activities such as digital making.⁵¹ We simply don't have enough technology professionals to work with young people at scale, but there are many examples demonstrating that non-professionals can facilitate digital making with the right resources and support. Rather than see the process as tackling a deficit, we see it as an opportunity to support enthusiasts and interested amateurs to learn alongside young people.

We would like to see: resources and support targeted at skilling up non-experts in order to engage new groups of young people in digital making, beyond tech enthusiasts. The potential of peer-to-peer learning should also be tapped into. Many online resources, such as Scratch, are also already designed for young people to access independently, as a tool or to supplement learning face-to-face while Code Club supports volunteers to teach programming to children in schools. These should set an example for future development ([See point 3 of Summary of research findings on page 53.](#))

- 4. There needs to be greater access to a variety of making opportunities catering for a wider variety of young people and their different interests, ages and genders.** For instance, our survey showed girls are interesting in digital making, but less interested in learning about technology for its own sake. Much of the public discourse has been around programming and fostering an interest in technology, and these are the most common activities provided by organisations. However, the demand from young people is to make things that are a culturally relevant part of their lives.

We would like to see: opportunities for engaging with digital making targeted at a broader range of young people's passions (for instance, music or fashion), rather than simply an interest in technology itself ([See point 4 of Summary of research findings on page 53.](#))

- 5. Clear pathways to excellence should be built to grow young people's ambitions as digital makers and help them fulfil their potential, in and out of school.** Many young people and their parents report confidence in computing, but some teachers do not think young people are reaching their expectations.

We would like to see: digital making opportunities that take account of young people's prior learning and aim to deepen their skills, providing regular activity and not just first-time experiences. Accredited informal learning with Open Badges would allow providers to build on this for progression. Achieving these ambitions will require joined-up informal learning activities and resources, some linked to the curriculum ([See point 5 of Summary of research findings on page 54.](#))

- 6. Schools must exploit their potential as a hub for digital making opportunities, work with informal learning organisations, raise parents' awareness and recruit volunteers.** Three-quarters of digital making organisations are already working in schools, but with very low teacher awareness of their activities there is enormous room for growth.

We would like to see: teachers supported at all levels to provide digital making activities across the curriculum; extracurricular opportunities in schools expanded; and the provision of the space and resources young people need to collaborate. The continued expansion of professional development is also needed to ease this transition ([See point 6 of Summary of research findings on page 54.](#))

- 7. Digital making organisations need to be supported to grow sustainably through new and existing partnerships with grassroots organisations and private companies.** Most digital making organisations are early-stage but promising, with huge opportunities for growth. They and their public and private sector partners have so far worked closely together with great success. As new organisations emerge, efforts must be made to sustain this collaborative approach.

We would like to see: an increase in industry support – through finance, through sharing expertise and providing volunteers. Scaling the collaboration between digital making organisations and the wider industry will ensure that young people have a range of opportunities that are diverse but complimentary. (See point 7 of Summary of research findings on page 55.)

Face-to-face digital making organisations identified

Apps for Good

www.appsforgood.org

Appshed Academy

appshed.com/academy

Bare Conductive

www.bareconductive.com

Barefoot Computing

academy.bcs.org/barefoot

BEC FabLab Cockermouth

www.britainsenergycoast.co.uk/fab-lab

Big Click

bigclick.org.uk

Black Country Atelier

www.blackcountryatelier.com

Blockbuilders

www.blockbuilders.co.uk

Bristol Games Hub

bristolgameshub.com

Cheadle coderdojo

cheadlecoderdojo.org.uk

Codasign

codasign.com

Code Kingdoms

www.codekingdoms.com

Codeacademy

www.codeacademy.com

Codeclub

www.codeclub.org.uk

CoderDojo Scotland

coderdojoscotland.com

Computing++

www.computingplusplus.org

Decoded

decoded.com/uk

Digitalme

www.makewav.es

Drum Roll

drumrollhq.com

Edge of Existence/ZSL

www.edgeofexistence.org

Epik

www.maklab.co.uk

Exploring Senses

exploring-senses.blogspot.co.uk

FabFoundationUK

www.fabfoundation.org

FabLab (MAKE) Aberdeen

www.fablabs.io/makeaberdeem

FabLab Airedale

www.fablabs.io/fablabairedale

FabLab Belfast

www.fablabs.io/fablabbelfastashtoncentre

FabLab Cardiff

www.fablabs.io/fablabcardiff

FabLab Derry

www.fablabs.io/fablabnervecentre

FabLab Ellesmere Port

www.fablabs.io/fablabellesmereport

FabLab Exeter

www.fablabs.io/fablabdevon

FabLab London

www.fablabs.io/fablablondon

FabLab Makernow Penryn

www.fablabs.io/makernow

FabLab Manchester

www.fablabs.io/fablabmanchester

FabLab Plymouth

www.fablabs.io/fablabplymouth

“fablab@strathclyde Glasgow”

www.fablabs.io/fablabstrathclyde

Farsetlabs

www.farsetlabs.org.uk

ffablab Pontio, Bangor, Gwynedd

www.fablabs.io/pontio

Fire Tech Camp

firetechcamp.com

Freeformers

freeformers.com

Freerange Industries

freerange.in/cumbria

Games Britannia

www.gamesbritannia.com

HomeRoom

www.homerom.org.uk

Ideas Foundation

ideasfoundation.org.uk

Jam Packed UK/Raspberry Jam

raspberrypjam.org.uk

Kidesign

www.playkide.com

Kitronik

www.kitronik.co.uk

MadLab

madlab.org.uk

Make Waves

www.makewav.es

Makers Academy

www.makersacademy.com

Makerversity

makerversity.co.uk

MAKLAB Glasgow

www.maklab.co.uk

Manchester CoderDojo

mcrcoderdojo.org.uk

Nature Bytes

naturebytes.org

O2 Think Big

www.o2thinkbig.co.uk

Open Computer Science

www.opencomputerscience.co.uk

Playir

playir.com

Printcraft

www.printcraft.org

Raspberry Pi

www.raspberrypi.org

Roundhouse

www.roundhouse.org.uk

Spitfire Fab Lab, Eastleigh

www.fablabsuk.co.uk/spitfirefablab

TechMix/Digital Skills Agency Ltd

techmixmag.com

TechnoCamps

www.technocamps.com

Technology Will Save Us

www.techwillsaveus.com

Teen Tech

www.teentech.com

YOMO (Youth Mozilla)

Young Rewired State

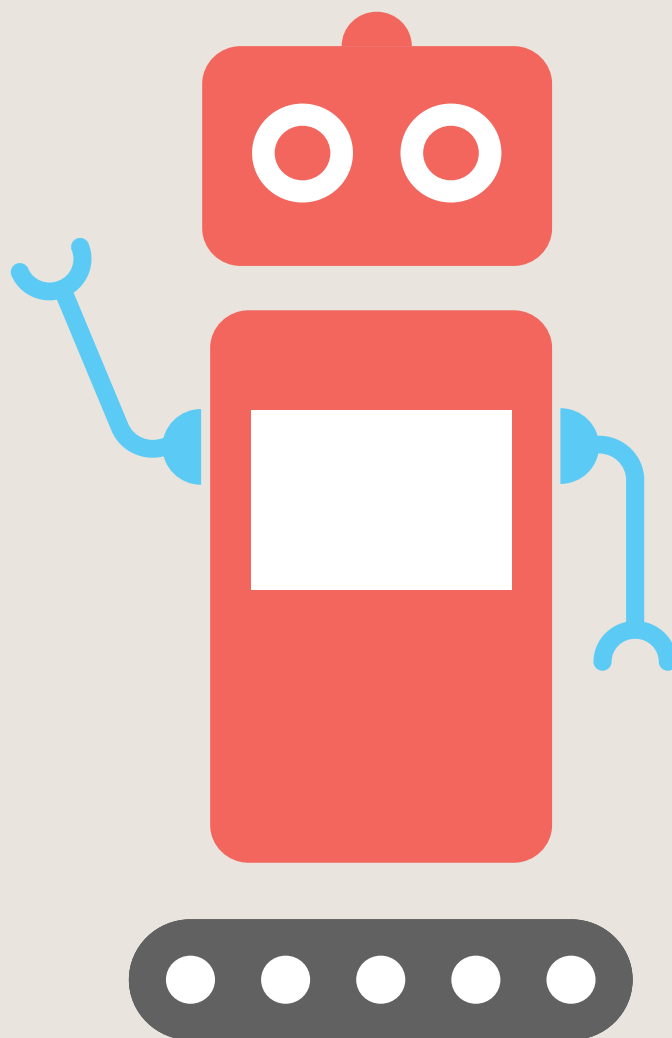
www.yrs.io

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