

(Hello World)

THE MAGAZINE FOR COMPUTING
& DIGITAL MAKING EDUCATORS

ACCESSIBLE CLASSROOMS

How to make computing lessons accessible and inclusive
for learners with special educational needs and disabilities

Issue 11 | Dec 2019 | helloworld.cc

INCLUSION & DIVERSITY

Making sure computer science is for all

CODING FOR AUTISTIC STUDENTS

Running a specialised Code Club

LANGUAGE BARRIERS

Letting the code do the talking

USING LIBRARIES TO BROADEN ACCESS

The scheme that's breaking down barriers

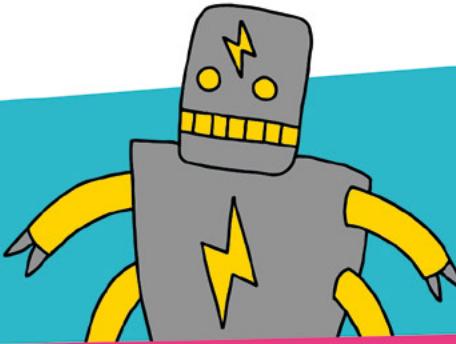


GETTING STARTED WITH DIGITAL LEADERS

Special guide inside

PLUS

UNCONSCIOUS BIAS • PRIDE IN STEM • DOJOS & THE TRAVELLING COMMUNITY • COMPUTING FOR THE VISUALLY IMPAIRED
WOMEN IN TECH & SCIENCE • TEACHING IN HOSPITALS • ACCESSIBLE CLASSROOMS • SUPPORTING REFUGEE CHILDREN

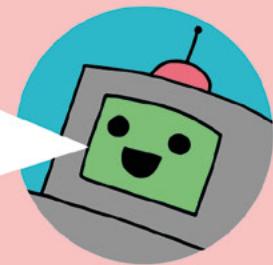


START A CODE CLUB IN YOUR SCHOOL!

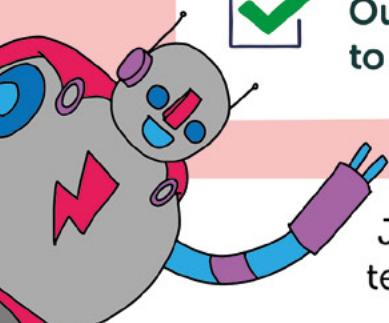
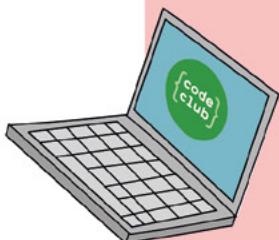
It's easy to get your school coding! Code Club supports educators to run coding clubs for 9- to 13-year-olds with free, step-by-step project guides for learning Scratch, Python, and HTML/CSS.

"I run a Code Club in our school for children in Year 5 and 6, which is always popular. Code Club activities encourage learning independence, and the children love to share the games they've coded with each other."

Jill, Teacher



- Code Club is free**
- Code Club offers engaging, hands-on activities that have been designed to spark curiosity and inspire creative thinking**
- Our free online training is perfect for teachers who are new to coding or are starting a Code Club for the first time**



Join the network of over 7000 clubs across the UK teaching more than 100,000 young people to code!

Get involved at codeclub.org



HELLO, WORLD!

I am excited to introduce issue 11 of Hello World with a focus on Inclusion and Diversity in Computing. In England the curriculum aims to prepare young people to be 'active participants in a digital world' and this needs to include all students. Educators have a duty to ensure those they teach are safe, responsible users of technology, but also to provide them with the chance to shape their world through computing. Future products and services will only be as diverse and inclusive as the workforce that creates them. The foundations of this start with us as gatekeepers of the subject.

Digital technology can support young people with special educational needs and disabilities (SEND) to communicate, access learning and express themselves creatively. Computing is a subject where students with additional learning needs can excel and thrive. In this issue I outline ways to make computing lessons more inclusive

by design, whilst **Alex Hadwen-Bennett** looks at making computing education more accessible to learners with visual impairments.

This issue also covers a wider definition of inclusion in computing and meeting the needs of all pupils regardless of, for example, gender, ethnicity or socio-economic background. **John Madden** writes about a CoderDojo initiative involving the travelling community and **Qumisha Goss** outlines how we can use libraries to promote diversity in tech.

We have taken particular care to be respectful in our language. If we have made any mistakes, let us know by emailing contact@helloworld.cc, and we will publish a correction in the next issue.

Catherine Elliott
SEND lead for the Sheffield eLearning Service



FEATURED THIS ISSUE



EWURABENA ASHUN
Ewurabena Ashun works on the Education Team at Black Girls CODE. Serving as the Curriculum Specialist, her focus is on impact. She works closely with all of BGC's technical volunteers as well as external companies to provide educational resources to BGC's programming. She tells us more on page 60.



REBECCA FRANKS
Rebecca is a learning manager for secondary at the Raspberry Pi foundation working on the learning resources for the National Centre for Computing Education. She was a computing teacher for over 15 years and has volunteered for CAS include since 2012. She chats about unconscious bias on 48.



CLAIRE ARBERY
Claire is the National programme Manager for the Computer Science Accelerator Programme at the National Centre for Computing Education, and has been writing this issue about a terrific new event hosted at Google.



(HW)

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(HW)

CONTENTS



INCLUSION SPECIAL

Making sure computing really is for all

14

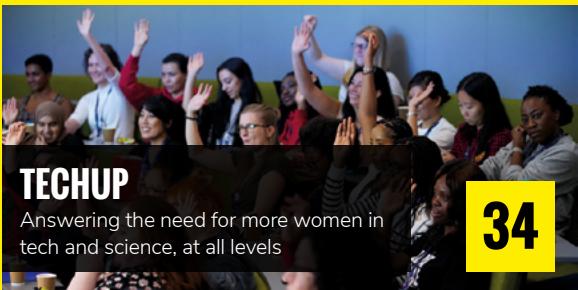
COVER FEATURE



28

INSIGHTS

Ideas and suggestions for inclusiveness from Raspberry Pi's research team



TECHUP

Answering the need for more women in tech and science, at all levels

34



ASTRO PI

How Mission Zero is getting young learners interested in STEM – through the wonders of space!

42

NEWS, FEATURES, AND OPINION

6 NEWS

Hubs, micro:bit Live, graduating at Google, and a whole lot of other goings-on...

14 THE INCLUSIVE CLASSROOM

Making sure your lessons can benefit all students

16 HOSPITAL SCHOOLS

The educators taking learning into hospitals

18 AUTISM SUPPORT

The story of a Code Club for autistic children – with plenty of tips, too

20 ENCOURAGING INCLUSIVENESS

Ensuring there's opportunity for all in computer science

22 COMPUTING FOR THE VISUALLY IMPAIRED

Strategies that can help make coding as accessible as possible

24 THE ACCESSIBLE CLASSROOM

Ten tips from the Computing At School working group

25 THE RIGHT TOOLS

Accessibility and differentiation tools, across a range of budgets

32 SUBSCRIBE IN PRINT TODAY!

36 LEADING FUN WORKSHOPS

Why educators need chances to learn as well

38 TECHNOLOGY STANDARDS IN CLASS

A collaborative support system to help standardise technology across the curriculum

40 DOJO ACCESSIBILITY

Making sure your clubs and classrooms are accessible to those with additional needs

45 SUPPORTING REFUGEE CHILDREN

Ways to give opportunities to those who really need them

48 UNCONSCIOUS BIAS

How it affects the world – and our computing classrooms...

50 CODING FOR THE 1%

CoderDojos for the travelling community in Northern Ireland and Ireland

52 PRIDE IN STEM

The importance of a safe space and a sense of belonging in the classroom

54 LET THE CODE DO THE TALKING

Coding strategies for people who don't natively speak English

56 AT THE LIBRARY

How Parkman Coders in the US is making the most of library resources



BLACK GIRLS CODE

The initiative that's helping drive the way girls see the tech industry

60



INSIDER'S GUIDE

Tips for getting started with digital leaders

88

LEADING DISCUSSIONS

The free online course on the impact of technology

EARLY WRITING AND CODING

The crossover between literacy and programming

A GAME OF CARDS

How playing cards can teach computer science principles

ECOLOGY, MATHS, AND DIGITAL MAKING

How real scientific research can bring it all together

CAMBRIDGE WOMEN IN TECH

Where are all the women, wondered Kat? She did something to find out...

REVIEWS



BOOKS ROUNDUP

Lots of titles for younger learners this issue.

LEARNING

RESOURCES & LESSON PLANS

72 TAKING THE TEMPERATURE

A micro:bit/physical computing lesson idea

76 SNAP!TWITTER

Analysing data using block-based programming

78 CRUMBLE

Using the Crumble controller robotics board to get children making

82 2D/3D USING P5.JS

Combining 2D and 3D to create amazing artwork

85 CRASH LANDING

Navigate the jungle using a Raspberry Pi and Python!



HERE COME THE COMPUTING HUBS!

Computing Hubs are being introduced across England this autumn, meaning the National Centre for Computing Education's CPD courses will be more accessible for teachers

Steve Clarke

The National Centre for Computing Education is increasing its geographical reach, through a school-based network of Computing Hubs across England, who will be delivering CPD by January 2020. It has always been the intention of the NCCE to develop a school-to-school model of support, where teachers can access computing CPD within a reasonable geographical distance, and the introduction of the new Hubs will be a big step towards achieving this. These first Hubs will be joined by several more during 2020. Visit teachcomputing.org/hubs for current information about who and where the hubs are.

Since January 2019, a network of ten regional delivery partners (RDPs) have supported the early phase of mobilisation of the NCCE, and many of the RDPs will continue to deliver CPD for the NCCE until the end of summer 2020 to ensure a smooth transition.

'Develop knowledge, skills, and creativity'

The Hubs have been selected based on meeting rigorous performance criteria, as agreed with the Department for Education.

Derek People, Headteacher at Park House School, one of the new Computing Hubs, explains why his school applied. He said that, "the unique opportunity to support the development of the knowledge, skills, and creativity of the teachers entrusted with the responsibility of shaping that learning journey is what inspired us to apply to become of one the first NCCE Computing Hubs."

He added that, "as a school with an already outward-facing computer science department, we now look forward to further building on our links with universities, charities, and leading edge business to provide a sustainable professional development network across the region."

Support for teachers

The Hubs will employ secondary and primary Hub leads to oversee the delivery of CPD and to work closely with CAS Communities of Practice to support teachers with their ongoing professional development. They will also be able to loan physical computing kits and accompanying resources to schools which will include hardware such as Crumbles, micro:bits, and Raspberry Pis.

The Computing Hubs will have been through a similar journey which many schools still face in transitioning from ICT to computer science or computing, and this experience will prove invaluable when helping others to do the same.

Simon Roberts is the Computing Curriculum Leader at Carmel College Computing Hub, County Durham. Simon has thoroughly enjoyed the transition from ICT to computing, but acknowledges that his development from a non-specialist background in science teaching would have been far more straightforward if there had been the support from the beginning of the transition. He hopes that by becoming a Computing Hub, it will allow all teachers in the region to have the opportunity to gain skills and competencies in teaching computing, whichever school or age they teach.

To view the wide range of CPD available from the NCCE, as well as subject-related news and resources, visit teachcomputing.org. If you teach in a state-funded school or college, your training will be subsidised and, in many cases, carry a bursary to cover the cost of your time away from the classroom. (HW)

MICRO:BIT LIVE! - AN INSPIRING GATHERING FOR EDUCATORS

Liz Smart on how attending conferences like micro:bit Live! gives her knowledge, contacts, ideas, and insight to plan affordable cross-curricular projects across a wide age range

Liz Smart

Back in July 2014, on my first day working for Code Club, I went to BBC Quay House to attend an event for teachers ahead of the new Computing curriculum introduction. If you listened hard enough, there were murmurings in the corridors about the possibility of an easy to use micro-computer that would inspire children to create digitally and shape their future. Fast-forward a little over five years, and I was back in that same room having just delivered the last workshop of micro:bit Live! day one – and it felt great! Not only has that micro-computer been built, but it's being used by children across the globe. This was the first of what will hopefully become an annual gathering

of the micro:bit community, educators, and partners. Here is how I approached and got the most out of micro:bit Live!

Choosing the best for you

We're all limited to what time we have available for conferences and meet-ups. Selecting an event that will be useful to you is key. I've always loved the micro:bit – I run the Code Club projects each year with my code clubbers and see them make handheld devices they can use with their friends. It felt like attending their first big event would be a good investment of my time and I wasn't disappointed.

A packed timetable

Often conferences have multiple strands. micro:bit Live! was running for two days, so I planned a schedule that allowed me to discover how micro:bits are used in district-wide STEM learning by teachers in Canada; to promote Computer Science for All in Ireland; to link with History and Art in Leeds museums and libraries; to save money, reducing energy consumption in UK schools; and learn of an innovative strategy across Uruguay. All by lunchtime on the first day!

The afternoon was just as engaging, with a sneak peak of forthcoming exciting new resources from the micro:bit team, an update from the National Centre for Computing Education for England, and an interesting look at learning methods in the classroom. I also managed to squeeze

in an emotive talk about building school makerspaces from nothing, before a British Council panel discussion about cross-cultural learning and engagement in the Western Balkans, Mauritius, Spain, and Hong Kong.

I'd also made my own micro:bit musical instrument, and played a micro:bit-controlled 3D snake game on ping-pong balls!

Keeping a record

Although my head is brimming with ideas, you do need to think about how to capture notes that will be useful to you when it comes to implementation. Phones are useful, as you can take pictures, voice memos, and quick videos to look back on later. Twitter event hashtags are useful during and after an event. The #microbitlive tag was very much alive with content. Some conferences also invest in filming talks, sometimes as a live stream for anyone not able to make the event.

What did I learn?

One of the most surprising outcomes was realising I'm part of a huge, diverse, and enthusiastic community brimming with ideas to use in the classroom. I've never felt more connected to like-minded individuals from across the globe.

A big thanks to the team at the Micro:bit Educational Foundation for putting together an excellent few days, and to the experts from micro:bit partners who were so accessible and open for questions and advice throughout the event. (HW)

KEY TAKEAWAYS FROM MICRO:BIT LIVE!

- Reach out to the #microbit community on Twitter - there are some excellent ideas and resources out there.
- Keep an eye out for the new projects coming to microbit.org soon.
- Download the latest issue of the community micro-bit magazine: micromag.cc
- For some global inspiration, read about the work of The British Council overseas
- Follow Spark Penketh School Makerspace on Twitter to see how they embedded maker education into their curriculum starting with a spare room and a handful of micro:bits.

THE JOURNEY OF A LONGITUDE EXPLORER

The Longitude Explorer Prize returns for the third time this year, and for 2019/20 it's bigger than ever. But what is the Longitude Explorer Prize, and what does it mean?

Maddy Kavanagh

The name Longitude Explorer comes from the original Longitude Prize, the first incentive prize of its kind set up by the British government in 1714, to solve the problem of extensive losses at sea. It demonstrated that solutions can come from unexpected places, as clock-maker John Harrison developed the chronometer that went on to save thousands of lives, by enabling sailors to know their exact coordinates to navigate accurately.

This heralded a new era of innovation!

Longitude Explorer began with the aim to encourage young people to shift from solely being consumers of technology, which has a significant impact on almost every aspect

FAQS

Are you eligible?

- Longitude Explorer is open to secondary schools and youth groups in the UK.
- Students must be 11-16 at the time of entry, and teams need 2-5 members.

What happens next?

- Submit your idea by 29th November and you could be chosen as a semi-finalist in December.
- Finalists will be chosen in March 2020, and the winners in July 2020.

of their lives, to become the creators, designers, and developers of a whole new generation of technology for social good.

Longitude Explorer has been successfully run two times before and is now back at scale, with the chance for schools and youth groups to win £25,000 and support young people to develop their technology and entrepreneurial skills in the process.

Follow the journey of some successful Longitude Explorer teams to know why you should apply...

It all starts with a...

All great ideas start by identifying the problem, which is why Longitude Explorer challenges young people to think about issues or problems that they care about, and how technology can tackle these issues.

Schools and groups are provided with support from the Explorer team and access lots of free resources on the website, including activity session plans to help identify the problem, creatively develop an idea, and understand the technology behind it. The sessions are designed to be as flexible as possible, from one-off activities which add on to existing learning, to a continuous series of plans – making it possible to fit into busy schedules. At this stage we wouldn't ask teams for a fully-formed plan, we just want to see an idea that has potential and make it as easy as possible to apply!

In 2015, after facing questions from his class as to why they even needed to learn about how technology like GPS worked, Jonathan Torbitt, Director of Computing at Rendcomb College, put forward a team with an idea for an app to support a local homeless charity. Jonathan knew this was something that his students needed to understand for their GCSEs, but also recognised how the prize could demonstrate how the technology could be used in a real world setting.

In 2017, when the theme focused on Internet of Things, a team from Southlands School knew that for students with autism, communication can be incredibly difficult. Which is why they came up with an idea for Octoptix, a badge or wristband which monitors activity through biometric sensors, and can discreetly alert the individual and their chosen contacts to a change in mood.

Turning an idea into reality

As part of the Longitude Explorer, students gain crucial knowledge on what it takes to turn an idea into a reality. During our practical and hands-on events, young people get to come together and take part in a range of both inspirational and practical activities where they develop both soft and hard skills, like prototyping and design thinking.

The events are also a chance to connect to industry experts as mentors but also connect with each other, building their networks.

Between events, mentors are on hand to support teams to develop their ideas and teams learn what it takes to see their idea come to life. As Octoptix say, "the project hasn't been like school work, it's been fun! It's inspiring us to come up with further ideas for the future. We have learnt that we work well as a team, we've learnt how to make conference calls, [we've learnt] we know more than what the staff think we know!"

For the team from Rendcomb College, this was an opportunity to get over fears such as meeting new people and public speaking. Jonathan noted a genuine transformation in the girls "from shy and nervous teenagers, to confident young adults, capable of presenting their idea in a professional manner." As a member of the Octoptix team said, "I've had to speak in front of people I've never met. I never thought I could do this. but I did!"



Longitude Explorers get stuck in to turning their idea into a reality at one of our events

" STUDENTS WHO HAVE TAKEN PART IN THE PRIZE HAVE GONE ON TO MENTOR YOUNGER STUDENTS IN SIMILAR INITIATIVES

What does it take to win?

A winning idea is one which has not only clearly identified how their idea answers a problem, but also how it could work as a business plan. By using the judging criteria, this is a way to help teams make sure they have everything the judging panel is looking for. In particular, how is it a piece of technology that is being used for social good?

The team from Rendcomb College, of which its students at the beginning had wondered why they even needed to know about satellite technology, went on to win £25,000 for their school with their idea. 'Displaced' uses location data and notes provided by users. The app will allow charities to better coordinate the logistics of supporting vulnerable people around the world.

Beyond one team

The Longitude Explorer Prize has been designed to provide opportunities and benefits to all participants, even if your team doesn't make it to the final, such as prizes for participation and continuous access to resources via our website.

But what does it mean to win the prize? For schools and youth groups that take part, it's meant disengaged students becoming passionate about a project, and has meant more girls engaging with STEM, as both subjects to study but also careers. Since engaging with the Prize, Rendcomb College reported they have had female students taking computer science for A level for the last two years. And, two out of the three girls from the winning team went on to study STEM subjects at university.

For winning teams, it has meant improving facilities, putting on events and workshops, and encouraging students to continue with their ideas. The prize has seen huge value outside of the impact of the financial prize. Throughout the 2015 and 2017 pilots, teachers and students have reported skill development in technology and entrepreneurship, but also team working, communication, and problem-solving. Students who have taken part in the prize have gone on to mentor younger students in similar initiatives, building on their new-found confidence.

Now, over to you!

In the words of the team from Rendcomb College, "every idea is a good idea. Even if you think it's silly at first, try developing it and testing it. You might be surprised how many clever ideas come out of that process."

This year, Longitude Explorer Prize is based on Artificial Intelligence (AI), and we're challenging 11-16 year-olds to come up with ideas for how AI can tackle the issues they care about. For learning resources to kick-start creative thinking, and more information on how to apply, visit longitudeexplorer.challenges.org. The application deadline is 5pm on 29th November, 2019. (HW)



MADDY KAVANAGH

Maddy works for Nesta Challenges as project manager for the Longitude Explorer Prize, [@NestaChallenges](https://twitter.com/NestaChallenges).



5 THINGS FROM SCRATCH CONFERENCE EUROPE

The talking points we took away from the first Scratch Conference Europe to be held in the UK

Tom Evans

This August, the Raspberry Pi Foundation was delighted to host the first UK edition of Scratch Conference Europe in Cambridge. Over the course of three days, educators from the international Scratch community came together to learn and share with one another their latest advice, projects, and lessons.

Far too much happened over the weekend for us to be able to summarise it all here, so instead we wanted to share with you five key things we at the Raspberry Pi Foundation took away from Scratch Conference Europe:

The Scratch community is truly international

Scratch Conference Europe was one of three major community-led Scratch Conferences happening around the world

this year, with the others held in Chile and Kenya. While our aim was predominantly to reach the Scratch educators within Europe, we were delighted to end up having guests from almost 30 countries in attendance.

This gave our conference a truly international feel, and meant that the ideas shared really do have a chance of being introduced to Scratch communities around the globe.

The Scratch Team are amazing

In total, 18 members of the Scratch team, including founder Mitch Resnick, came over to the UK to participate in the conference. Not only did they present a wide range of very popular discussions, workshops, and talks at the event, but they had members of their team participating in every other community-led activity!

Mitch's talk on 'Coding at a crossroads' was a particular favourite amongst visitors, and can be viewed in its entirety on the Raspberry Pi YouTube channel.

Code Clubs and CoderDojo volunteers are also very involved in the Scratch Community

On the Friday night, there was a meet-up for volunteers from Code Clubs and CoderDojos attending Scratch Conference, to get together and get to know each other better. In total, over 70 volunteers participated in a series of fun and lively sessions led by members of the Code Club and CoderDojo teams.

From the Raspberry Pi Foundation's perspective, it was amazing to see so many volunteers from our own communities also heavily participating in another excellent



Mitch Resnick talking to a packed auditorium during his 'Coding at a crossroads' presentation.

digital education community. To top it all off, we are hoping to see several new clubs around the world starting as a result of this conference.

You can use Scratch to burst balloons

To round up the Saturday and Sunday, we tasked science presenters Neil Monteiro and Fran Scott to come up with their own Scratch-based interactive shows. On Saturday, Neil presented 'Scratch Cat and the Code of Doom', where he took audience members on a Scratch-based Indiana Jones-style dungeon adventure, laced with some awesome physical computing challenges.

Fran closed the conference on Sunday with 'Scratch Error 404'. As well as being a science presenter, Fran is a maker and pyrotechnician who has hosted shows on coding and blowing stuff up.

Unfortunately, due to the main auditorium being attached to an archives centre, Fran had to leave the pyrotechnics



The first conference has been a big success!

at home. This wouldn't stop her from blowing things up, however. Using Scratch and some physical computing, she built a programme where an audience member was able to blow up multiple balloons on stage. It ensured we closed Scratch Conference Europe with a bang, and left many of the attendees working out how they might replicate this activity in their own classes and clubs in future.

You can find both Neil and Fran's shows in full on the Raspberry Pi Foundation's YouTube page: [youtube.com/raspberrypi](https://www.youtube.com/raspberrypi)

It's the turn of attendees to share what they have learnt

Once again, we wanted to say a massive 'thank you' to everyone who contributed their time and knowledge to making Scratch Conference Europe the awesome event it was. We hope all our visitors returned home inspired to share what they learned with their communities, and that they continue to help expand digital learning globally.

If you have any examples of putting what you learnt at Scratch Conference Europe into practice, we would love to hear from you! **(HW)**

THIS WOULDN'T STOP FRAN FROM BLOWING THINGS UP, HOWEVER!



TOM EVANS

Tom is events assistant at the Raspberry Pi Foundation, and spends his time coming up with new ways to make the Foundation's flagship events as awesome as possible.

FIRST TEACHERS GRADUATE THE CS ACCELERATOR PROGRAMME - AT GOOGLE

Read what happened when our first NCCE teachers completed their training

Claire Arbery

It's nearing the end of the summer term, and you're looking forward to the summer break to refresh and revitalise. Why on earth would you commit to 40 hours of training and development? To graduate at Google of course.

Hundreds of teachers actively engaged with the NCCE Computer Science Accelerator programme during the last half term of the 2018-19 academic year, and some even used some of their summer holiday to upskill and train. One of the incentives for them, apart from a generous bursary to the school for their time, was the opportunity to graduate with Google in September.

Why at Google?

Google.org has invested £1m into the NCCE over the next three years, to support the development of the online courses that underpin the offer of the Computer Science Accelerator programme. Twelve are currently live, and there will be a full selection of 20 by September 2020. It also supports the wider NCCE offer.

So what happened?

The event was totally oversubscribed, with many more teachers passing the end of course test than we expected. This created a few logistical challenges, and some sleepless nights for me as the organiser. Sorry to those

of you that could not attend: security and space were tight.

The event was hosted by Google.org, who pulled out all the stops to treat the teachers to a great afternoon, not least with high tea on arrival. Liza Belozerova, Google.org Programme Manager for Europe, Middle East and Africa, opened the event and spoke about Google's passion for improving the way Computer Science is taught in schools. It believes every student deserves the chance to explore, advance, and succeed in CS.

We were very fortunate that the Chair of the Academic Board – Simon Peyton-Jones – was available for the evening, and he gave a rousing speech to the assembled guests on the importance of Computer Science, and how proud he was of all the teachers that have graduated the programme. Not just the ones in the room.

We also had key members from the DfE and Chris Skidmore MP – Minister for Universities, Science, Research and Innovation – in attendance to present certificates to teachers. He spoke about CS and how it's as important as Maths and English, and how teachers are the apostles and the agents of change for pupils.

Social media storm....

After the event, teachers were busy tweeting about their success, and patiently queued

for a photograph with Simon Peyton-Jones, whilst the STEM Learning CEO acted as chief photographer. There was more generous hospitality from Google.org, with a well-deserved glass of wine and some nibbles. It was lovely to see so many teachers reconnecting after maybe sitting on face to face courses together, and finding out how their pupils had done in the exams, and asking us what was next.

A final word

Thank you to all of you that have embraced the programme. Please continue to share your successes, and spread the word on all the fabulous support available from the NCCE and the teachcomputing.org website. Do check out the #GraduatewithGoogle hashtag too. It's been emotional! (HW)

CAN I JOIN?

The Accelerator Programme is open to all teachers who would like to improve their computer science subject knowledge. The programme includes a diagnostic tool to help you decide what you might like to study first, and is supported by a number of Computer Science Champions. Find out more at teachcomputing.org/cs-accelerator.

CHANGING GIRLS' ATTITUDES TOWARDS COMPUTER SCIENCE

The Gender Balance in Computing programme

HAYLEY LEONARD

We know that females are under-represented in computer science at GCSE and A Level, and in technology careers. In a previous issue we shared news of our programme of research, Gender Balance in Computing (GBIC), which has been funded by the Department for Education in England. Here, we outline the first part of the programme to be rolled out, with a focus on the research background behind it.

Non-formal learning

Code Club and Apps for Good are two examples of how young people can gain experience in computing outside of the standard curriculum. These non-formal

learning opportunities promote fun and creative ways to engage with computing, and they attract equal numbers of female and male pupils. The aim of the current trial is to build on this balanced gender profile in non-formal learning settings to attract more girls to computer science as a formal subject.

Links to formal curriculum

It is perhaps not always clear to young people how the skills they are developing in non-formal settings can be applied in computing classes. Archer Ker et al (2013) suggest that the 'brainy' image of scientists may lead young people, especially girls who consider themselves to be more feminine, to think that more formal science qualifications are not for them. We wanted to highlight the skills that young people were acquiring in non-formal settings to show that computer science qualifications were not out of reach.

We used the concept of 'endowed progress' to guide us. This effect is tested

in a study conducted by Nunes and Drèze (2006). They found that people are more likely to persist towards a goal if they believe they are already some way to achieving it. In our trial, we have included activities and resources that encourage young people to identify skills they are developing during the programme. We then highlight how these skills are important for computer science as a subject, and for different careers involving computing. This should give them a sense of endowed progress towards qualifications or career goals using computing.

Next steps

We are running this trial until April 2020, when we will be able to evaluate its success in changing girls' attitudes towards computing.

If you would like your school to be involved in this or any of our future trials, you can register your interest at ncce.io/gbicregister. (HW)

COLLABORATORS

Gender Balance in Computing (GBIC) is a collaboration between the consortium of the Raspberry Pi Foundation, STEM Learning, BCS, The Chartered Institute for IT, and the Behavioural Insights Team. The Raspberry Pi Foundation are working closely with Apps for Good and WISE in the delivery of this research programme.

WE WANTED TO HIGHLIGHT THE SKILLS THAT YOUNG PEOPLE WERE ACQUIRING IN NON-FORMAL SETTINGS

THE INCLUSIVE COMPUTING CLASSROOM

How to make your computing lessons more accessible and inclusive for learners with special educational needs and disabilities, with effective approaches that are beneficial for all students

Consider the students in your computing classes. What are their strengths and weaknesses; their passions and hates; the barriers they face in learning? In an ideal world we would be able to meet the precise needs of every individual learner, but this is simply not practicable.

However, there are some ways to make your computing lessons more inclusive and accessible for the greatest number of learners, in particular those with special educational needs and disabilities (SEND). The good news is that these approaches harness effective pedagogy which can benefit all students in your computing classroom.

Warning: These approaches won't work for 100% of students 100% of the time! Some students may require specific adaptations. Talk to your individual students and find out what works for them.

In this article I will outline a few ways for you to improve your practice in terms of how information is presented to students, and how students interact with the learning material. For more information on these strategies, and more specific advice on programming environments and activities, look out for the upcoming online course from the National Centre for Computing Education (NCCE): 'Creating an Inclusive Classroom: Approaches to Supporting Learners with SEND in Computing' (bit.ly/2qyrHXH).

Reduce cognitive load

One of the most effective changes we can make as teachers is to reduce the cognitive load of learning new information and concepts. There has been an increased focus on understanding the role of cognitive

load in the classroom in recent years and, for more detail, you can read Phil Bagge's article in Hello World issue 8, and the new Pedagogy Quick Read from the NCCE here (bit.ly/34RY7Ls).

In essence, the amount of new information being introduced to learners can lead to cognitive overload, as the capacity of their working memory is finite. The complexity of the information and how it is presented can also increase cognitive load. Many students with SEND have poor working memory and so can reach overload sooner than their peers.

Here are some ways to reduce cognitive load for learners with SEND:

- Teach key vocabulary in advance of a topic. Provide word lists that can be sent home for students to learn, ideally with image support. When the word is met in the classroom, the learner doesn't have to use up working memory decoding the word, or remembering how it is spelt, and can concentrate on understanding it in context.
- Teach basic skills explicitly and routinely. Once knowledge is transferred to long term memory, it doesn't use space in working memory. As such, if students have a routine of logging on and accessing work from the same folder at the same stage each lesson, it's more likely to become habit.
- Introduce content in smaller chunks, and practise what is learnt before moving on.
- Use familiar contexts to introduce new programming and computer science concepts, such as repetition and selection. This can be done effectively in unplugged tasks, to reduce the amount of new information being introduced at one time.

Accessible teaching materials

Provide information in a range of formats – e.g. text, images, video, and audio – so that students with sensory disabilities can access content and to support weaker readers. In addition, presenting information both verbally (narration or text) and non-verbally (i.e. as an image) allows the learner to access more working memory capacity, and can enhance recall. This is the central idea of dual coding theory (Paivio, A. (1971). *Imagery and Verbal Processes*. New York: Holt, Rinehart & Winston).

Ensure materials are accessible by the greatest number of students with regard to font, colours, layout, and content.

For example:

- Use sans-serif font of at least 12pt in documents or 24pt in presentations.
- Avoid italics and underline which make text harder to read.
- Include lots of white space and break up

Part of a computer – key words



screen

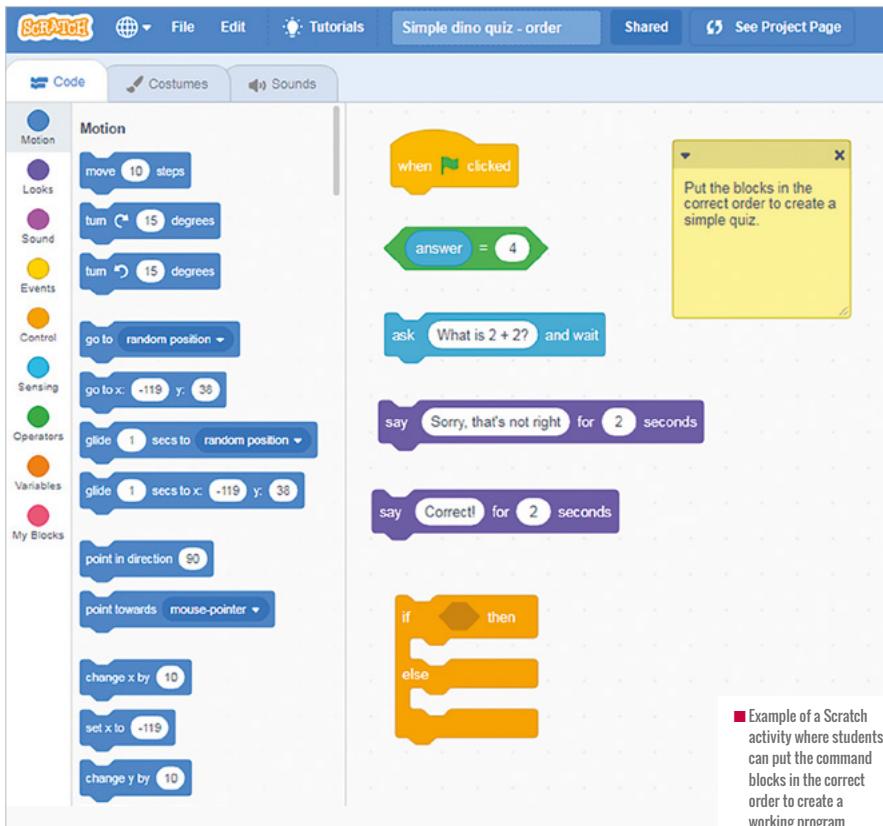


mouse



keyboard

■ Provide word lists with image support for learners to pre-learn key words



text with titles, paragraphs and bullet points to help readers make sense of content.

- Make sure that the text colour contrasts well with the background colour, and don't use colour as a sole indicator of meaning.
- Use simple language where possible, and keep your sentences short.

use a mix of unplugged activities, physical computing devices and screen-based tasks.

Unplugged activities tackled away from technology are an effective way to introduce computer science and programming concepts. Curzon et al detail how they can help students make sense of abstract concepts

slow writing may be able to express him or herself far more effectively and with a wider vocabulary through recording a video or audio clip or drawing a diagram than via a written answer to a question.

Scaffolding learning activities

The Use-Modify-Create model posited by Lee et al (2011) is incredibly useful for scaffolding learning across the computing curriculum (also the more detailed PRIMM framework, developed by Sue Sentance). The cognitive load associated with creating digital content or writing a program from first principles is much greater than when adapting a working model. Students can begin by running working programs or playing a good quality animation. They can learn about the key concepts and features without having to worry about making mistakes or writing a large amount of text.

Students can then move on to modifying a working program or a template of digital content to create a more personalised version. This provides a level of guaranteed success in the activity, which will help to boost the confidence of learners with SEND and increase engagement with the learning. This model also helps teachers to include every student in the lesson, with a number of different entry levels. You can find a selection of Scratch activities at sheffieldclc.net/scratch that can be used to scaffold learning for all students, with options to debug, order, explore and modify code. (HW)

MAKE THE MOST OF IN-BUILT ASSISTIVE TECHNOLOGY IN EVERYDAY TOOLS YOU USE

Finally, make the most of in-built assistive technology in the everyday tools you use. Immersive Reader in Microsoft One Note and Office 365 will read text aloud, highlight key parts of speech and includes a picture dictionary (see onenote.com/learningtools). Pupils with poor or slow typing can use Voice Typing in Google Docs to add content. Android tablets and iPad include a number of accessibility options, including magnifier, zoom, screen readers and colour options.

Provide variety in activities

Provide a variety of ways for students to interact with learning material, for example

through physical objects that can be touched, manipulated and described. "This can make it much easier to explore the concepts involved and makes it easier to ask questions about things that aren't understood ... By providing a physical representation, the learner can point to and ask the question at the level of the analogy rather than having to fully verbalize it at the technical level." (Curzon et al in Computer Science Education, ed. Sentance et al, 2018).

Allow students to present their learning through a range of media, for example animations, videos, comic strips and graphic organisers. A student with poor spelling and



CATHERINE ELLIOTT

Catherine is the SEND lead for the Sheffield eLearning Service (sheffieldclc.net), and she has spent the last five years working on ways to make computing accessible for all learners. She is a member of the CAS Include working group, and co-leader of the Sheffield and South Yorkshire Secondary CAS Community. [@catherinelliott](https://twitter.com/catherinelliott)

INCLUSIVE EDUCATION FOR CHILDREN WITH MEDICAL NEEDS

Katharine Childs speaks to educators who use technology to provide learning opportunities for children with serious and chronic illnesses

Education is a basic right for all children. But what happens when a child is too ill to attend school full time, or cannot attend school at all?

A 2019 report, called *Invisible Children*, highlighted that the number of children affected by the problem is currently unknown, but estimates that tens of thousands of children in England alone could have been absent from school due to conditions such as cancer, cystic fibrosis, Chronic Fatigue Syndrome (ME),^s or mental health illnesses.

For mainstream teachers juggling busy workloads, supporting children who are not able to be in the classroom is a challenge which requires additional resources. The work of educators who teach in alternative provision is vital to maintain learning opportunities for children who are ill.

FIND OUT MORE

More information about the AV1 project in Northamptonshire is: nhoe.org.uk/av1

You can read more about the Robots in Schools project in Oxfordshire at: obs.oxon.sch.uk/robots-in-school-project

A summary of the *Invisible Children 2019* report is available at: noisolation.com/uk/research/invisible-children

The type of setting varies, but the overall aim remains the same: via a hospital school, medical pupil referral unit (PRU), out-of-school tuition (OOST), or home tuition, these educators provide temporary educational support to help minimise the impact of being absent when children return to school.

help children remain part of their school community, even when they are too ill to attend. The AV1 robot goes into a child's usual mainstream classroom, and becomes the eyes, ears, and voice of the child. Video and audio are streamed from the robot via an end-to-end encrypted connection which the

“ THESE EDUCATORS PROVIDE TEMPORARY EDUCATIONAL SUPPORT TO HELP MINIMISE THE IMPACT OF BEING ABSENT

I spoke to two educators who work with children who have medical needs and asked them how they innovate with technology to provide learning opportunities.

AV1 robots in Northamptonshire

Cath Kitchen, Head Teacher of the Hospital and Outreach Education team in Northamptonshire, oversees provision for children and young people aged 4 to 18 who cannot attend mainstream school due to a diagnosed complex medical and/or mental health conditions. Cath explained to me that, while delivering education is important, her team also consider the social aspects of learning. Ill children often lose touch with their peers, and learning in a new environment without the presence of familiar classmates can be difficult.

Cath's team have been using a telepresence solution called AV1 to

child watches from home on a tablet. The app provided allows the child to be interactive and raise their hand to answer questions or discuss ideas as part of a small group.

Once set up, the AV1 robot becomes embedded into all kinds of activities within a school. "One child even went on a school trip to the supermarket via an AV1 robot which was placed in the shopping trolley and pushed around," Cath revealed. Every case is different, and each young person requires an individualised approach. "We tweak the system to fit the child, not vice versa," Cath told me, and added that the support of the child's mainstream school was vital.

90 AV1 robots are currently being evaluated in classrooms around the UK as part of a Department for Education-funded project which aims to deepen the evidence base on how to improve outcomes for children in alternative provision. Teachers



The Double2 robot lets two students work together in paired talk, even if one student is not in the classroom

have access to an online resource bank to cover everything from privacy and data protection to presentations for staff and parents. It is hoped that the project will provide best practice guidance about using telepresence solutions in education that can be disseminated amongst schools.

Innovation in Oxfordshire

James Shyrane is Assistant Headteacher at Oxfordshire Hospital School and teaches computing as part of the Outreach Teaching Service, working to help local schools support pupils with medical needs. In any one day he could be delivering a computer science lesson involving Python in a pupil's home, or working with a small group of children to code a micro:bit in a public library.

The Hospital School won the TES Schools Award 2019 for innovative use of

technology to influence outcomes, and a project called Robots in Schools was a key part of this success. James explained that the hospital school is using a fleet of 11 telepresence robots to live-stream classes to children who are unable to be in school due to their medical condition.

As well as AV1 robots, the Hospital School is also trialling some Double 2 robots. These are self-driving, two-wheeled video-conferencing robots which mean that children can walk virtually around a school with their friends, as well as being present in lessons via a secure, streamed video feed. James said: "The project has made a big difference to our pupils, enabling them to stay connected to their home school's academic programme and, just as importantly, to maintain social links to their peers."



KATHARINE CHILDS
Katharine (@IAmKatharineC) is a Programme Coordinator at Raspberry Pi Foundation and a former primary school teacher and network manager.

Looking to the future

Formal education is not the only thing which children miss out on when they are too ill to attend school. They also lose access to all the enrichment activities which schools offer, including after-school clubs. The Raspberry Pi Foundation is currently working with the team at Southampton Children's Hospital to set up a Code Club in their communal play space. An initial training session for the Play Specialist team has already been delivered, and this exciting new project is now in pilot phase.

By combining inclusive approaches and innovative technology, educators have the chance to support children with medical needs. There is work to be done on assessing strengths and challenges of different telepresence solutions, as well as pulling together a richer and more accurate dataset of how many children are unable to regularly attend school due to illness. Provision for children with medical needs varies substantially depending on where families live, and so sharing best practice nationally is also important. Finally, it's crucial to make sure that teachers in mainstream schools are aware of the possibilities and supported to work with alternative provision educators to deliver inclusive learning opportunities.

Ultimately, the use of technology offers exciting opportunities to help ill children continue to learn and achieve. It also gives children social connections which are vital to their emotional health and interpersonal skills and will enable smoother transitions when children are ready to return to school. (HW)

FROM THE TRENCHES: SNOWFLAKES AUTISM SUPPORT CODE CLUB

Snowflakes Autism Support started a Code Club for autistic children and their siblings in 2018.

Located inside the Holywell Community Centre in Swords,
it runs monthly and can accommodate up to ten children

Snowflakes is a charity based in North Dublin, created and run by parents of autistic children. The main aim of the group is to organise activities for the children and their families, as well as to create a support network. Some examples of such activities are messy play, brix club, swimming lessons, horse riding, family days out, and such like.

The idea to include a 'Learn to code' activity into the offering was there for a long time. After all, computers are a common interest of autistic people. But an idea is not enough, you need a champion: meet Trevor.

Trevor is the current volunteer coordinator of Snowflakes, and always tries to find new ways to engage people into starting new activities or helping with existing ones. And he kept asking me.

I have been a member of Snowflakes for a while. I have two autistic children and I am also autistic myself, which I found out after the diagnosis of my first child. I wanted



to give something back and this activity is something that really appealed to me. I love teaching (I even taught at the University for a term) and I thought it could be a challenging and rewarding activity. My own children are still too young to participate, but I hope they will eventually try it.

the role of the champion, taking care of all the logistics, organising registrations, and many other small things, while I have settled into the role of the mentor, picking projects, bringing new ideas, and going around helping the children.

We have been running the Code Club for

THERE'S A LOT OF CHALLENGES WITH AUTISTIC CHILDREN, BUT THERE'S A GOOD CORE OF THEM WHO ARE REGULARS. SOME KIDS TRY IT AND DECIDE THAT IT'S NOT FOR THEM, BUT THERE'S A GOOD CORE OF THEM WHO ARE REGULARS

The story so far

The 'Learn to code' idea ended up taking the shape of a Code Club. Given that Snowflakes requires membership to participate, we couldn't really start a CoderDojo, but both are very similar. We've used the materials from Code Club since day one, and while we are quite flexible and encourage kids to do their own project, I have discovered that the children find the structure of the projects in the Code Club reassuring and organised.

The other big benefit of being part of Code Club is that it provides a sense of belonging to a community. There are plenty of Code Clubs and CoderDojos, and they are the same activities other children do, just in a slightly different setting.

As the club goes, Trevor has settled into

over a year now. Some kids try it and decide that it's not for them, but there's a good core of them that are regulars and really passionate about coding.

Special challenges

Autism is very diverse – which is why it's called a spectrum – and no two individuals are the same. We used to say that 'if you've met a person with autism, you've met a person with autism'.

Obviously, hosting a Code Club for autistic children comes with some challenges and, as parents of such children, we were ready.

One key difference from other Code Clubs is that we recommend parent supervision, especially if a child needs significant support. We are more than happy to have the



parent in the club, and some of them have discovered that they like coding too.

Autism usually comes with sensory processing difficulties, so some children need movement breaks (like running around the room every 20 minutes), others are sensitive to sound, so they wear noise-cancelling headphones. All in all, it's about letting each child have whatever means of support they need to be comfortable.

Another common trait is to miss nonverbal clues, invade personal space, or need things to be explained very clearly. These are all things that are easy to accommodate if you know in advance.

Routines are worth mentioning. Most autistic people like routines and can get stressed if changed – especially without preparation – so we try to keep things quite stable. We try to run the club on the last Thursday of the month, at the same time. We start with announcements, look at the state of the projects (some children push their project at home), plan the work for the day, reserve time for Show and Tell at the end, and when possible we assign the same laptop to the same child over sessions.

Show and Tell is very interesting. It helps with the social aspect of the club, which is good for any child, but for us, given how difficult it can be to learn and practice socialisation skills, it's a great exercise and also a self-esteem boost.

Special children are special

However, that's only half of the picture. Autistic children are well-equipped to make the most of a Code Club, and they are amazing at it.

Let me tell you about special interests. If an autistic person gets interested in something, there's no middle ground, we will learn everything about it. Special interests are very diverse: trains, dinosaurs, Pokemon, juggling, and so on. But computers are usually a special interest, and the intensity of a special interest is an amazing driving force.

There are other traits that are also handy for writing code. It is common to be very literal; and that is precisely what programming is about, telling the computer exactly what to do. Another one is to be very logical, which is also useful when trying to read code. Extreme attention to detail is another common autistic trait, and a very useful one for a developer. Even more, autistic people can hyperfocus, which is like being in the zone, but better.

Looking at the future

In an ideal world, our Code Club should not need to exist. All Code Clubs and Dojos can provide the support these children need. I am well aware that not everyone can have a ball pool at their club, but most likely you won't need one. Most of the accommodations are easy. It's just a matter of having more awareness.

I also want to give a hats-off to the people of the Raspberry Pi Foundation, who actively asked me to collaborate on the accessibility guidelines for Code Club/CoderDojo (that you can read more about this issue), as well as participate on the recommendations for Coolest Projects, on which two of our members exhibited past year.

As a closing note, we recently had our first external volunteer – a colleague from work – and after his first session he told me that it was easy, everyone is different, we just have to be flexible and meet each child where they are. He also ensured that it was a great experience, signing for next month straight away. [\(HW\)](#)



RAUL PORTALES

Raul is a software engineer specialized on mobile and IoT and works on the mobile team at Workday Dublin. Twitter handle: [@sla_shalafi](#)

ENCOURAGING AN INCLUSIVE COMPUTER SCIENCE ENVIRONMENT

Equality, diversity, and inclusion are big objectives that are highly focused on everyone's agenda. In this article, **Beverly Clarke** presents information and an opportunity to reflect on how we work with and within each of these areas, ensuring there is promotion of equal opportunity for all

Recently I attended the Microsoft Philanthropies Summit and participated in a workshop on Equitable Computer Science presented by CSforALL (csforall.org). This thought-provoking session made me reflect upon my own teaching and resource writing experiences, and whether I was meeting the needs of all pupils within the classroom.

Additionally, it encouraged me to think wider and consider society as a whole, and the experiences that individuals have with technology and the impact upon their lives.

With this in mind, the first activity was to identify what equitable CS education meant to me as an individual. Circle the items in **Figure 1** that resonate with you. Then consider:

- Why do certain areas get more attention?
- Why are some not getting attention?
- Which of the items guide your work?
- Are there areas that can be developed at teacher, department, or senior leadership/whole school levels?
- The table mentions a lot about youth – why is this so? This is so that we

are ensuring a skilled workforce for the future; however, what about other sections of the population – such as those of pensionable age, etc.? The discussion can be extended into how they are included in a digital society.

Building upon this, we then looked at the words we use to talk about equitable computer science, such as access, diversity, equity, culturally responsive teaching, inclusion, intersectionality, and universal design to ensure we were looking

1. Helping to bridge the 'digital divide', helping those that haven't had access to technology participate in CS education	2. Students working on tech projects that solve problems in their communities	3. Making sure that young women have access to CS learning experiences
4. Creating pathways into tech careers to combat poverty and create financial security for youth and communities	5. Making sure that people with disabilities or special needs have learning environments, tools, and curriculums that are accessible	6. Teaching CS in a way that actively takes into account youth's interest, identities, cultural and linguistic practices, and histories
7. Making sure that youth don't just get a small introduction to CS, but rich experiences that let them go deep and develop real skills	8. Students working on tech projects that help solve society's big equity challenges, like the climate crisis, economic inequality, or healthcare	9. Helping youth see that not all technology is in their best interest, and to think critically about technology tools and platforms
10. Youth being able to use technology to give voice to their perspectives, and express to others things that they care about	11. Youth and communities being active in deciding or designing what kinds of CS learning experiences they want	12. Bringing in more diverse voices into the tech sector so that it ends up focusing on better and more important problems
13. Youth learning about the social impact of Computing in terms of power and opportunity (privacy, surveillance, bias in algorithms, disinformation etc.)	14. Making sure that groups that have been historically excluded from technology fields have real opportunities to participate and shape those fields	

■ Figure 1 - Credit: Taken from CSforAll (Microsoft Philanthropies Summit, 2019)

Equitable participation in computing education

Access

Availability of CS to all students

Diversity

Student participation reflects school demographics

Inclusion

All students are engaged and learning

Culturally responsive teaching and learning

Engaging curriculum

Universal design

■ Figure 2 - Credit: Microsoft Guide to Inclusive computer Science Education

Rigorous CS Education – Experiences that are high quality in terms of pedagogy and robust in terms of nature and scope of learning goals, taking students beyond the curriculum.

Culturally Relevant Computing (CRC) education – Teaching and learning that takes into account context of learners in terms of interests, identities, culture, language and histories. CRC includes all of these aspects and does not seek to have culturally neutral projects.

CS for community-based problem-solving

- Focuses on youth creating or participating in computing projects that address local needs within their own communities.

CS for youth voice and power – This looks at teaching computer science to amplify youth voice, allowing youth to express their views, explore interest, and deepen identities.

CS for Economic mobility – Learning experiences that actively aim to reduce economic inequality and promote opportunity for both individuals and communities to gain wealth.

Teaching social impacts of Computing and Ethical CS – Seeks to promote learning about ways computing impacts society in terms of power and opportunity, such as around issues of privacy, surveillance and security, how bias can be present in computer systems, and impacts of technology on democracy, governance, and civil society.

■ Figure 3 - Credit: Taken from CSforAll (Microsoft Philanthropies Summit, 2019)

RECOGNISING EQUITABLE COMPUTER SCIENCE

- More students taking up Computer Science at GCSE and A level
 - An increase in girls taking the subject
 - More students from different backgrounds taking up the subject
 - A greater number of girls, SEN students, and students from different backgrounds entering competitions
 - Computer science contextualised to the needs of the environment
 - Supporting students for whom English is an additional/second language
 - Using voting systems in the classroom so that everyone has a voice
- Are there other items that can be added to the list?



BEVERLY CLARKE

Beverly Clarke works for BCS - The Chartered Institute for IT, as the National Community Manager responsible for the management and delivery of the Computing at Schools (CAS) community of practice programme, which is a part of the National Centre for Computing Education (NCCE) programme.

social mobility. This can be explored further in the BCS Report on social mobility: bit.ly/2O3UziE.

We are still relatively early in discussions, thoughts, and examples around equitable CS. As a call to action, I would encourage you to answer the questions that have been posed in this article, to share and discuss this through teacher networks and at CAS Community meetings – perhaps to continue this discussion, consider sharing examples of your experiences of equitable CS on the CAS discussion forums, so that we gather evidence of this occurring in our classrooms and communities. (HW)

COMPUTING FOR LEARNERS WITH VISUAL IMPAIRMENTS

How can computing education be made more accessible for learners with visual impairments? **Alex Hadwen-Bennett** explores strategies to use in your teaching

Computing education can be challenging to access for learners with visual impairments, particularly with the inaccessibility of most programming environments and the tendency to rely on visual representations to convey abstract concepts. This article will outline four specific examples of approaches that I have employed to make computing education more accessible to learners with visual impairments.

Physical programming languages

For many children, programming is challenging to learn, and for learners with visual impairments there are a number of additional barriers which need to be overcome. Block-based languages are a popular choice for introductory programming courses; however, their visual nature makes them inaccessible to learners with visual impairments.

Researchers are working on the development of accessible block-based languages, yet while these enable learners to navigate and hear the code, it's still very challenging for children to develop an overall understanding of the code structure and relationships between the different elements. Physical programming languages, which offer a tangible representation of the code, offer a potential solution to this problem.

A number of physical languages have been developed, enabling learners to experience the structure of the code through touch.



■ Students from New College Worcester, who participated in a beta test of the technology behind Code Jumper.

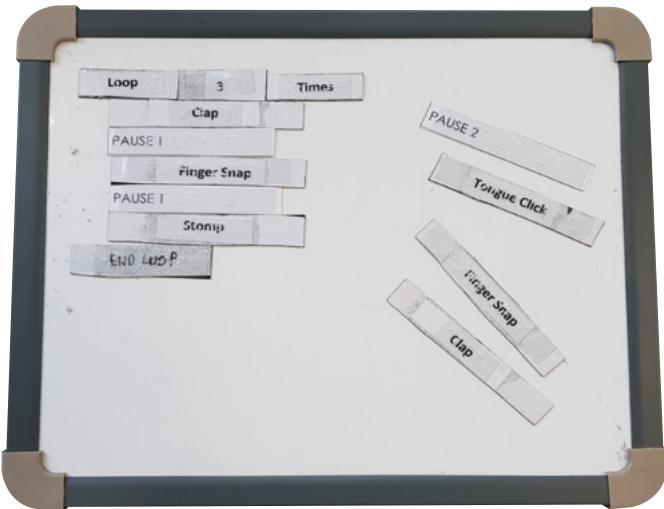
Most of these languages are not fully accessible due to the individual elements not being distinguishable through touch alone. Code Jumper, on the other hand, is a physical programming language that was developed to be inclusive of learners with visual impairments. It uses physical pods to represent commands that can be joined together to construct programs that produce sound in the form of music, stories, and poetry. To find out more about Code Jumper, visit codejumper.com.

Physical computing

So physical programming languages are a potential alternative to block-based languages, but what about text-based languages? The use of physical computing

devices such as robots and micro-controllers has been shown to be an effective mechanism for engaging novice programmers, including those with visual impairments. The BBC micro:bit is currently a popular choice of educational micro-controller in the UK due to its relatively low cost and plug-and-play nature. Therefore it was chosen as the most suitable candidate to use when I explored the potential of physical computing to introduce learners with visual impairments to text-based programming. The first step was to explore how the micro:bit could be made accessible to learners with visual impairments.

Many different programming languages are available to the BBC micro:bit, however Python was chosen for two reasons: it is



■ Magnetic algorithm design board.

the most popular text-based programming language in UK schools, and the micro:bit implementation of Python has a basic speech synthesiser.

The excellent programming environment, Mu, has been developed to enable learners to easily program the micro:bit using Python. Unfortunately, at the time of writing, Mu doesn't work with screen readers and is therefore inaccessible. There is, however, a command-line tool – uFlash – that can be used to transfer a Python program onto a connected micro:bit. uFlash can be used in combination with Notepad++, an accessible and customisable text editor that allows the user to define custom keyboard shortcuts. A custom configuration file was created that transfers the current file onto the connected micro:bit. This setup enables visually impaired learners to write their Python program in Notepad++ and simply press a keyboard shortcut when they are ready to test it on their micro:bit.

In order to hear output from the micro:bit, it needs to be connected to headphones.

This can either be done using crocodile clips or by using a board such as the amp:bit. It was decided to use the amp:bit as the learner simply needs to slot their micro:bit in and plug in their headphones.

Tangibles

Computing education relies heavily on the use of visual representations to

teach abstract concepts; tangibles can offer an alternative and more accessible approach. A number line is often used as a technique for visualising the representation of numbers in binary. I created a tangible representation of this concept in the form of the binary braille ruler. It's a 3D printed tool that features the place values in braille along the top and a series of slots that 'bits' can be placed into. Each 'bit' is a separate tile with the braille representation for 0 on one side and 1 on the other. The learner can represent numbers by flipping the 'bits' to the correct side and placing them under the appropriate place value. This proved to be very successful with the learners I trialled it with.

Tangibles can also be used to design programs; I use an algorithm board, which is a magnetic board with magnetic strips for each command that learners can arrange to create their design. The strips have a written label identifying command and on top is placed a clear sticker with the braille representation.

The board can be used in a number of ways in order to scaffold the learning process:

1. Providing them with a complete program design to read and interpret.
2. Giving them a partially complete program design that they need to complete using given pieces.
3. Providing them with the mixed-up commands they need to create a program design.
4. Starting with a blank board and getting them to say which pieces they need to create the design.
5. Using their design as a reference when constructing the program using a physical or text-based language.

There are many challenges we need to take into consideration as we seek to make our computing classrooms more accessible places for all learners. This article has highlighted just a few of the barriers that children with visual impairments may face, and suggests some strategies to help start breaking those barriers down. [\(HW\)](#)

TEXT-BASED PROGRAMMING

The accessibility of text-based languages is largely dependent on the programming environment, with many being inaccessible. If an appropriate development environment is not available, a plain text editor can be used. However, they lack debugging tools. The choice of language is also important: it needs to have simple syntax and make limited use of non-alphanumeric characters – an example would be Ruby or Quorum.



■ 3D printer binary braille ruler.



**ALEX
HADWEN-
BENNETT**

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MAKE YOUR CLASSROOM ACCESSIBLE BY DESIGN

10 top tips on how to make your classroom accessible by design from CAS Include:
the Computing At School inclusion and diversity working group

Teaching computing comes with its own set of challenges when working with students with special educational needs and disabilities.

At CAS Include, the working group for Computing At School educators, we encourage computing teachers to think about making their classroom accessible by design in the first instance, rather than adapting the settings as an afterthought. A well-designed and thoughtful space, along with good SEND practice makes the subject great for everyone, regardless of background or needs. Here are our top ten ways to help make your computing classroom accessible by design:

- Think about cognitive load and try to reduce it.
- Teach the terminology. Create a language-rich classroom and expect learners to use the language of computing by using physical actions, songs, or signs.
- Check for understanding of key prerequisite knowledge before moving on through diagnostic questioning. By investing time in checking for misconceptions, you can really help students have a deeper knowledge of concepts and skills.
- Scaffold learning, for example by using PRIMM or Parson's problems. You can design algorithms away from screens in different ways, like using flow diagrams or by acting it out. Before moving on to modelling some code for learners to build on. That, or provide completed programs for learners to trace or tinker.
- Use unplugged activities with familiar contact and sensory approaches to introduce and reinforce key concepts.
- Teach computational thinking explicitly as a framework for problem-solving. Teach strategies to encourage resilience like debugging or decomposition.
- Use physical computing as a method of engagement and expression. Use technology that has different outputs like Sonic Pi (music) or Bee-Bot (movement) to engage and include learners.
- Provide opportunities to submit homework in different formats like audio, video, or through animation, as well as access to technology to do the work on.
- Ensure teaching and learning materials are accessible and include image or audio support. Ensure background and text colours are high contrast, and find out if any colours are more readable for your students. Use sans serif fonts.
- Use assistive technology. Your Computing classroom should be at the forefront of using technology! Allow all students to access the tools to spark questions about usefulness, purpose. Can they work to build something better or more appropriate?

Although this list was designed with SEND learners in mind, it is our belief at CAS Include that you can apply this to any class and transform it into an engaging and inclusive space of learning. As our research around computing education pedagogy grows in the coming years,

we hope to develop more support for educators to apply, so why not start a discussion with your community of practice, wherever you are in the world, about accessible computing classrooms and let us know what works for you? (HW)

JOIN THE TEAM



CAS Include is a group of educators and academics who are passionate about giving all students the opportunity to study computing without regard to background, race, gender, or ability. We concentrate on producing outputs to support teachers, based on current research. Join us at computingatschool.org.uk



CARRIE ANNE PHILBIN
Director of Educator Support at Raspberry Pi Foundation, CAS Board Member, Chair of CAS include, author, and YouTuber.



COMPUTING FOR ALL - DIFFERENTIATION AND ACCESSIBILITY TOOLS

Ideas for meeting a broad range of needs on a tight budget, whether you're in a specialist or mainstream setting

I asked myself the same questions with this article as I ask myself every year when I look at the breadth of the computing curriculum.

- Where do I start?
- How am I going to fit all this in?
- How can I make it accessible?

The answer to the last question will change from cohort to cohort, and sometimes even on a daily basis with the same learners. When selecting or reviewing resources, bear in mind that it's not the original intended audience of the material but its impact that is most important. Whether you're handing out a worksheet from Twinkl or using a video from one of the NCCE courses on FutureLearn, if it suits your learners and they make progress, it's a winner. What I would like to do is recommend resources and pedagogical strategies which you can mix and match to suit your learners' cognitive ability and social maturity.

One size fits none

In my experience, too many resource providers and organisations equate SEND learners with a specific set of needs and expect resources adapted for this set to suit all. Some do not even provide adapted resources, but merely recommend using the ones for an earlier Key Stage. This leads secondary learners to feel belittled or even excluded by resources packed

lead to increased workload while you are setting up classes, the temporary negative impact is outweighed by the long-term benefits for both you and your learners.

Once I've found out more about each pupil, I can place them along a 'differentiation compass' (pictured over the page), with axes denoting cognitive ability and social maturity. Each quadrant represents a different spectrum of needs and a different approach

" IN ORDER TO AVOID WASTING TIME AND MONEY, IT'S VITAL TO GET TO KNOW YOUR LEARNERS AND THEIR NEEDS

with references to primary school life. It's inevitable that you will have to either adapt resources or even have multiple sets in use so you can enable your learners to engage and progress. In order to avoid wasting time and money, it's vital to get to know your learners and their needs. While this can

to teaching and learning – not always tied to the resources being used but a different way of delivering or 'selling' generic resources to learners.

The 'vocational' approach, for pupils with low cognitive ability but high social maturity, improves their access to the IT ➤

and Digital Literacy curriculum strands (these pupils respond best to being treated like young adults preparing for independent living, showing them how they can use tech to overcome cognitive difficulties). It does so while linking digital making projects to their career aspirations. It also helps them to engage with the computer science strand, alongside an IDE which colour-codes syntax and delivers jargon-free error messages, such as micro:bit Python, or more advanced block-based coding platforms such as EduBlocks or Tinkercad.

Pupils in the 'aspirational' quadrant also respond well to work-related learning and reference to adult life. They are the group with the most potential to achieve at average (or even above average) level for their age and stage. That's once appropriate physical assistance or psychological support is in place, as their needs tend to be more related to neurodiversity conditions, mental health difficulties, or physical disabilities. Drawing the curriculum strands together by researching and creating adaptive technologies, participating in competitions such as BAFTA YGD, and looking at the range of tech career pathways offered by initiatives such as BBC Extend and Google CS First, will show them that their potential

is only limited by their level of participation.

For pupils who are academically average or above, but not as socially mature as their mainstream peers, a 'guiding' approach is needed, where challenging tasks are framed in contexts familiar to their narrower experience of everyday life – and media

the simplest of language and sometimes only visual cues.

When working with these students, the priority is enabling them to access a digital lifestyle safely. They are the most vulnerable to inappropriate content and contact due to their lack of understanding of adult contexts,

“ YOU MAY FIND YOURSELF ADVISING PARENTS ON HOW TO MONITOR THEIR CHILD'S USE OF TECH

consumption. They are more likely to respond positively to high-level primary resources, especially ones using popular characters as stimuli, for example **Code.org**'s 'Code with Anna and Elsa'. They may already be familiar with Scratch and BeeBots, so developing their coding skills through App Inventor and Probotix will provide challenge without straying too far from their comfort zone.

For some pupils, any progress is to be celebrated. The lowest-ability learners, who may never be able to live without care and/or supervision, need a 'nurturing' approach with frequent reinforcement of the basics, using

so you may find yourself advising parents on how to set access controls and monitor their child's uses of tech. Otherwise, primary level resources from sites such as Twinkl and BBC Bitesize work with these groups. Targeted and specific support may take the form of adapted equipment to develop gross and fine motor control, or use of graphic keyboards and systems such as PECS or Communicate in Print for non-verbal or pre-literate learners.

For all groups, alternative forms of recording and assessment are extremely useful. Cameras and microphones can either be bought cheaply or come built into laptops and tablets. Tools like Google Classroom and GSuite give learners free access to collaborative tools that they can use in a secure, safe online environment managed by staff as admin.

Exploring alternative qualifications to GCSE computer science enables learners to showcase their computing skills, even if they are unable to cope with the level of language in the GCSE or its final exam structure. For example, the iDEA Bronze award provides digital challenges to suit a broad range of abilities and interests including coding and systems administration, while OCR Cambridge Nationals in Creative iMedia has a Game Development unit which covers algorithms, pseudocode, programming, and computational thinking.

Safety always

Choosing appropriate online safety resources is a challenge when your pupils are at different levels of cognitive ability and social maturity. Prioritising risk factors for pupils and keeping abreast of new technologies and trends can be daunting,

Vocational

- Low cognition, high maturity
- SEMH
- MLD/SLD
- Excluded/disengaged

Aspirational

- High cognition, high maturity
- Physical disability
- SEMH
- Neurodiverse

Nurturing

- Low cognition, low maturity
- SLD/PMLD
- Developmental delay

Guiding

- High cognition, low maturity
- MLD
- SEMH
- Neurodiverse

Internetmatters.org reports that vulnerable children need "relevant, proactive, and nuanced education." The quadrant system makes it easier to plan accessible and engaging work.

RESOURCE FINDER

- Repl.it
- Scratch & ScratchJr
- App Inventor
- EduBlocks
- Tinkercad
- Hour of Code
- Code Club
- Microbit.org
- BBC Bitesize
- iDEA.org.uk
- internetmatters.org
- nationalonlinesafety.com
- 360safe.org.uk
- Google Interland
- projects.raspberrypi.org

but the resources above make good starting points.

A recent position paper entitled 'Vulnerable Children in a Digital World' by Adrienne Katz and Dr Aiman El Asam of YouthWorks, in partnership with Internet

recap data protection and online scams during an otherwise dry data handling unit, explore fact-checking and cyberbullying as part of web design, and investigate the ethics of self-driving cars and military drones before building and programming their own, smaller-scale, service robots.

Game development is a great time to discuss the psychological effects of gaming and do some anti-RSI exercises. This enables me to keep online safety at the forefront of learners' minds without it seeming like nagging. You may wish to employ a similar strategy with more vulnerable learners.

You can find free resources suitable for all levels and stakeholders at Internet Matters and National Online Safety – which also offers premium resources, CPD, and outreach. As an effective aid to self-evaluation and development of best practice, South-West Grid For Learning's '360 degrees safe' whole-school online safety review tool is free to use until you are ready to apply for a online safety mark assessment. Google's 'Interland' E-safety game is engaging and accessible, with narration built-in.

settings in your operating system, handily ticking off a few assessment criteria as you help them access other content. Accessibility plug-ins are also available for web browsers. Exploring the accessibility features of your operating system, such as magnifier, narrator, and on-screen keyboard, may help you to meet a broad range of physical and cognitive needs – once you ensure your school's technical staff have set permissions appropriately!

Many of our learners are already accessing free sites and software which enable them to create, curate, and collaborate – the key for staff is not so much finding the appropriate resources as catching up with the kids and guiding them towards safe and relevant uses for the same software in school.

This has the added bonus of breaking down the disconnect between computing as a school subject, and computer use as a ubiquitous everyday activity. Consider learners who will barely type one sentence in class and openly rebel if asked to wield a pen, but then go home and type hundreds of words across a range of social media applications on up to four devices at a time. With the right approach and a toolkit of financially, technologically, cognitively, and socially accessible resources, we can enable learners with SEND to embrace their potential and help them develop the knowledge and understanding which will prepare them for independent living in a fast-moving digital world, whatever their level of need. The fact that they also make progress in computing as a school subject is merely a beneficial side-effect by comparison. [\(HW\)](#)

" THERE ARE PLENTY OF ACCESSIBILITY-FOCUSED EDTECH COMPANIES CREATING EFFECTIVE EQUIPMENT AND RESOURCES

Matters, collates findings from Youthworks' CyberSurvey and broader academic research. It identifies online risk factors associated with a variety of needs, and proposes a three-tier model to enable teachers, parents, and external agencies to target support more effectively.

The paper also acknowledges the elephant in the room where online safety is concerned: "As teenagers increasingly become bored with the idea of learning more about online safety, it becomes more challenging to engage them and deliver a meaningful message."

My preferred approach is to embed elements of online safety into all areas of the curriculum, placing the risk factor in a relevant and relatable context for the learner. For example, pupils at Oakwood

Free and easy

There are plenty of accessibility-focused EdTech companies creating effective equipment and resources, but with school budgets being cut relentlessly, frontline staff need to make unpleasant decisions balancing potential impact, number of learners benefiting, and cost. Here are a few tricks I employ to meet learner needs within financial constraints. Please tweet me any others you think of or already use.

For learners with sensory requirements, everyday over-ear headphones with decent padding, such as TTS's EasiHeadphones, can serve an additional function as ear defenders. Packs of A4-coloured acetate make a cheap alternative to expensive overlays, and you can teach pupils to change the colour and contrast



EMMA BENNETT

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One of the first cohort to complete the NCCE Computer Science Accelerator programme and a regular contributor to #CASChat on Twitter.

#INSIGHTS

'RUN ROBOT, RUN': USING ROBOTICS TO ENGAGE CHILDREN WITH SPECIAL EDUCATIONAL NEEDS IN COMPUTING

STORY BY Hayley Leonard

One challenge of the computing curriculum is making it inclusive and accessible to learners of varying abilities and a range of educational needs. Recent research has found that using robots with children with special educational needs and disabilities (SEND) can be an effective tool for developing programming skills.

Learning programming is a difficult task that relies on a wide range of other skills, such as reading, writing, and memory, which can all be affected in children with SEND. Researchers have been trialling different

methods of teaching programming through robotics to overcome some of these issues.

Robots and SEND

In recent years, robots have been developed as assistants or 'teachers' in the classroom to support children with SEND. However, robots can also be used as a highly motivating tool to develop children's programming abilities. Three recent studies have taken different approaches to using robots in terms of the hardware, software, and teaching methods they employed.

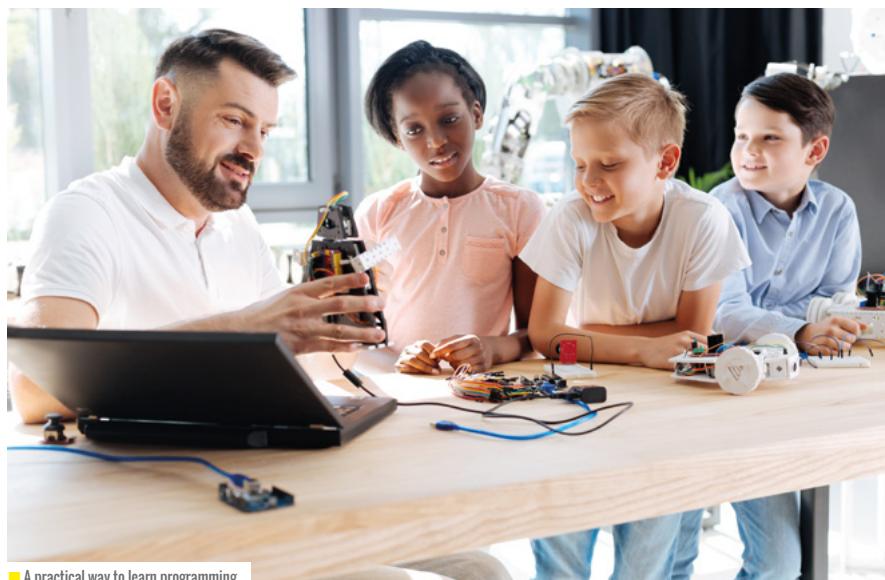
All three provide promising avenues for future research, but also highlight specific strategies for making programming lessons more inclusive.

Reducing the text required to produce programs

A key barrier to engaging with programming is a student's literacy level. Studies by Lahav, Talis, Shelkovitz, and Horen (2019) and González-González et al (2019) addressed this issue by using symbols to aid children with SEND to program their robots.

González-González et al used the KIBO robot and software with children with Down syndrome (DS). This system involves the robot moving along interlocking wooden blocks on which there are symbols corresponding to different movements. Children put the blocks together to make a program and then scan the barcodes on the blocks using the scanner embedded in the robot. The program is sent to the robot which then moves as directed along the blocks. Of the seven participants with DS involved in the study (cognitive age 3-6 years), five of them understood the KIBO blocks and could program basic sequences by the end of the training. Four of them could produce the program independently.

Lahav et al used the EV3 robot built from the LEGO Mindstorms EV3 flexible



A practical way to learn programming

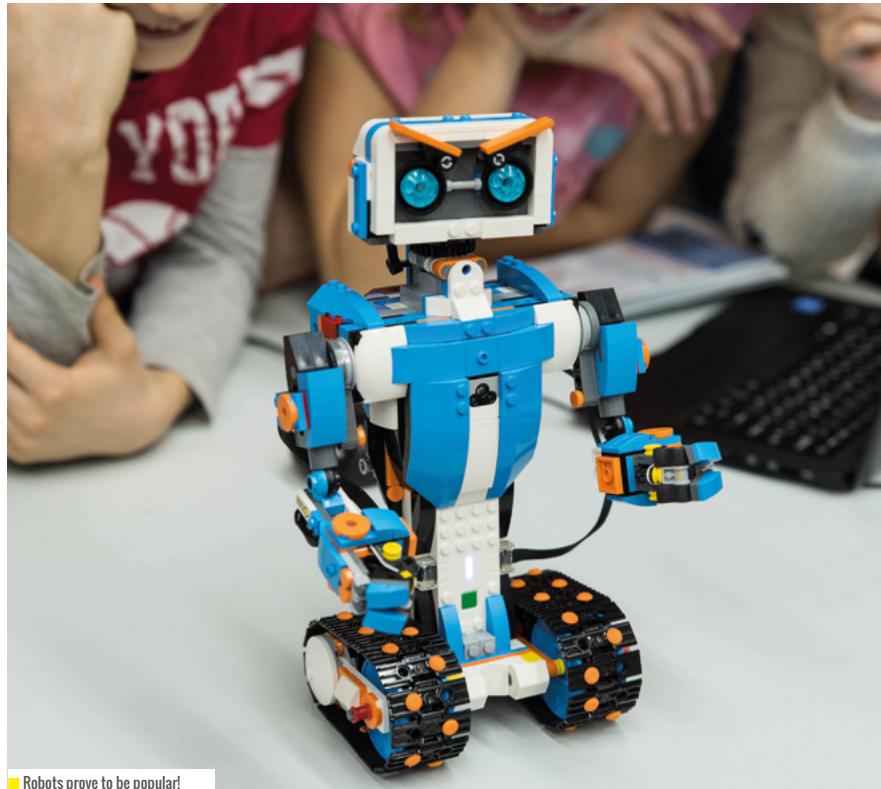
“**ROBOTS CAN BE USED TO DEVELOP PROGRAMMING**

kit, alongside a free visual programming language app called Kinderbot, which was developed especially for young children. They recorded the programming abilities and descriptions of the robot behaviour in two primary school children with high functioning Autism Spectrum Disorder (ASD). While there were some difficulties in producing more complex programs involving subroutines, the children did begin to use more technological descriptions of the robot and its movements after the training.

Using ‘unplugged’ activities and modelling

Another key feature of the study by González-González et al was the use of an ‘unplugged’ activity, in which the students put together programs using cards with symbols before engaging with the wooden blocks and robot. This allowed them to concentrate on the programs without the distraction of the robot and scanner. Using these types of tasks has also been encouraged when teaching all children programming, showing that pedagogical strategies used to assist those with lower abilities can be beneficial to all.

In a study by Knight, Wright, Wilson and Hooper (2019), a ‘Model-Lead-Test’ strategy was used with children with ASD and challenging behaviour aged 15–18 years. This involved first modelling block-based programming using an app (OzoBlockly) to control an Ozobot Evo robot. They then worked with the students to produce the same program, before allowing the students to do the task independently. Using this approach, they found that the three participants were all able to produce explicitly-taught programs. Most importantly, they were able to generalise their learning to produce different programs that were directed by the teacher but not explicitly taught, and also programs that were self-directed.



■ Robots prove to be popular!

Developing research and further practice

The studies are all based on work with a small number of children who were taught individually. While this is beneficial for testing principles in research, it will be necessary to scale up the approaches to make them useful for teachers working with larger groups. Using strategies that can benefit all children, not just those with the lowest ability, will aid teachers in delivering the computing curriculum effectively for all learners.

There is also a challenge when it comes to dealing with text-based coding, which is

important for teaching computing later in the curriculum. Catherine Elliot, an eLearning consultant with Sheffield County Council’s eLearning service, has some great ideas about how to approach this. You can see an interview with her on the Computing at School website or through #include on CASTV. There are plenty of other resources for teaching computing to students with SEND on the CAS website. Other good banks of resources can be found through SEND computing and Barefoot Computing, including lesson plans for working with robots and other hands-on activities. (HW)

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TEAM DIVERSITY AS A PREDICTOR OF INNOVATION

STORY BY Thom Kunkeler

Team diversity is one of the core advantages of learning in groups, and new research has shown its benefits for project innovation. The study, conducted at the Israel Institute of Technology, found that inclusion of people from various academic disciplines and levels in classroom settings helps students create innovative and implementable solutions. Individual differences, researchers find, invite students to approach situations in various ways, and stimulate new ideas and perspectives.

Over the past few decades, student populations have become increasingly mixed on bio-demographic variables, such as gender, age, and ethnicity. Although barriers to participation in education still persist, classrooms are increasingly mixed, especially in online settings.

For this study, Usher and Barak (2019) were interested in how diversity relates to project innovation, both in face-to-face university settings and in online classrooms, for the course Nanotechnology and Nanosensors. The diversity of a team

was rated according to four variables: gender, mother tongue, academic discipline, and academic level. Not surprisingly, the group of online learners was more diverse than the group of university students, with followers from over 150 countries. The group of university students, although less diverse in mother tongue than the online group, showed slightly more diversity in gender.

To understand how diversity relates to project innovation, both groups of learners were split up in teams of four before they had to develop a new product. In the creative stage, students had to create new ideas, and in the application stage, the implementation was carried out. Innovation of students' team projects was assessed on product necessity, STEM interdisciplinarity, market readiness, and innovation type.

The results of this study indicate that diverse teams were rated higher on project innovation, both for online and face-to-face learners. This evidence supports the idea that working in collaboration with people from diverse backgrounds enhances

creative ideas and innovative solutions. In particular, this study found that a mixture of academic discipline and academic level – the task-related diversity – was key to project innovation. For teachers, this type of research should be taken as an incentive to experiment with classroom diversity for group projects. How diverse is your classroom? [\(HW\)](#)

FURTHER READING

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How diverse is your classroom?

INCLUSIVE, COLLABORATIVE AND SOCIAL

MAKING PROGRAMMING ACCESSIBLE FOR CHILDREN WITH VISUAL IMPAIRMENT

STORY BY Hayley Leonard

The development of visual programming technologies to introduce young children to coding has been highly effective, but excludes children with visual impairment (VI) from the early stages of learning programming.

The majority of children with VI are in mainstream or mixed-disability schools. The computing curriculum therefore needs to be accessible and not reliant on vision alone. While previous research has focused on increasing the accessibility of text-based coding, which is more suitable for older or more experienced students, Torino was developed to focus on the initial introduction to programming.

Using Torino as a collaborative learning tool

Torino was developed as a physical computing language which uses instruction beads that can be physically connected and manipulated to create code that generates stories and music using Sonic Pi: projects.raspberrypi.org/en/projects/getting-started-with-sonic-pi (Morrison et al, 2018). A paper by Thieme, Morrison, Villar, Grayson, and Lindley (2017) presents

some interesting insights into how it also encourages collaborative learning and increases accessibility for children with a range of visual abilities.

The authors conducted an exploratory study with ten primary-aged children of mixed visual abilities, who worked in pairs for two sessions to produce programs using Torino. Children were first asked to describe each of the beads within their pairs. While those with relatively more vision focused on the colours, those with partial sight were able to describe the beads in terms of their physical properties. This activity provided a shared vocabulary on which to base conversations about the beads to be used when planning their programs. Children were also encouraged to touch the instruction beads as they executed the program, which promoted an abstract mapping between the beads and their audio representation.

Overall, working in pairs with mixed visual abilities resulted in a range of social and collaborative strategies, including clear verbalisation of planned actions and the use of touch to guide each other's physical manipulation of the beads. The design therefore not only provided an accessible technology for learning programming for both sighted and visually-impaired individuals, but also promoted key collaborative working skills that are of great importance in computing careers. The social

nature of the activities and opportunities that contributed to the project also allowed those with VI to feel included and valued.

Further developments to the technology are planned, including adding functionality to allow the code to be read out. This would make it more compatible with other accessible programming tools.

Since the publication of this research, Torino has been renamed 'Code Jumper'. More information can be found on the Code Jumper website: codejumper.com. For other developments in accessible technology for VI, Alex Hadwen-Bennett's article in this issue provides a useful overview. (HBM)

FURTHER READING

✓ C Morrison, N Villar, A Thieme, Z Ashktorab, E Taysom, O Salandin, D Cletheroe, G Saul, AF Blackwell, D Edge, and M Grayson (2018). *Torino: A tangible programming language inclusive of children with visual disabilities*. Human-Computer Interaction, pp.1-49.

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WHAT IS TORINO?

- Made up of three types of instruction beads: play, pause, loop.
- Each bead represents a line of code in the program and is distinguishable in terms of size, shape, physical controls (buttons and dials), and colours.
- Auditory feedback is provided when beads are added or removed from the network, and also for the generated story or music.
- Torino was designed to help children learn basic programming constructs (sequence, threads, variables, iteration) and to develop problem-solving skills, domain-specific vocabulary, and an understanding of abstraction.

Making sure everyone's included



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TECH UP: THE WOMEN-IN-TECH REVOLUTION HAS BEGUN!

How the need for more women in tech and science – at all levels – is slowly being answered

Did you know that only 17% of the tech workforce are women? Or that out of the top 16 tech companies in the FTSE 100, there's only one ethnic minority woman on the board? Did you know that HESA (Higher Education Statistics Agency) found that female students only accounted for 17.2% of computer science students and 17.6% engineering students?

This lack of diversity in technology and science has very real consequences. You only have to read Caroline Criado Perez's *Invisible Women* (winner of the 2019 Royal Society Insight Investment Science Books Prize), or Angela Saini's *Inferior*, for a thorough examination of the dangers of lack of diversity in the design, implementation, deployment, and evaluation of science and technology.

Examples are abundant and they go from frustrating (to regulate temperature, office buildings use a version of Fanger's thermal

comfort equation, which was developed during the 1960s, and which takes into consideration the metabolic rates of men), to discouraging (NASA famously delaying its first all-female spacewalk due to lack of spacesuits in right size), to downright terrifying (women are more likely to suffer fatal heart attacks than men, but also 50% more likely to be misdiagnosed during the heart attack because they can present different symptoms to the usual chest pain).

These statistics paint a clear picture: we need more women in science and technology at all levels. This is what inspired our team to develop the TechUP Women programme.

What is TechUP Women?

Launched in May 2019, TechUP Women retrains 100 women across the North and Midlands for a career in tech. The programme is led by Sue Black OBE,

Professor of Computer Sciences and Technology Evangelist at Durham University, and is delivered by Durham, York, Edge Hill, and Nottingham Universities.

The programme aims to tackle the shortage of women in technology, particularly those from under-represented groups, including women from British, Asian, and minority ethnic (BAME) backgrounds.

The course is completely free and participants are guaranteed an interview with one of our industry partners once the course is completed. Those partners include Capital One, BJSS, Experian, Atom Bank, and MSP.

TechUP is mainly completed online, allowing for flexible learning that can adapt to the participants' current commitments. Participants go through an intensive six-month retraining course over three terms.



■ TechUP is primarily an online course, with meet-up elements too

#Techupwomen First 100

The first cohort of TechUP Women started their journey in July 2019 at our first residential at Durham University. These incredible women, along with our industry partners and invited guest speakers, came together for two days of activities, talks, and self-discovery.

There are no words to describe the amount of potential, determination, and energy we felt during that first residential. 'The First 100', as they have taken to be called, included women from all backgrounds, ages, religions, sexual orientations, and education levels. We had PhD students, entrepreneurs, lawyers, carers, journalists, just to name a few. But, regardless of their different experiences and journeys, they all had one thing in common: a commitment to improve their knowledge and skills ready for a career in the tech industry.

Our students are currently learning about subjects such as human computer interaction, Python, and artificial intelligence. In the second term they'll choose between a technical or a managerial path. By the end of their journey, they will specialise in four different job roles: business analyst, agile project manager, developer, and data scientist. Each participant also has at least one mentor providing support, who works in the industry sector.

We could clearly witness the effects

that the first term had had on 'the First 100'. Participants were more confident and outspoken. Their progress and curiosity had motivated them, and they had started looking at their future paths.

With this in mind, we are looking forward to our next residential taking place in November and hosted by the University of York, and to our final graduation ceremony in January, hosted by the University of Nottingham. We can only imagine and anticipate the growth and development that the participants will show then!

ONLY 17% OF THE TECH WORKFORCE ARE WOMEN

The future

So, what is in store for TechUP Women? Well, the sky is the limit! We are now working to build a network of people and resources to support its growth, and to ensure that we can continue giving our TechUP Women the best possible chances in years to come.

We are also working on extending the programme to include more women across the whole of the United Kingdom. However, the team's ultimate goal remains the same, and that goal is to support the female tech leaders of tomorrow. (HW)



■ A TechUP Women event in action



MERCEDES TORRES TORRES

Assistant Professor at the School of Computer Science at the University of

Nottingham. Her research interests lie at the intersection of machine learning and healthcare. She enjoys science fiction, logic puzzles, and all things chocolate.



CAROLINA FUENTES

Research Fellow at the School of Computer Science at the University of Nottingham. Her

research areas are Human-Computer and Human-Robot Interaction (HRI). She enjoys reading and outdoor activities (when it is not so cold).



EMJAY NICHOLAS

Project administrator who specialises in non-profit initiatives engaging with under-represented

groups. She's a former Member of UK Youth Parliament and regional officer for Youth Voice Yorkshire & Humber. She enjoys board games and spending time with her two cats.

LEADING COMPUTER SCIENCE PROFESSIONAL DEVELOPMENT

Andrew Collins shares his go-to techniques for leading fun and informative computer science workshops

Educators need opportunities to learn too. When we put ourselves in the student seat, we get the chance to build new skills and gain knowledge that directly improves our teaching.

Every summer, I meet educators who are excited to spend time doing exactly this. They're looking to grow their practice through professional development workshops like Picademy, a two-day workshop focused on building and creating with Raspberry Pi computers. Over time, I've learned what techniques work best for meeting teachers' learning needs, and most importantly, how to provide a creative, engaging, and impactful professional development experience. I hope these top tips provide inspiration as you plan for your next workshop.

■ Andrew leads a Picademy workshop at the Computer History Museum in June 2019



Get coding quick

If you're leading a computer science workshop, the majority of the time should be dedicated to coding. While that may seem like a given, it's often tempting to teach coding concepts before letting attendees do their own coding.

This is a mistake. Your goal should be to get educators coding – writing their own programs, debugging, and problem-solving – as soon as possible. Don't delay. If you're trying to teach concepts in the abstract, you're missing out on huge self-discovery moments and learning opportunities, as well as potentially confusing new starters who have no point of reference for the terms being used. Like in any field, learning by doing is key, and so don't be shy about jumping right into the coding.

When to discuss computer science concepts? My recommendation is to share them as they arise. For example, let educators learn the concept behind a loop in Python as they explore creating a random name generator, or a blinking LED circuit. Lead with an active learning experience rather than a passive listening experience. You'll be surprised how quickly they learn.

Provide challenges

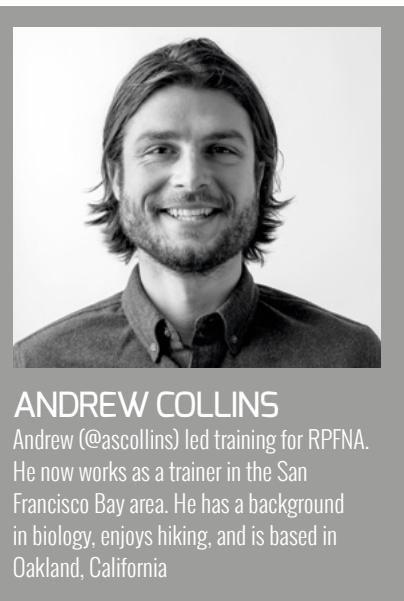
As with most workshops, attendees arrive with varying interests as well as degrees of prior coding knowledge and confidence. Take advantage of this by scaffolding content within your workshop sessions.

My go-to approach is to start with a base activity and then provide 'reach challenges' at increasing levels of complexity. For example, start with the following: 'Can you code a blinking LED in Python?' Once some of the attendees have accomplished this base goal, you can offer up additional challenges like 'can you change the speed of the blinking LED?' and 'can you add additional LEDs?'

Most educators will appreciate not only the opportunity to extend their learning, but also the option of choice; multiple pathways to select from once they've accomplished their base goal. Providing challenges also allows educators the opportunity to F.A.I.L (first attempt in learning), which is key to building their resilience and problem-solving skills.

Allow for open exploration

While providing challenges does allow for an amount of self-directed exploration, I encourage you to take this a step further by



“ THIS OPEN EXPLORATION APPROACH IS PART OF THE ‘LEARN SOMETHING, DO SOMETHING’ STRATEGY

offering educators fully open-ended challenges. This means dedicating at least half your workshop time to letting educators design, build, and showcase a project completely of their own creation. Your goal should be to have attendees brainstorm a practical need and then develop a solution with code and/or a physical computing project. You can use the design thinking process to facilitate this experience, or simply let educators choose a project that's fun, creative, and perhaps a little whacky.

This open exploration approach is part of the 'learn something, do something' strategy, which I believe is essential to

computer science pedagogy – introduce students to a bit of code and then immediately allow them to apply that learning in context.

Prioritise group learning

Building projects is a great way to tap into the power of group work. Educators will gain more from your workshop when they are given opportunities to create and learn in collaboration with their peers. This process also models what their students experience and reinforces the value of pair programming, which has been well researched as a best practice in computer

science teaching. You can emphasise group learning not only in how you deliver the content in session, but also with how you organise the room – try setting up tables of four so that attendees always have a neighbour to discuss and collaborate with.

Learn alongside attendees

My final point is perhaps the most important one: always make sure you're learning alongside your attendees, rather than instructing static content with a preset outcome. Incorporating open-ended challenges helps create this type of 'free learning' environment, however, it is also up to you as a facilitator to be open to new ideas and content extensions as they arise. One of my favourite responses to give at Picademy is "I have no idea! Let's try that out together." I would encourage you to carry a similar mindset as a workshop facilitator. (HW)

INTEGRATING TECHNOLOGY STANDARDS IN THE CLASSROOM

Implementing technology standards across the curriculum can be frightening for teachers. Having a collaborative support system can help ease the fear of this

How do educators implement technology standards when they are struggling to teach core content? Most educators know that technology needs to take place within their classrooms, but struggle with how to make this happen. The State of Alabama recently adopted new Computer Science and Digital Literacy Standards, so it was brought to teachers' attention on how important technology integration truly is. Technology is constantly updating, so we must change the way we share technology education with our students. Technology standards are requiring teachers to not only share computer science, but implement digital citizenship too. This shift has taken many teachers out of their comfort zones.

How to get started

To help with the implementation of technology standards, one district organised a team of teachers to write lessons that would guide other teachers with the implementation process. Simply having a go-to resource helps to ease the



Children enjoying one of the lessons

pressure of implementing new standards into your already established content. Many educators have a fear of technology and need a support system. Creating digital lessons is one way to help.

I spear-headed teachers in the design of digital lessons. With standards ranging from digital citizenship all the way to computational thinkers, it took a team of teachers from many different content areas and media specialists who were experts in

would work on which standards, what online platform would be used, how the lessons would be designed, and the time frame for the project to be completed.

The team discussed where each member believed his or her strengths were, and selected standards to complete based upon these areas of expertise. In this particular district, Nearpod was used as the online platform for each lesson. Working with Nearpod allowed the

I WILL ADMIT THAT FINDING THE RIGHT PEOPLE FOR THE PROJECT MIGHT BE THE BIGGEST CHALLENGE

digital citizenship. Teachers were selected based on their technology skills level, but also how knowledgeable they were with the new standards. These teachers had track records on implementing different types of technology, and had been a part of technology professional development, as well as experts in coding and computer science standards. Media specialists were also selected to be on the team to provide their expertise with digital citizenship standards. Many of the technology standards can sound like a foreign language to some, so lead teachers could design lessons that matched the new standards. This helps to relieve some pressure of the implementation of those standards.

The work begins

Once the team had been selected, I held a face-to-face meeting to determine who

team to use premade digital citizenship lessons from Common Sense Media, edit lessons from the library to fit the state standards, as well as include new lessons linked to hands-on activities and web resources. Teachers were able to work over the summer remotely to create lessons. Members could create lessons and upload to the Nearpod school library for evaluation. I reviewed all lessons before adding them to the district library. The team might have worked remotely, but collaboration was ongoing through the use of Microsoft Teams.

Supporting the process

It was imperative for the lessons to be shared with educators in a meaningful way. Teachers are all too often overwhelmed with new requirements and demands within the curriculum. Knowing this, the district decided to do



DR. ALLYSON CHAPPELL

I have been in education for 18 years. During my time, I have been an elementary teacher, math coach, technology support teacher, and test coordinator. I am currently serving as a district technology resource teacher and adjunct professor for online graduate students.

a 'soft' rollout the first year. This allowed teachers to not feel pressured to complete every single lesson in that first year. Two lead teachers, an administrator, media specialist, and technology resource teacher were all trained the first year in regards to the new technology standards and the support system created through Nearpod.

The standards were rolled out and shared through professional development sessions. During these sessions, standards were unwrapped and the teams were able to review the corresponding lessons. Professional development is effective when participants are able to engage in hands-on lessons, so opportunities were in place for educators to work in groups practicing the deployment of lessons as a teacher. Difficult standards regarding

coding, and activities like this, allow teachers to see how the resource is helpful but pre-planning is still needed. The team discussed how to implement the turn-around training at their schools, ensuring all students experience these standards. Using Nearpod would allow us to check lesson reports to determine if students were meeting the standards. All of our students would be taught the district's acceptable use policy, allowing us to ensure the lessons were being completed, and provide follow-up with any schools who needed further support. This will equip our future leaders with the digital skills necessary to effectively engage in society with technology.

Reflection

I truly believe the creation part of this process ran smoothly. Giving teachers the flexibility to work remotely was key. Knowing they had me at the district level as a point of contact, as well as other team members, allowed them to have a support system. I will admit that finding the right people for the project might be the biggest challenge. It is key to have teachers who are knowledgeable with technology as well as the standards, but also have a track record of being able to supply work outside of the classroom. Making sure teachers are aware of the task and fully committing to it is a huge part. As this is our second year, it is essential for training to continue with the onboarding of new teachers and with those teachers who are shifting to new roles. This process will be continued through the Instructional Technology Department. I truly believe this is a good model for other districts to try. (HW)



■ Some added support in coming up with engaging lessons

Pseudocode and Algorithms

Grade 7

Lesson objectives

1. Explain pseudocode and algorithms.
2. Create pseudocode using various conditionals and Boolean statements.
3. Create algorithms and explain the difference between that and pseudocode.

Standards

- Algorithms:**
2. Create pseudocode that uses conditions
 3. Identify algorithms that make use of sequencing, selection or iteration.
 4. Design a complex algorithm that contains sequencing, selection or iteration.
- Programming and Development:**
5. Create and organize algorithms in order to automate a process efficiently.
 8. Formulate a narrative for each step of a process and its intended result, given pseudocode or code.

Teacher notes

Teachers will want to make a teacher account with scratch. This will open up a wide variety of tools for you, including tutorials that will walk you through how to use scratch so you can teach your students. The next slide is a snap of what the home page for a teacher will look like. Your account is free.

The first lesson is meant for beginning students and takes roughly 30 minutes. Depending on how well your students master scratch and coding, you may want to customize your lessons based on the child and not the class. Some kids catch on quickly and some need more time with the basic concepts!

This lesson can accommodate 6th and 7th grade students.

Materials needed

1. Computer with internet access
2. Scratch download (short cut on a slide to come) Teachers can use the following site as a resource to learn to navigate through scratch to give their kids a tutorial: <https://scratch.mit.edu/educators/resources>
3. Headphones

Project 1

This is a great project for beginner students:
The project takes about 30 minutes for the kids to complete after the teacher shows a tutorial of scratch.

Students will Create their own simple animation with music. They can pick any sprite or draw their own. Their sprite should move and change costume at least once. You can have them write their name and animate it if they can't come up with other ideas.

A good page to go to for a tutorial for you and your students is:
<https://scratch.mit.edu/tips>

SUPPORTING ACCESSIBILITY AND INCLUSION IN CODING

Introducing an accessibility guide that's designed to make CoderDojo clubs an environment for all

In any club or classroom you will have participants with different needs, including participants with disabilities and/or additional needs. The vision of CoderDojo is that all young people should have the opportunity to learn about technology and be creative in a safe and social environment. Therefore inclusion and accessibility are key to what we do in our volunteer-led coding clubs.

Leading by example

Prior to the development of our accessibility guide, multiple club organisers noted how they wanted to make their CoderDojo clubs (Dojos) more accessible for participants who have a disability, but they weren't sure where to begin.

When Dojo volunteer and UCD SU Disability Rights Campaign Officer, Hannah, approached us with her experience and resources she had helped develop already for her University, we jumped at the opportunity to support clubs to become more inclusive.

Hannah Bryson is the UCD CoderDojo champion, and she says that "I have been teaching kids coding since 2013. As an autistic adult, I have always tried to make the CoderDojo clubs I have been involved in inclusive for disabilities. I noticed there was a need for me to share my knowledge to give people more ideas on how to make their club more inclusive. I approached the CoderDojo Foundation with the idea of creating a guide, as previously I had developed something similar for my University societies. I suggested the structure for the guide

which they approved. This incorporated the concepts of inclusive language, reasonable adjustment, accessible information, the importance of dealing with disclosure, and ideas that have worked in my experience as a mentor. Thankfully this inclusive organisation took my ideas on board and ran with it. What started to be a two-page leaflet has now grown into a 34-page guide. At every stage, they have asked for my input and sent the drafts to disability charities for feedback. A lot of work has gone into this guide by many people and I am proud to be part of this inclusive community."

What we learned

In the guide, we discuss how you can make your club more accessible. Listening to your participants, making reasonable adjustments, and deciding what works best in each unique situation means we can all have the best possible experience. Some snippets from the guide include:

- Ask the person what terms they are most comfortable with you using in relation to their disability. Avoid using terms that may be considered offensive, or any language that may exclude or isolate the person.
- Include detailed accessibility information about the venue. Be as specific as possible. Bear in mind that the venue building may be accessible, but the room in which you host your club or class may not be.
- Examples of reasonable adjustments include using posters to signpost the

room where your Dojo is held, rearranging tables and chairs to create a more accessible space for wheelchair users, and designating a 'quiet corner'.

- Describe the environment to the person when they start at your club. Describe where different things are in the space and make use of landmarks, so that they can become comfortable with moving through the environment.

In the words of Natasha, the champion of Derry CoderDojo, "the most important thing we have found is to talk to the parents or guardians. Every child is different, and some have certain things that will help them. One boy in our Dojo has Asperger's syndrome, and a grandparent explained that he zones out his hearing when sensory overload kicks in. We now know to place a hand on

HOW CAN YOU LEARN MORE?

We are currently in the process of designing editable social story cards for children with ASD. The draft versions of which are being tested by children at the moment. You can read the full screen-reader friendly CoderDojo Accessibility Guide for free in both a digital and print-ready versions at: bit.ly/33J3deY. Find out more about CoderDojo, our network of free volunteer-led coding clubs, and avail of organisers' resources, such as our meet-up guide and more at coderdojo.com.



■ There are best practices well worth adopting

his shoulder when speaking to him, as this helps him to focus on listening to us.

There is another child in our Dojo who finds making choices very difficult when faced with too wide a range. So, we tend to restrict choices where possible. For example, when choosing a colour for something, instead of 'What colour is this going to be?', we would ask 'Will we make this red or blue?' These are very specific examples for individual kids and will not work for all Ninjas. So, family members really are your first port of call."

In-person discussions

As well as creating a guide of best practices that clubs can use to improve the accessibility of their own spaces and the support they provide to people who are impacted by a wide variety of disabilities, we held an in person meet-up in Dublin. At this event, guest speakers who are experts in their specific field spoke on how Dojos could implement changes and understand the positive impact these changes would have on people's lives. Speakers included:

- Dave Milliken, a freelance consultant in the healthcare world, working with both government and private organisations. He is passionate about making sure that people using services are not left out of the decision-making process.

- Hannah Bryson, UCD SU Disability Rights Campaign Officer, CoderDojo volunteer, and Disability Activist. Hannah also advised at length on the Accessibility Guide, mentioned earlier.
- Gearoid Kearney, CEO of MyAccessHub, an Irish startup making it easier for companies to incorporate disability access into their workspaces.
- Magda Jadach, a software developer and accessibility lead at the Raspberry Pi Foundation. She is an advocate for diversity in technology, in and out of the office.

What we learned from the meet-up

The meet-up itself was an inclusive and informal event, where attendees were encouraged to chat, share experiences, and learn from one another. In particular, the layout of the agenda worked well; a combination of presentations, hardware and digital making demos, and splitting into small groups to discuss various issues allowed the event to flow smoothly, with everyone having the chance to share their own experience in a way that suited them.

We were lucky to have a panel of engaging and dedicated speakers at the meet-up, each of whom were directly involved in some form of accessibility provision, in widely diverse ways. The personal experiences of disability that each speaker shared undoubtedly struck a

chord with the audience and prompted an engaging Q&A dialogue at the end of the session, aided by the application MentiMeter.

- People are diverse and unique, not everyone that is neurodiverse or has a disability have the same needs or interests.
- Dave shared three pieces of advice for working with any one who has additional needs – patience, perseverance, and listening.
- There is a fear about asking the 'right' question without causing upset or offence. During the meet-up we asked all the attendees to 'assume good intent'. This helped to prompt questions that people had previously been afraid of asking.
- There is a spectrum of ability and disability that we are all on. Everyone needs support sometimes, even mentors and parents.

We are delighted to have worked, and continue to work with, community members like Hannah, Fiona Baxter, Sandra, Ewan, and those involved in Curtain Dojo in Western Australia to make our Dojos more inclusive and accessible. We also acknowledge there is plenty more work that we need to do. Neurodiversity and disability are not the only accessibility issues that we need to overcome. Making coding more accessible to young people regardless of their race, gender, or socio-economic background is something we are continuing to work on with our global community of volunteers. (HW)



TARA MCGRATH

Tara is a learning project manager based in Dublin. Prior to this she was the Community Coordinator for Ireland, working for the CoderDojo Foundation.



NUALA MCHALE

Nuala is the Global Engagement manager for the CoderDojo Foundation. She has worked for the Foundation for more than three years. @NuliBouli

ASTRO PI IN ACTION

INTRO



The Mission Zero Challenge engages young people in STEM learning through the wonder of space!

Run in collaboration with the European Space Agency, Mission Zero offers young people the chance to have their code run in space on the International Space Station, by writing a simple program to display a message to astronauts onboard.

Thanks to the help of an online emulator, teams can replicate exactly how their

message to the astronauts will display on the Astro Pi computers onboard the space station in the classroom.

Aimed at young people under the age of 14, Mission Zero can be run during a single lesson and helps to improve their knowledge of Python coding, logical thinking, simple space science concepts, as well as team-work skills.

Within this article, we speak to two club leaders that discuss their experience of running a Mission Zero session."

TAKING THE ASTROPI CHALLENGE AT CODERDOJO

The Astro Pi Mission Zero challenge is an entertaining and educative activity that can be easily set up in class or in a coding club.

STORY BY Mircea Patrascu

For the last two years, the most attractive sessions of our Dojo were those where we took the Astro Pi challenge. The sessions were divided into two parts of approximately one hour each.

The first part was dedicated to a presentation of the International Space Station and of the activities that take place on board. We presented to the children some basic information about gravity or life in space, but without providing too many theoretical details, because some of our ninjas are very young (7 years old).

ESA and NASA websites allowed us to track the real-time position of the International Space Station and to see impressive live images of the Earth streamed by its cameras.

We then discussed the experiments carried out on board. This part was very engaging and the children asked a lot of questions. They wanted to know what astronauts eat and drink in space, how they prepare their food and how they can sleep when there is almost no gravity. They were also really excited watching some fun (but also educative) experiments like playing with a fidget spinner or playing ping-pong with a water ball.

The second part was dedicated to the creation of the programs to be run on the ISS. We introduced Python to them and, although the mentors had only basic knowledge of the language and our ninjas have only used Scratch before, they quickly understood how to write code inside the emulator and created nice short programs.

Everyone tried to add some visual elements to stand out, like flags, hearts or emojis.

Preparation

Preparing the introductory part of the Astro Pi related session is very easy, as there are a lot of resources available online and parents who want to help can get involved in organising the session without having any coding experience. We prepared in advance a list with videos related to the questions we were expecting, but we were also able to find on the spot a YouTube video answering to almost every question they had.

The astro-pi.org webpage is clear and informative and the project page on raspberrypi.org is also very easy to follow.



MIRCEA PATRASCU

Web developer and champion at CoderDojo Eduhub Veranda Bucharest

Even if the coding was done inside the emulator, we gave the children two Raspberry Pi units to allow them a better idea what an Astro Pi looks like (and they declared it is very powerful for how small it was).

Engagement

Children are usually fascinated with space, so our ninjas actively took part in the discussions. Some of them already knew a few things and they were eager to contribute. Others learned about the ISS for the first time and they wanted to get more information.

Last year, when our Dojo took the challenge for the second time, I warned the children who were with us also during the previous year session that we would repeat some of the activities and that they might find them boring. They answered that it was okay, because it had been “a cool activity” and I was surprised to find out that, after the first session, some of them searched for more information on the matter and that they still knew it one year later.

Two years ago, I also organised a similar session at the school where I worked as a CS teacher for 5th and 6th grades, and I received only positive feedback. It was one of the lessons with the highest involvement on the children’s side. Even those who didn’t seem very enthusiastic about coding were interested in creating some cool programs for the astronauts.

And everyone was more than happy a few weeks later when we received the certificates from AstroPi Team, proving that our code ran in space. **(HW)**

TAKE OFF WITH MISSION ZERO

Our journey so far with the Mission Zero challenge – lessons learnt and kids inspired

STORY BY Jon Samuel

Our Code Club has been running for around four years now and this year we had some kids from the previous year continuing to attend. They had worked through quite a few of the Scratch projects and really enjoyed coding a band, designing games and seeing the creations from their heads come alive on the screen. This year I thought it was time to have a go at the Mission Zero project.

Initially, I was a little wary as the kids had, up until now, only used Scratch and didn't even know what Python was, let alone have the first idea of how to use it to code a message for astronauts. It was this thought that then gave me my starting point of introducing it to the kids: what would you like to ask an astronaut?

But they're not ready!

I thought the kids weren't ready, but how wrong I was! As a teacher, you're told

not to move kids on to the next stage too quickly but let them embed what they have learnt first. I believe that with coding the best way is to just try it out and see what happens.

Experimentation and getting things wrong are two great learning tools that you as a teacher can use when helping kids develop their coding skills. The resources available from the Astro Pi website are clear and to the point, with step-by-step instructions of how to use Python code to make the Raspberry Pi display a message and take a temperature reading. If you run a Code Club and use the resources then this is something you come to expect.

What's next?

Now that the kids know what they would like to ask an astronaut they need to start to work out how to turn this into code that can be run on the Raspberry Pi, 240 miles above them. As a teacher you are always looking for those ➤



We've all loved taking part in the Mission Zero project, it's been great fun!

► 'hooks', those ways to help kids remember what they've learnt in class. What better hook can there be that their code will be seen by the astronauts living on the ISS?

As the kids continue to develop their ideas for the Mission Zero challenge, I am amazed, and also sometimes unsurprised, at some of the questions they come up with. How long have you been an astronaut for? What is the best gadget on the ISS? How do you sleep in zero gravity? What happens to all your poo?

If you're thinking about taking part in the Mission Zero challenge then there really is only one thing to say to you – do it! I have seen my kids really get to grips with how Python works, that certain words need to be used in a certain order and way if they want their code to work. This then opens the door for you to introduce more Python coding projects and challenges – especially if

they didn't really have a full understanding of Python before taking part in the challenge.

And who knows, you may well be inspiring the next Helen Sharman or Tim Peake. Wouldn't that be an amazing story to tell? [\(HW\)](#)

JON SAMUEL



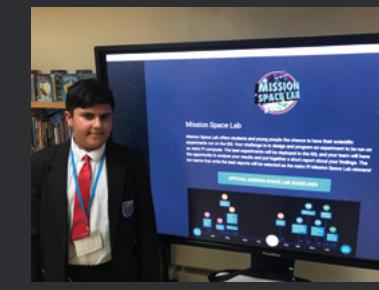
I'm a primary Computing Teacher at Primrose Hill Primary School, Salford, Greater Manchester. RPi Cert. Ed., Code Club Host for a Star Club, Wonder Squad Ambassador. Twitter handle - [@JonSamuel_ICT](#)



■ Mission Zero has really helped pupils get to grips with Python

GET EX-PUPILS INVOLVED

At our Code Club we have two ex-pupils who are now in their second year of helping to run the Code Club. As well as helping out the kids with their projects, they have also started to work on a submission for Mission Space Lab. Great role models for our younger kids!



TO LEARN MORE

NEXT STEPS

To learn more and register for Mission Zero visit: astro-pi.org/missions/languages/. Once registered, you'll receive your classroom code and you can then get going use the step by step project guide at bit.ly/2q85yj5.

Anyone from around the world can participate. However, 50% of your team needs to live in an ESA Member State (bit.ly/2Xa9tTyb) in order for your code to

be sent into space. Teams that aren't nationals of an ESA Member State will not have their code sent to the ISS, but they will still receive a certificate of participation. Once your team has got a taste for space coding, why not put together a team to enter Mission Zero's big brother, Mission Space Lab? It's an annual competition to design experiments that run on an Astro Pi. [\(HW\)](#)



SUPPORTING REFUGEE CHILDREN THROUGH NON-FORMAL EDUCATION

How not to let your own limitations prevent you from giving opportunities to those who need them most

I work at the Raspberry Pi Foundation where I manage the translation of our educational resources, to localise and make them accessible to all children, regardless of the language they speak. In my spare time, I volunteer for the Cambridge Refugee Resettlement Campaign (CRRC), a charity that supports refugees and asylum seekers in Cambridge.

Seeing the amazing work of both organisations inspired me to take personal responsibility for giving refugee children the opportunity to learn about computers, coding and digital making in a safe, fun and informal environment offered by Code Club. Given the difficulties refugee children face when accessing education while displaced from home, I hoped that participating in extra-curricular activities would supplement

their formal education and would help them catch up with their peers more quickly.

Refugee children often face a significant delay in accessing education after arriving in the UK. When they finally secure a school place, the circumstances in which they learn make it difficult for them to remain in school and thrive. Many of them are likely to have been out of school for some time so they are lagging behind their peers academically. Other problems include limited language support, mental health issues, poverty and/or unstable accommodation.

The voluntary sector plays a vital role in supporting the educational wellbeing and progress of refugee children. However, I personally believe we should all play a role in making our formal and non-formal education systems more inclusive and equitable.

Overcoming challenges

As I set out on my mission to start a Code Club for refugee children living in Cambridge, I knew it wouldn't be easy. I had no background in coding and I had never worked with children so it was always going to be a steep learning curve. But I didn't want my own limitations to prevent the children from having this opportunity so I decided to go ahead anyway. Instead of coming up with my own ideas for what to teach, I use the resources that Code Club have developed to teach Scratch, Python, HTML and many other skills. Before each session, I go through the project we plan to work on to have a good understanding of what it involves. This way, I can guide the children and help them when they struggle. The added bonus is that I'm learning the same programming concepts as they are, □

so I develop my own skills too! I also rely on Code Club's support on pedagogical and practical issues, and I have plenty of help from knowledgeable volunteers who have come forward to support me with running the club. I noticed that I started analysing my teaching methods to try and find better ways to achieve our learning objectives, so I also develop as a teacher.

Some of the challenges have caught me by surprise: the logistics of bringing the children together, and the varying levels of English language and computer skills that the children have. Typically, a Code Club is run by a teacher for pupils in their school. This was not possible in our case - the children supported by CRRC go to different

■ Learning how to code in Scratch. Children set up their Raspberry Pi at the beginning of each session and then clear it away.



REFUGEE CHILDREN OFTEN FACE A SIGNIFICANT DELAY IN ACCESSING EDUCATION AFTER ARRIVING IN THE UK

schools, and they all live in different parts of Cambridge. It was therefore necessary to set up the club at a central location that would be easy for the children to get to. Many of the parents don't know the city well and don't speak English, preventing them from being able to bring the children on their own, so we had to involve a group of volunteer drivers who pick up the children from home, bring

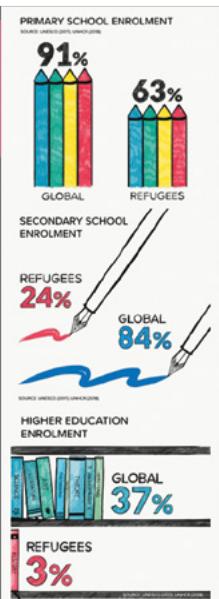
them to the club, and drive them back home at the end of each session.

When we first started the club in September 2018, the children who attended were at very different stages in their resettlement journey. Some of them had already lived in Cambridge for two years and attended school for most of that time, while others had only just arrived in the UK



EDUCATION IN EMERGENCIES

According to the UN Refugee Agency, 3.7 million refugee children are currently out of school. Only 63% and 24% of all displaced children attend primary and secondary school, respectively. This can be due to the limited number of school places in host countries or because mainstream education systems are not well prepared. At the same time, other provisions such as non-formal education might not be available or sufficient.



and spoke very little English or had very little experience using a computer. We considered using Arabic translations of the resources provided by Code Club, but we would not be able to read them or provide the children with Arabic language support so decided against that. In the end, providing each child with one-to-one support that matched their individual needs worked best, but it requires more volunteers to run the club than what a typical Code Club needs. Thankfully, many people want to support the club so we are never short on volunteers.

Celebrating successes

Despite the many challenges and hiccups along the way, we have now completed two Scratch modules, each consisting of six projects that teach children how to create simple animations, games and programs. Halfway through the school year, a few newly resettled children joined the club. At that point, they were unable to communicate in English so to help with the language barrier, one girl who had attended from the beginning stepped in and started to translate, explaining to new members how to use Scratch and the project resources. It was really great to see how confident she was and how easy it was for her to teach others what she had already learned. For her, it was an empowering moment, and it was great for us to see how much she learned.

After the first term, to acknowledge the

"WE OBSERVED INCREDIBLE PROGRESS WITH THE CHILDREN'S LANGUAGE SKILLS, THEIR ABILITIES TO USE COMPUTERS AND UNDERSTAND WHAT CODING IS ABOUT"

club finishing Module 1 of Scratch, we arranged a celebration to recognise the children's hard work and achievements. Code Club certificates were printed off and handed out, and parents were invited to see what their children had been working on. The parents brought chocolates and biscuits, there was lots of laughter and happiness at receiving certificates, and generally such a lovely, friendly atmosphere.

Since we started the club, we observed incredible progress with the children's language skills, their abilities to use computers and understand what coding is about. I hope that attending Code Club makes a significant difference to the children's experience of learning, and that it helps them to catch up on their education after so much disruption.

If you're interested in setting up a Code Club for refugee children in your area, you can find local organisations supporting refugees over at the City of Sanctuary website: cityofsanctuary.org. Please get in touch with me if you'd like some help getting started. [\(HW\)](#)



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MAKING THE UNCONSCIOUS, CONSCIOUS

A look into unconscious bias and how it can affect how we see the world, and our computing classrooms.

When you hear the words CEO, manager, doctor or engineer, what descriptions of those people pop into your head? If you are anything like me and many others then you will picture a male in those roles. This is because your unconscious associations with those roles have built up over time and the images in your environment of people in those roles have mostly been of men.

Building schemas

Your memory is really helpful to you because it builds schemas that allow you to quickly remember knowledge or skills. These schemas are built up over time and they are supported by your experiences and cultural surroundings. When you first

leru.org/files/implicit-bias-in-academia-full-paper.pdf on Implicit Bias in Academia states that “human beings are not neutral in their judgement and behaviour but instead have experience-based associations and preferences (or aversions) without being consciously aware of them.”

Unconscious bias and diversity

It's long been suggested that unconscious bias could be influencing the lack of diversity in computer science. If you grew up in an environment where she and her were the pronouns used to describe nurses then you are going to associate nurses with being female. The opposite goes for computer scientists. If your environment projects the image of a computer scientist as being a

white male sat in a darkened room tapping away at a keyboard then this is the picture that you are going to build in your head as you grow up.

As a teacher, you make hundreds of decisions every day. You multi-task and you're constantly on the go. This makes it more challenging to ignore your unconscious bias. When you need to make decisions quickly, you tend to go with your instincts and sometimes those instincts can be influenced by your own unconscious bias.

Imagine that your line manager has just emailed asking for five learners to be digital leaders and they need the answer by lunchtime. Your instincts kick in and you come up with five names. You can probably picture a few of them now in your head. You can almost guarantee that when decisions like this are made really quickly that the chosen group will lack diversity. Even when you think hard, you could still come up with a group of people that are very much the same culturally and socially.

What can you do?

Luckily these biases are not permanent. In fact, they are malleable and steps can be taken to limit their impact on our thoughts and behaviors (see here for more on that: <https://diversity.ucsf.edu/resources/strategies-address-unconscious-bias>). As educators, we need to ensure that unconscious bias is addressed by us and by our schools.

Here are three steps to help you get started:

Step 1: Be aware of your own unconscious biases. Project implicit from Harvard University has a collection of Implicit

YOUR UNCONSCIOUS MIND IS GREAT WHEN YOU NEED TO DRIVE A CAR, BUT WHAT HAPPENS WHEN WE MEET NEW PEOPLE?

learnt to write it would have been really challenging because you would have needed to remember how to hold the pen, move it in the right direction and be able to form words. Through repetition your memory built a schema that now allows you to write without too much extra thought.

Your unconscious mind is great when you need to write something or drive a car, but what happens when we meet new people? What happens when we pick a student from the class to help us with something? What happens when we are reading CV's and interviewing candidates? The 2018 paper





■ Do pupils see a computer scientist as a male profession?

Association Tests. These tests cover a variety of categories and allow you to discover where your biases are. You can take the tests here: <https://implicit.harvard.edu/implicit/takeatest.html>

Step 2: Take a look at your current resources and activities and see if your unconscious bias has influenced them in any way. Check that you've used a diverse range of names in example scenarios. Ensure that you've been sensitive to those from disadvantaged backgrounds when setting tasks, particularly homework. Think about activities that relate to specific cultural holidays and question whether they are being inclusive to all.

Step 3: Widen your social groups to include people from diverse backgrounds.

By knowing and understanding more about people from other cultures, gender identifications and social classes, you can reduce your levels of unconscious bias towards those groups.

Unconscious bias isn't an excuse but it is a reason. Once you're aware of your own bias you can start to correct it. Don't be afraid to start correcting others as well. We have a social responsibility to get this right and it will only happen if we all work together to become more conscious.

Why not start a discussion on this with your colleagues at a team meeting or even run a session at a CAS community using the CAS Include workshop kit https://www.computingatschool.org.uk/custom_pages/271-cas-include-toolkits (HW)



REBECCA FRANKS

Rebecca is a learning manager for secondary at the Raspberry Pi Foundation working on the learning resources for the National Centre for Computing Education. She was a computing teacher for over 15 years and has volunteered for CAS include since 2012.



Just some of the young coders, working with the STATUS project

CODING FOR THE 1%

There are approximately 40,000 members of the traveller community across Ireland and Northern Ireland. How can coding education get to them?

Ireland is becoming a growing melting pot of diverse and vibrant cultures. Yet within Ireland, even long before the growth of globalisation and ease of migration, there are a number of ethnic minorities that make up many facets of Irish society. Like many ethnic minorities, there are many within these subgroups who are at a major disadvantage in society.

In Ireland, the traveller community makes up less than 1% of the country's entire population. It's projected that there's a population of approximately 40,000 travellers living in Ireland and Northern Ireland.

The roots of this minority lie in nomadism, hence the name, 'travellers'. However, in recent decades, legislation has made the nomadic way of life impossible, and, as a result, this has caused great friction as well as large-scale institutional racism across the island.

This racism is endemic across the Irish population. For a country renowned for its 'Cead Mile Failte' ('100,000 welcomes'), the

discrimination shown towards this ethnic population is flagrant; like so many beliefs and attitudes, of course, these are all learnt behaviours. Unemployment is rife in the community, due to employer discrimination. Mental health issues abound. One in ten take their own lives, and children from the community are often treated as second-class citizens in schools.

There's a myriad of inequalities in the community and a severe lack of political will to make any changes. In fact, most political representatives are just as racist, if not worse, as they block housing allocations, reinforce the racist diatribes, and even go so far as calling for a 'final solution' on the traveller issue. The same words were used in 1940s Germany. So, life for travellers in Ireland can be bleak, to say the least.

Overcoming ingrained societal racism is a monumental task and many travellers, NGOs, and activists are leading the way towards the change that is needed. One organisation, among many, that plays a small role in endeavouring to create a more inclusive Ireland is Involve.

This organisation works primarily with young people from the traveller community through youth clubs and employability projects. One specific project that the organisation is running is called the 'STATUS Toolkit'. STATUS is an abbreviation for 'Supporting Travellers Advance Through Universal Services', which in essence sets out to help services be more inclusive and enhance their ability to engage, retain, and have young travellers participate. CoderDojo was among the first to reach out to Involve to get involved with the STATUS Toolkit.

CoderDojo

The reason for bringing CoderDojo to our organisation was to create more awareness around the field for young, tech-savvy youth club members across the country. We saw the resounding success that was achieved by Kathleen Marie Maughan and saw the potential for so many more young people who might follow her lead.

Kathleen Marie, a young woman from the traveller community, had captured the

national attention in 2014, having won a CoderDojo Coolest Project Award at Dublin City University. Her rationale for her award-winning projects was simple. "I made an anti-bullying quiz because I always used to get bullied for being a traveller." She added that the app took about three weeks to make and was "easy."

As previously mentioned, Involve also has an employment focus, and given the huge rise in STEM education and its necessity for the future, we want to be able to explore as many options with our young people as possible, to open a few doors to possibilities that may never have even crossed their minds.

For Involve, CoderDojo was a phrase that had only been heard of and/or seen in passing. So much so, that when it was mentioned to the young people in the Involve Youth Services, we got questions such as 'Is that karate?'. But the Irish team comprised of Tara, Darragh, and Darren certainly demystified the entirety of it for the service users.

Taster course

CoderDojo came to Involve head office in May to give the youth group leaders of the Midlands a taster course in what it was, and how they might be able to introduce it to their young people. That, and maybe whet their appetite for more knowledge in the area.

The vast majority of people who attended had a very limited understanding of the concept. They had used computers in work, for social media and basic needs, but the notion of coding was somewhat new to most. That, however, did not matter in the slightest as the team from CoderDojo put everybody at ease within minutes of starting.

Most of the day was spent learning how to do the basics in a very fun way, and it certainly wasn't rocket science. From the experience of the process, it's almost like driving a car for the very first time. It's unnerving and daunting. Nobody who gets into the driving seat for the very first time knows what they are doing, and confidence is key. You learn to drive by trial and error, but before you know it, it becomes second nature, and the same can be said of all things CoderDojo.



■ The idea is to open doors for as many young people as possible

" CODING MIGHT NOT BE FOR EVERYBODY, BUT MINDS AND OUTLOOKS CAN BE CHANGED WITH A GREAT DAY OF FUN TRAINING

After a number of attempts, most of the group were able to animate a flying hippo that zipped around the screen, more or less from facing a blank computer screen. It took time, effort, and patience but we got there in a single session. That laid the foundations for more that could be done through CoderDojo, and how straightforward it can be to do with youth club members.

The experience was really worthwhile and the Involve team cannot recommend them enough. Perceivably, coding might not be for everybody, but minds and outlooks can be changed with a great day of fun training, where learners are immersed in a hands-on, practical, and highly supportive environment.

Involve would like to acknowledge the amazing work of CoderDojo in Ireland, and are keen to work with the group in the very near future, to see how they can collaborate in extending the Dojos across Ireland in the most inclusive way possible. As Lao Tzu stated, "A journey of a thousand miles begins with a single step". (HW)



JOHN MADDEN

is a National Strategy Coordinator for Involve Youth Services, an organisation which provides youth services to young people from the traveller community in Ireland. He is also a suicide prevention trainer and published author in the area of mental health. You can follow John on Twitter: @johnmadden1



ALFREDO CARPINETI CHAIR, PRIDE IN STEM

FOSTERING LGBTQ+ INCLUSION AND BELONGING IN TECH

Why under-represented groups benefit from a safe space and a real sense of belonging in the classroom

Whether we want it to or not, technology shapes our lives and the future of our world. As it affects us all, everyone, no matter their identity, should feel that they can be part of a team within the field. Sadly this has not often been the case. People from under-represented groups can feel that the tech industry is not a welcoming environment for them, or even face some obstacles given the same level of abilities. Educators might not have a massive role to play in changing the tech work culture, but they do have the opportunity to play a large role in bringing up the next generation of tech workers. And this much-needed change in outlook needs to happen from the get-go, starting with computing and STEM education.

"Tech for me in school was simply about IT and there never was a reference to any behind-the-scene development. It was more a case of how to successfully navigate Word without waking up The Paperclip." James Brumpton, a senior test engineer working at BBC News said.

"Something that I found interesting when I studied language in my adult life is being taught about the culture, which clearly influences how languages mature. In terms of computer science, this would be teaching not just 'what to do', but also why and how. And teach who is responsible. As such, it allows us to celebrate people from all backgrounds that contributed to the field."

A safe space

I always advocate thinking about diversity, inclusion, and belonging, because without creating this sense of belonging, a community of sorts, your efforts in diversity and inclusion won't have a long-term impact. One simple step educators can implement is a safe environment. Imagine being out in school, university, or even a workplace and the fear for personal safety that sometimes brings. To foster true inclusion, helping students to meet allies cannot be passive: it must be active. If you're able to create a safe space and a sense of belonging in your classroom, it will support every under-represented group, including LGBTQ+.

■ A learning room needs to be a safe space





Pride in STEM, out and about!

Role models

Visibility and role modelling is often praised as an approach for people trying to challenge the status quo of tech. We can repeat over and over that the field is for everyone but, until we show solid and unquestionable examples, then the words are just words.

"I would have liked to see more people who fit more than one category and/or defied categories, e.g. an advocate from the disability community and LGBTQIA+ community. A lot of us who do it identify with more than one community, and visibility is really important so we don't feel as if we can only champion one part of our identity, or have to downplay a part of ourselves to be accepted," comedian, podcaster, and researcher Dr Cerys Bradley said of their experience in tech education.

There is a lack of LGBTQ+ role models, which make this approach challenging to implement. Many groups that work in the overlap between science and activism have been trying to remedy this. A recent study highlighted how sexual minority students (Hughes, *Science Advances* 2018) are seven percent less likely than heterosexuals to persist in STEM after four years in the field. One crucial factor was the feeling of not belonging. Role models are critical to challenging those assumptions. Initiatives like LGBTQ STEM, 500 Queer Scientists, and Unique Scientists, provide a library of lived experiences of being LGBTQ+ in STEM. It's a useful and excellent resource to share with your students.

Not just for men

Our goal as educators is to also challenge the image that technology is just for men. Too often when an environment becomes coded as 'male-dominated', it develops a toxic culture and prejudice that can be unsettling for women, LGBTQ+ folk, and other under-represented groups.

"I think schools need to have workshops aimed at girls specifically to show them the joys of coding. They can

bring in groups (there's quite a few for women who code) to give talks and lead these workshops. They need to be taught about pioneering women in the field, like Margaret Hamilton, Ada Lovelace, and others," software engineer and writer Vaneet Mehta suggested. "I think this could then be replicated to LGBTQ+ people too. Alan Turing is a great role model. But we need role models who are alive too."

Get involved

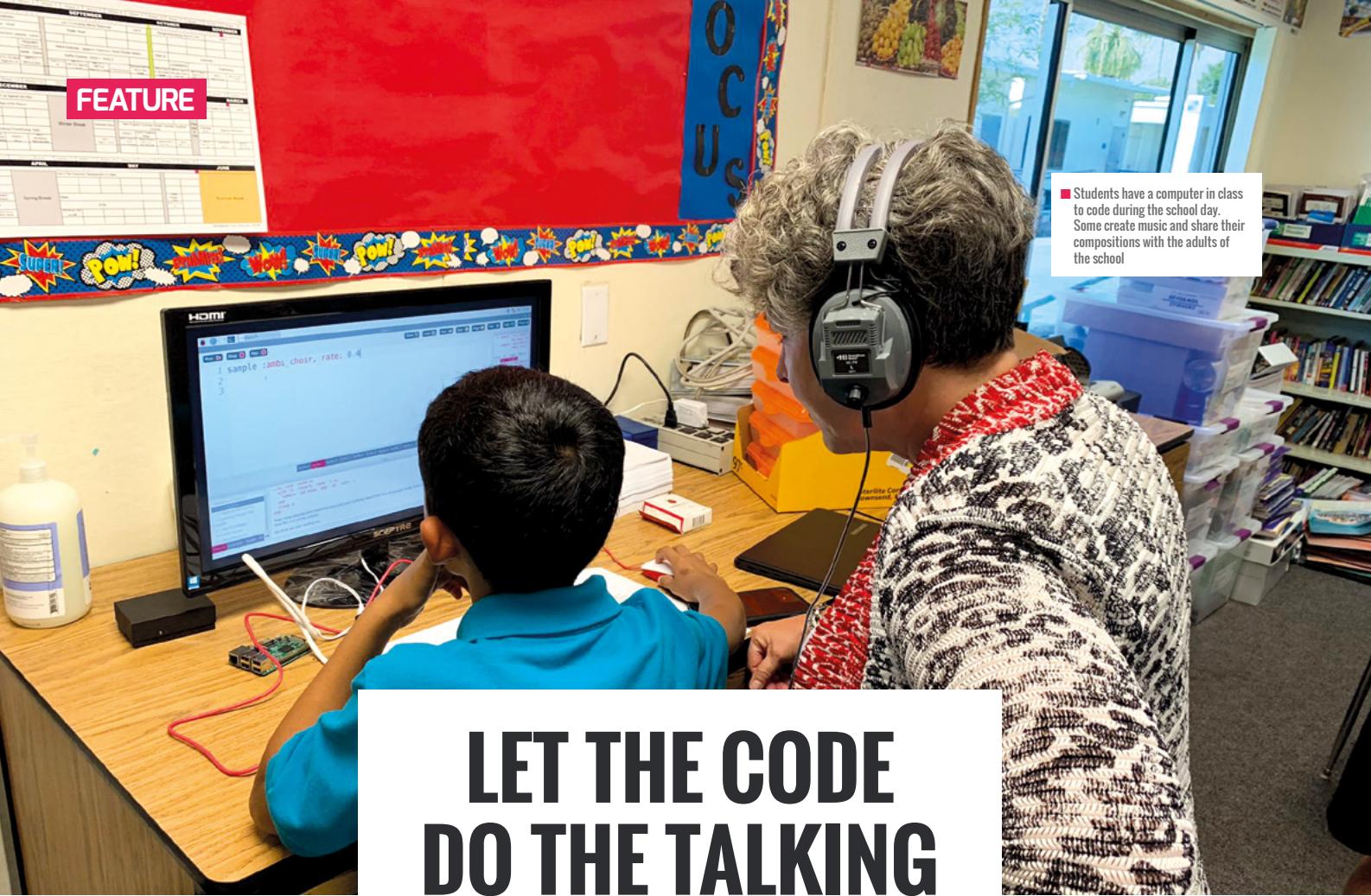
If you want to learn more about the issues discussed in this article, then there are a number of organisations and initiatives designed to help you create an inclusive learning environment. Celebrating International Day of LGBTQ+ people in STEM is a great way to get started. If you're looking for role models, then groups such as Intertech, InterEngineering, and Pride in STEM provide a way for members of our community to become more visible.

Pride in STEM is a leading charitable trust working to showcase and support LGBTQ+ people in STEM. Our flagship series of events, called Out Thinkers, provides a place where members of the community can talk about their experiences and their work. It is our hope that not only will our work help LGBTQ+ people in tech and in STEM fields in general, but that it will help to truly break down the barriers that under-represented groups still face in the world. We need wider efforts from allies, educators, companies, and institutions. And this is why we need you! Help us stand up for acceptance. (HW)

ALFREDO CARPINETI

Alfredo is a gay Italian astrophysicist, science journalist and social activist. He is the chair and founder of Pride in STEM, an award-nominated British charitable trust dedicated to supporting and showcasing LGBT people in science, technology, engineering, and maths. [@DrCarpineti](#)

FEATURE



■ Students have a computer in class to code during the school day. Some create music and share their compositions with the adults of the school

LET THE CODE DO THE TALKING

Students that are not English language natives can and will succeed in coding classes. Giving support and implementing strategies creates the atmosphere for any student to learn

I was born and raised in New York and when I moved to Palm Springs, California, I was always told 'I love Manhattan.' I was from a small farm town that smelled like cows in Upstate New York. The differences between rural New York and Palm Springs are quite drastic. One gets a yard (one metre) plus of snow a day and everyone knows everybody, while the other one gets to a temperature of 120F (49C).

However, the biggest learning curve was learning the new culture and language of Southern California. I learned to enjoy my fish in a taco rather than wrapped in newspaper and, most importantly, the language of Spanish. In my school 70% of students are English Language Learners (ELLs). To be classified as an ELL, the student or someone in his or her household speaks any other language than English. This presents a very unique opportunity challenge as a teacher. Many students, when compared to the national average,

would be considered low or behind in their reading and writing abilities. For these students, learning can be difficult because of the lack of comprehending the text and no background knowledge on many vocabulary words.

The decision to start a Code Club was a no-brainer. This was the outlet needed to reach my English Language Learning students. With very little setup and preparation, I was able to start this program after school.

Success not failure

Students learn at their own speed. There is a saying common amongst teachers, 'to teach a fish to climb a tree'. What this means is that you cannot teach every single student the same way. Some animals are just not designed to do certain tasks.

Unfortunately, this is not how most classrooms are managed. Most classes are taught to teach to the state test or to district benchmarks. This should never be

the measure of what a student is capable of. To fully understand whom a student is, you need to witness their strengths, no matter what topic it may be.

Coding is a topic that many students strive to learn. This is because they are able to see their outcomes. Code on the computer creates something that is real, tangible, and most importantly theirs. ELL students are often told to follow along and play catch-up with their learning. Just imagine being taught in only sign language or braille. Even if you were a mathematician, you would never learn how to do long division, or learn the Pythagorean theorem, because you do not learn the why. Coding for ELLs students is easier than for native English speakers. This is because they are accustomed to learning a new language. Native English speakers struggle with this because they are not normally tested, and confused on what words mean and the actions each take, while coding Python syntax is very much tested.



PAUL GORDON

Paul is a 5th grade teacher at Cielo Vista Charter School in Palm Springs California. He is a RPi Certified Educator and you can find him on Twitter at @TeachtheTech.

If you do not feel bold enough to have students jump directly into Python, Scratch is a wonderful starting point. Block coding is not just for primary students. Block-based programming reduces the need for learners to be able to know the syntax, which reduces cognitive load. With Scratch, students do not have to worry about writing words down perfectly into their code. All they need to know is how to connect the pieces. This levels the playing field for all students, not just English Language Learners.

have the students physically move their bodies. On printer paper, write different exercise movements on the cards and hand them out to the students. Have them stand in a line and treat each exercise movement as a line of code. After the students go through the code, you add the 'Start' and 'Stop' lines by giving those cards to the students at the front and end of the line. Once you explain how code is read, you then will have to add pauses and loops. Teaching students to code through Total Physical Response allows students to learn how coding works even before they sit down at a computer.

Pairing up

Another requirement I have seen is that every student needs a coding buddy, otherwise known as pair programming. Pair programming allows the students to work together and has two students per computer.

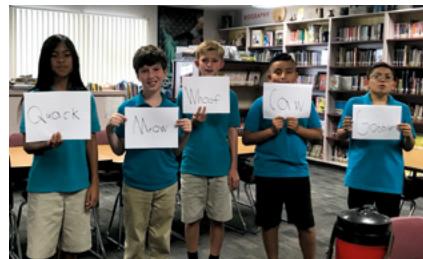
Using pair programming, the students can problem-solve with each other and work together. Just like when my students are writing an essay in class, I require them to go through a peer review, the pair programming approach is exactly the same. When creating buddies you have two options. The first option is to let the students work with whomever they

When using pair programming you need to view it as co-pilots, whereby one person 'drives' and another 'navigates'. This allows EEL students to develop English language skills at the same time as developing their programming skills.

One way I have reduced the burnout is by giving students cheat sheets. These cheat sheets are index card-sized papers with a few codes they are to use. Physical objects are the most useful resources for students. When resources become tangible, the students are able to understand more clearly what it means. This really works with students who are visual learners. Teaching students through visual concepts resonates with ELL students most.

Embrace the learners

Many students join Code Club because they do not feel as comfortable in a formal education setting. Empowering the students to have their own projects gives them confidence and creates a sense of belonging. Next time a student who is not a native English speaker asks about joining, don't brush it aside, but rather embrace it. Every single student learns a new language while coding. Just remember an ELL student has already gone through the feeling of not understanding the words in front of them. **(HW)**



BLOCK-BASED PROGRAMMING REDUCES THE NEED FOR LEARNERS TO BE ABLE TO KNOW THE SYNTAX

Strategies for ELL students

I have found out that good ELL teaching strategies are put simply as good strategies for all students. We live in a world in which students are used to instant gratification, and get easily frustrated when they need to work for the objective. There are limitless strategies for helping students, but here are some that I have found to work well.

The first thing you must teach students is what coding is. Every year I start out with one strategy that I picked up at Picademy Denver. Learning to code through Total Physical Response. Total Physical Response, or TPR, is when you

choose. The benefits to this are that the students will be willing to take more risks when they are most comfortable with their partner. However, the downside to this is that behaviour issues appear more with this model.

The second way is to make buddies based on ELL status. I create groups based on one student being ELL and the other student as a native English speaker. With this model it is very clear that ELL students learn the more difficult vocabulary and have a deeper level of thinking. Forcing students to work with people they are not the most comfortable with always can create issues.

TOTAL PHYSICAL RESPONSE

Total Physical Response is a way to get students moving and talking. Use Total Physical Response early, while students are still learning how code works. Have students write down their favourite animal sound or dance move and, when it is their turn, make them do what they wrote down on the paper. The crazier the move or sound the better!



DIVERSITY, INCLUSION, AND THE PUBLIC LIBRARY

How Parkman Coders is but one innovation from Detroit Public Library to help address diversity and inclusion

A lot of times we think about diversity in terms of colour, gender, and sexuality. However, I find that generally the lines for those who are not included are more prominently drawn along economic means.

The world embraces technology as the magical tool that can make all fields and processes more efficient. Yet technology also has the potential to alienate those that can benefit from it the most. In a talk at PyOhio – find it here bit.ly/2JRwKcw – I presented a section called the 'Diversity Shortcut', to discuss how the tech world can work on its diversity problem. Spoiler alert: my proposed solution is public libraries. While there are no real short cuts to diversity and inclusion, a more direct route to reaching diverse people can be found at the public library.

Imagine a place that you can go to to learn new things, or find more information on something you heard about or saw somewhere. Most people might say that place is Google or YouTube. Now imagine you don't have a computer and/or access to the internet. Imagine that you need to fill out an application for government services, or you need to fill out an application for a job, or you or your child need to submit homework online. Without that access to a computer and the internet that we can take for granted, the answer to the question 'where do you go to?' has to change. For many people the answer is the library.

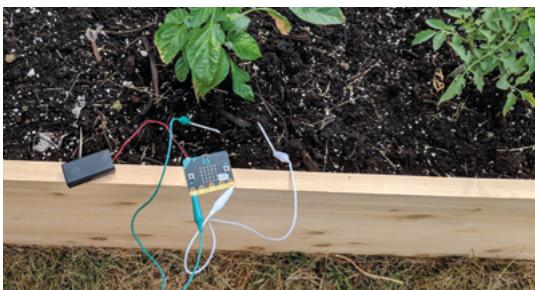
Reading up

The library has become the primary point of access for some people who cannot afford a computer and/or internet service. Without online access, we find that a number of demographics face added hardship: for students to access homework assignments on the internet, people of all ages looking for employment who are sent to the internet, people who need assistance from governmental agencies, and seniors looking to access information about their health care and or retirement. The library provides access for these people to essential activities that promote

their personal advancement as well as leisure-time activities.

In recent years there have been discussions about whether the library is still necessary and could it be replaced by some combination of Amazon and Starbucks, as suggested in a since deleted Forbes article. These options will allow you to access the internet and get books, but libraries are more than the internet and books. Access is not the only barrier to people's success. Once you have access, there is also the problem of how to use these tools and resources. The thing that makes a public library superior to an afternoon at Starbucks is that you have





QUMISHA GOSS

Qumisha, or Q, is a librarian at the Detroit Public Library specialising in Technology and Library Instruction. With undergraduate degrees in History and Classical Studies, Q is a self-taught Pythonista, and a Raspberry Pi Certified Educator.

staff and additional resources to support you as you gather information and navigate new tools. Your barista probably won't help you format your paper.

Public libraries have a very unique position in this conversation about diversity. We provide access to resources and we also provide training to navigate those resources. As such, we help better prepare people to use those resources independently in the future.

In addition, working and spending time in public libraries fosters strong communities. More than that, libraries as public spaces offer people a chance to connect one on one and get hands-on experience with resources that range from reading books to growing plants, cooking food, and even programming.

Detroit

'Parkman Coders Program' at the Detroit Public Library here in the US is one small instance of how libraries engage diverse populations. We give them access to resources, the skills to navigate those resources, as well as real-world interactions.

Parkman Coders was created out of concern for our youth and how they interact with technology, the community, and the world at large. The goal of this programme is to present youth in the city of Detroit with resources to study computer science – because we at the library recognise that

now and in the future, computers will be an essential part of how they interact with the world. By giving these kids exposure to this subject matter, we are empowering them to go out into the world as creators, not just as consumers.

Parkman Coders focuses on learning about computer science through physical computing and integration with other fields. Raspberry Pi computers and micro:bits have been an integral part of this learning experience for our kids. It's important that our youth get to be hands on with their projects, and the price point of the

to come along, and a few have gone on to be summer interns who assist with other Parkman Coders. One of my young coders is waiting to be a summer intern and eventually wants to be a librarian. Two others are working on college admissions, and they want to be engineers. These are some of the same kids who, when asked what they wanted to be when they grew up three years ago, stated 'someone who makes a lot of money'.

While we're now more likely to search for information on digital platforms than in books, the library is and always has been

PUBLIC LIBRARIES HAVE A VERY UNIQUE POSITION IN THIS CONVERSATION ABOUT DIVERSITY

technology makes it possible for us to give the students who complete the projects their Raspberry Pis or micro:bits so they can continue their exploration. It's also important that we let the kids have a say in the projects so they can learn that technology and computers are tools that can be used to support their primary interest, whether that's art, music, gaming, or gardening.

It's exciting to me to see the effect that library programmes have on our patrons. Children who started participating in Parkman Coders three years ago continue

a repository for information. A repository boasting staff trained to help find and navigate information. While the formats may change, the mission is the same. The library is a place where you can go not only when you need resources, but also when you need the support to use them.

At the Detroit Public Library, Parkman Coders is one way in which we try to present diverse populations with access to basic resources. That, and the opportunities to advance themselves and their communities. **(HW)**



TECHNOLOGY, THE CLASSROOM, AND LEADING DISCUSSIONS

Develop your knowledge of the impact of technology in society, gain access to classroom activities, and take part in discussions worldwide

A new free course from the Raspberry Pi Foundation will give participants the knowledge and skills required to teach how technology has impacted our world. The course is aimed at teachers of GCSE Computer Science, as well as anyone who has an interest in the subject. The aims of this course are to:

- Provide some background knowledge for a range of impacts of technology across the curriculum.
- Help to guide students to discuss and consider the impacts of technology, so that they are able to synthesise their thinking into a piece of writing, particularly one that could act as an answer to an exam question.

The course runs for three weeks, with approximately two hours of study per week.

Over the three weeks participants will learn:

- Selecting a topic and planning a discussion around it.
- Facilitating a discussion in the classroom.
- Encouraging critical thinking on a complex topic.
- Transitioning from group discussions to written questions.

The course directly links to examination boards' GCSE specifications by using real life examples, and considers how to frame discussions to get the full potential out of students. When framing classroom discussions, the course outlines three areas to consider:

- The technology
- The stakeholders
- The area of impact

ENGAGING AND INCLUSIVE



Did you know within the first five months of the launch of Pokemon Go, 4.5 billion kilometres were walked by its users? This is another relevant and engaging topic to discuss, and gives educators the chance to discuss possible benefits and drawbacks before using this topic in the classroom.

COMPUTER SCIENCE ACCELERATOR PROGRAMME

This course is part of the Computer Science Accelerator programme, which is designed to support teachers in improving their knowledge of computer science and teach it at GCSE level. If you are a GCSE Computer Science teacher at a school in England, you are eligible for a free upgrade of the course to gain unlimited access: teachcomputing.org/courses. This course counts towards a nationally recognised qualification, 'The National Centre of Computing Education certificate in GCSE Computer Science subject knowledge'.

other participants on the course. Lots of ideas have already been generated from previous courses, and had a direct positive impact on the teaching and learning happening in the classroom.

Throughout the course there are relevant examples of social media posts to discuss, and ideas about how to structure discussion and promote higher order thinking that will support students when structuring a discussion question in an exam.

Morals and ethics

The course clearly outlines the difference between morals and ethics. Morals are principles that guide individuals in deciding what is right and what is wrong. They are personal and vary between individuals. Ethics are rules of conduct that are

timeline of music distribution which leads into what type of debate could be used for this discussion.

As the course progresses, the focus becomes more about extending the participants' discussions, involving 'The Power and Influence Matrix' to analyse stakeholders' impact, and how to draw a conclusion to discussions. A framework for writing long-form answers and higher mark question extensions by making links and drawing conclusions is given. 'Cheat Sheets' are included that discuss: the overview, talking points, and implications of 16 topic areas – these can be used directly in the classroom, or in a training session for other Computing teachers in schools.

At the end, the participants will have learned the objectives of the course, as well as a plethora of tools to use with students directly in their own classroom discussions. They can use the pedagogy that has been discussed to enable students to potentially gain the higher mark bands in the essay questions in the exam.

The Impact of Technology: How To Lead Classroom Discussions course is available now from bit.ly/34VUDrr.

If you are taking the CS Accelerator program, be sure to sign up for the course via teachcomputing.org. Further information, and other courses that are part of the Computer Science Accelerator Programme, can be found at this link: teachcomputing.org/courses. (HW)

THE COURSE ENDEAVOURS TO EXTEND THE LEARNING OF PARTICIPANTS BEYOND THE GCSE SPECIFICATIONS

Each area is broken down and discussed in detail, providing the participant with the tools to use directly in the classroom and boost the engagement of all students, irrelevant of their level of ability.

GCSE specification coverage

The course has full coverage of the GCSE specification's categories of impact that students are expected to discuss. The categories are broad, allowing participants to narrow the scope of questions.

They are as follows:

- Ethical: considerations about right and wrong, morality, and power.
- Environmental: the effect technology has on the world around us.
- Legal: pieces of legislature that have grown around technology.
- Cultural: how have society and the ways we interact been impacted?
- Privacy: what impact does technology have on the right to privacy?

There are lots of opportunities to discuss different pedagogical approaches with

recognised to relate to a certain area of human behaviour or to a particular group or culture. They are systemic and come from external sources.

During the steps in each week, participants will consider how the principles that have been covered apply to the classroom by discussing:

- What can the participants try and implement in your classroom?
- Which discussion principles will participants prioritise?
- How will participants set up their classroom to encourage more students to contribute to discussions?
- What topics do the participants think have the most relevance and excitement for your students?

Technologies that are engaging and relevant to the participants include: single sign-on mobile devices by face or fingerprint recognition, cloud services, real examples of Creative Commons Licensing, and policing cybercrime.

The course endeavours to extend the learning of participants beyond the GCSE specifications. For example, including a



MATT HOGAN

Matt is a Learning Manager at the Raspberry Pi Foundation and has been a Computing Teacher for 20 years, working across five very different schools. When not writing and delivering training courses, he enjoys travelling, skiing, playing tennis, and still tries to play football.



BLACK GIRLS CODE: THE FUTURE IS HERS

How Black Girls CODE is revolutionising the way in which girls see the ever-growing tech industry, and giving them the tools to not only watch it grow but be part of its growth

Black Girls CODE (BGC) is a non-profit organisation that lives in the beautiful space between tech and social impact, with its goal to train one million girls by 2040 to lead, innovate, and create in STEAM (science, technology, engineering, art, and mathematics). BGC is on the road of making that goal a reality through code; where we are able to equip girls of colour with confidence for today, tomorrow, and a purpose for a lifetime.

Who is BGC?

For the past eight years, Black Girls CODE has empowered girls of colour all across the USA to become future leaders, innovators, and creators in the technology ecosystem that's growing in their very own backyards. BGC currently stands at 14 chapters in the United States, and an international chapter

in South Africa where, thanks to committed volunteers, we are able to introduce girls 7-17 years old via one-day Saturday Workshops, access through quarterly Enrichment Activities with technical companies, as well as Summer Camps, Hackathons, and Code Clubs.

Powered by over 4000 volunteers across the United States and South Africa – BGC volunteers are committed to empowering young girls of colour in our Chapters located in the Bay Area, Atlanta, New York, Memphis, Detroit, Chicago, Dallas, Houston, Los Angeles, Washington D.C., Seattle, and Johannesburg, South Africa. Volunteers that work with BGC are technology professionals, recent grads, teachers, and students dedicated to scaling and creating a sustainable organisation to educate and empower BGC students. They're gaining

valuable leadership skills and life-changing experiences, while developing a strong foundation for our daughters to learn and become the tech leaders, innovators, and entrepreneurs of tomorrow.

What we do

Black Girls CODE open their doors to young female learners who are classified as Tech Divas. In programs these Tech Divas develop technical skills in mobile/web/game development, robotics, circuits, and IoT (amongst many topics). They join these technical skills with the soft skills of ideation, paired programming, and presentation.

BGC's Tech Divas create everlasting connections with each other and with the mentors and communities that step forth in their path. By discovering how tech can be a tool for social change agents, students

#FUTURETECHBOSS- FOLLOW OUR SERIES

Follow our program with emphasis on our #FutureTechBoss Series on our medium @blackgirls.code.

build continuous solutions and engage with the community and volunteers at hand.

This past summer, we had students work on creating mobile applications for their final projects. Working in pairs, they built out applications through Android Studio, and we got a glimpse of some of their feedback throughout the process:

peers as they prepare for their post-secondary careers. Our intent is to provide early career development support by way of exposure to internship and mentorship opportunities, strengthening their leadership and collaborative skills, and providing them exposure to tech industry influencers and leaders.

This year, our first Alumni Summit kicked off on November 7th-10th. With our first iteration of this program, we are excited to introduce to the world how we are following the transition of our Tech Divas every step of the way through their journey of life. We want to reiterate the saying that 'The Future is HER'S'. Remember that, when you see a BGC Alumna from our programme.

“ THEY'RE GAINING VALUABLE LEADERSHIP SKILLS AND LIFE-CHANGING EXPERIENCES

"I learned... how to wait, how to be patient with programming", "We had the most fun starting to build out our app-", "We learned ... How to work through confusion" ..."

We see their thought process through from beginning to end, but also, how it impacts families and communities after they leave. Here's the view of one parent, who shared her experience upon picking her child up from camp each day:

"Each day when she came home she would have a smile on her face, and tell me all about what she had learned. She was so excited about creating her app, and I could see her creativity run wild in her eyes..."

This shows that Black Girls CODE emphasises the strength of community, support and also the impact the programme has, not only with our Tech Divas, but the families and communities around them.

Ambassador and Alumnae Program

This year, BGC launched its Ambassador and Alumnae programme. The Black Girls CODE Ambassador and Alumnae Program is an extension of our pipeline programmes for girls of colour aged 7-17. The BGC Ambassador and Alumnae Program was developed to create a community for BGC alumnae and their

Future

We hope this article will serve as motivation and empowerment for the future generation of Tech Divas, and show the world that girls and black girls who code can, and will, run the world. Which is why Black Girls CODE ensures our Tech Divas know that they are #FutureTechBosses, and we give notice to the world that the future is on the horizon, and that our girls are ready to take the reins. We hope to expand in the UK, and other parts of the world. Again, what makes us active in our communities are the volunteers, partnered sponsorship, and people who truly support and spread the word upon our mission. We cannot do this without you. (HW)



EWURABENA ASHUN

Ewurabena Ashun works on the Education Team at Black Girls CODE. Serving as the Curriculum Specialist, her focus is on impact. She works closely with all of BGC's technical volunteers, as well as external companies, to provide educational resources to BGC's programming. She is also an RPI Certified Educator recognized at Denver, CO.

@abenashun



GET INVOLVED!

If you're looking for a way to get involved with BGC, through volunteering opportunities, ways to partner, or you want to register a girl at an event near you, please visit BGC's website at blackgirlscode.com/volunteer-signup.html.



Tech Divas engaging in BGC's Digital Making Workshop! Making with Raspberry Pis and programming Sense HATs!



It's never too early to start!

INTRODUCING PROGRAMMING THROUGH THE WIDER CURRICULUM

Ben Hall looks at the crossover between literacy and coding, and how it can help in the classroom

Much of the research around how we learn to program, and which approaches are most successful, has been focused on older learners, particularly undergraduates or those transitioning into text-based languages. There is very little research on how children learn to program from an early age. If we want children to become curious and confident programmers, then surely an understanding of their formative experience would help?

Computing is usually seen as a STEAM (science, technology, engineering, arts, and maths) subject. However, are we missing a trick? Are there parallels between programming and literacy, and could this

broaden the appeal of the subject for both learners and teachers?

Waite et al (2018) drew parallels between the design level of a program – where a pupil uses simple language to explain what characters will be needed and what they will do – and the planning of writing in a literacy lesson. Lister, Fidge, and Teague (2007) also investigated the links between writing skills and early programming, but in the context of text-based (in this case Python) languages for older learners. Can this research help us develop our understanding of how the youngest learners are introduced to programming?

Skill acquisition

As a specialist computing teacher in primary, I have been fortunate to teach learners from K-1 (aged 6–7), right through to the end of K-7 (aged 12–13). This has given me some insight into how children pick up key skills.

Typically, I've introduced computing to the youngest learners by looking at concepts such as instructions, and developing

vocabulary to help learners access floor robots such as Bee-Bots or Code-a-Pillars. This works really well in a continuous provision environment where children immerse themselves in the language before applying it to a different context, much like you might do with many other subjects. Use of 'fake bots' or grids can be a really useful way to introduce directional language. Once the language is secure, symbols can be introduced to represent movements.

This is very similar to literacy, where children are immersed in the language through opportunities to be spoken to, listen to stories, and explore books. Through this, they understand that books convey meaning and that they have an order and a sequence: spot the link?

In a blog post (bit.ly/2Kj9hkL), Sway Grantham has explored 'Talk for Coding' as an approach based on Pie Corbett's 'Talk for Writing' learning sequence. She draws on findings by Burke and Kafai (2010), who found that sequence, structure, and clarity of expression are as important in programming as they are in writing.

Parallels

As children's literacy skills develop and they become more aware of structure in writing, there are some really interesting parallels we can draw on.

Firstly, nursery rhymes. They're sequenced (e.g. one, two, three, four, five), and may include some form of repetition





(Hickory Dickory Dock or Ten Green Bottles). Knowledge of these patterns can be directly applied to a sequence of instructions, or even used as a basis for programming projects. In Scratch Jr we have a perfect platform for storytelling. One of my favourite learning sequences with Year 1 tied in with their class book at the time, *The Three Little Pigs*, which they retold through Scratch Jr.

I was careful not to bring in the programming element too quickly, it was much more effective when children were able to plan an element, using a storyboard, which they could then apply within the tool.

is not widely used: Waite et al identified that 82% of K-5 (primary) teachers thought that design in programming was at least very useful, whereas only 44% actually used it always or usually in their teaching. Double this amount always, or usually, used planning in writing. This could reflect a lack of confidence in teachers' subject knowledge, a shortage of materials to support design-led activities, or reflect the curriculum itself. In England, the curriculum for English states that children should 'plan, evaluate, and improve' their writing – there is no mention of planning or design in computing.

To develop your computing teaching,

subjects? The key is to ensure you use all of your experience to make computing as accessible as possible to the broadest range of learners.

Many of the concepts that have been discussed in this article also will be explored in a National Centre for Computing Education online course, which runs from the end of November 2019 and into December as well. It is called 'Primary programming pedagogy: developing computing teaching' (rpf.io/primarypedagogy) and depending on when you read this, I hope to see some of you there! (HW)

IT WAS MUCH MORE EFFECTIVE WHEN CHILDREN WERE ABLE TO PLAN AN ELEMENT, USING A STORYBOARD

This is very similar to how most teachers would encourage children to plan a story before writing it. Design in programming is equally important, and this is a way to introduce it by using a known context and drawing from prior learning. There are many parallels with literacy – we plan writing and design algorithms, and storyboards can be used for both.

The research suggests that this approach

it can be really helpful to draw from other subjects, not just literacy. Consider languages. How could learners apply their experience of learning a second spoken language to learning a programming language? In maths, when you teach patterns and sequencing, how can you translate these into the corresponding programming concepts? Can you link debugging to correcting errors in other



BEN HALL

Ben is a Learning Manager at Raspberry Pi, developing curriculum resources for the NCCE. He also runs a CAS community in Rochdale. He was previously a primary teacher specialising in computing. Twitter: [@hengehall](https://twitter.com/hengehall)

PLAYING CARDS WHICH TEACH COMPUTER SCIENCE PRINCIPLES

William Lau launches a set of playing cards which helps deliver several key topics from the Computer Science curriculum

Trumps is not a new game – it was developed by the French and the Spanish in the 15th century, and was known as Triomphe or Triunfo respectively. The word itself comes from the Latin word ‘triumphus’, meaning triumph. The modern game, as many of us know it, originates from Austria around the 1800s with an educational card game called Quartets. In the early 1970s, German company Altenburg-Stralsunder released Ace Trumps. This was followed a few years later by British company Dubreq, who released Top Trumps in 1978, which is arguably the most popular format of the game.

Many computer enthusiasts have created their own computer-themed versions of

the popular Trumps game including David Phillips, Simon Johnson, Rachael Duckster, James Abela, Jim Brown, Jamie Mitchell, Richard Herbert, Gavin Craddock, Dominic Pajak, Dave Smale, and Mike Jenkins. I do not claim to be the first to create such a game and I hope I am not the last. As technology and the computer science curriculum evolve, I hope this game will inspire others to create their own games or suggest improvements.

Whilst I had made a version of the game with my students in 2014, it was my five-year-old son who inspired this creation when he came home from school one day enthusiastically showing me a Top Trump card that his friend had given him. I thought

it would be a fun idea for us to make our own cards and feature computers. I was aware that others had made similar games before, however none of these games covered enough of the key topics in the GCSE Computer Science qualification that I was teaching. Specifically, I wanted to cover the number of CPU cores, the amount of cache, the CPU clock speed, and the type of secondary storage for each computer.

I was also keen to compare contemporary devices such as smartphones with historical computers such as ENIAC and the Manchester Baby. Looking through my son's card collection I noticed that some cards were numbered, so I decided to number the cards in binary and hexadecimal; this allows teachers to explain different number representations.

Lastly, it was essential to ensure that the Creative Commons and Public Domain images were correctly credited and so I created a credit sheet. These credits also enable teachers and students to discuss the different types of licenses and how the images can be used.

Variations of popular games

There are two primary ways the game can be played. Firstly, following the modern Trumps format whereby a player reads out a statistic e.g. CPU clock speed. In order to determine who wins each round, the players have to compare their cards and understand that a CPU with 1GHz clock speed is faster than a CPU with 100MHz





clock speed. This leads to a further teaching point as the teacher can explain the units that computer scientists use. Likewise, when a player chooses secondary storage type, they learn that solid state storage is 'better' than magnetic storage in this game. The teacher can explain that this is because solid state storage has no moving parts and therefore has faster access speeds.

The second way the game can be played is by using the binary or hexadecimal values to play a 5-bit version of 21 (also known as Blackjack). As there are five bits, the highest value is changed to 31. Players each start with two cards, and they can request more cards by popping from the stack of cards or they can choose to stop. The player closest to 31, without going over 31, wins. Given that some students may be unfamiliar with binary and hexadecimal, a cheat sheet is provided. Students can choose to use the cheat sheet or convert the hexadecimal to decimal. An alternative method of calculating a hand's value is to use binary addition and to keep going until there is an overflow error i.e. the player's total is greater than 31.

A social mobility project

When the game was being created, I intended to give a physical deck of cards to each of my GCSE and A level students, and one way of financing this would be to sell physical copies of the game. However, as with all of my student resources, I did not want money to be a barrier for anyone wanting to learn through playing the

game. I'm a great believer in computer science being an agent for social mobility, so as with all my student resources, students and teachers can also download and print their own copy at home at computercombatcards.com/freebies.

Should readers wish to support the project by buying copy, they can do so at computercombatcards.com and use the discount code HelloWorld, which will reduce the price to £8.75 for one deck, or £69.99 for packs of 10 decks. [\(HW\)](#)



WILLIAM LAU

William (@MrLauLearning) leads Key Stage 4 Computing at Central Foundation Boys' School. He is a CAS Master Teacher and the author of *Teaching Computing in Secondary Schools* and *The Little Book of Algorithms*.

UNPLUGGED SEARCHING AND SORTING ALGORITHMS

For many years, teachers have used playing cards or numbered pieces of paper to physically demonstrate searching and sorting algorithms. As each Computer Combat Card is numbered in binary and their equivalent hexadecimal, the cards can be used to demonstrate these algorithms. A shuffled deck is useful for showing the inefficiency of a linear search. Using the Python program shown, a random card can be generated and students can attempt to find the card in a linear fashion, noting down the number of comparisons. Once the deck is sorted, students can be shown a binary search to find the same card using a divide and conquer method. Given a deck of 32 cards ($n=32$) and using the formula: $\log_2(n)+1$, the maximum number of comparisons will be six. A level students can also be taught the time complexity of the binary search as $O(\log n)$. Tutorial videos demonstrating searching and sorting algorithms are also available at computercombatcards.com/how-to-play.

```
import random

all_computers = [{"0": "Titan OLCF-3"}, {"1": "BBC Microbit"}, {"2": "Raspberry Pi 4.0 Model B"}, {"3": "Xbox One"}, {"4": "Gamebuino Meta"}, {"5": "Apple Ipad"}, {"6": "Asus EEE PC 1000"}, {"7": "IBM Thinkpad R51"}, {"8": "Apple Mac Pro 5,1"}, {"9": "Commodore 64"}, {"10": "Eniac"}, {"11": "iPhone XS"}, {"12": "Raspberry Pi Zero W"}, {"13": "Nintendo Entertainment System (NES)"}, {"14": "Sega Master System"}, {"15": "Acer Chromebook"}, {"16": "Nintendo Gameboy"}, {"17": "IBM Personal Computer 5150"}, {"18": "NeXTCube"}, {"19": "Nintendo Wii"}, {"20": "Summit OLCF-4"}, {"21": "Sierra ATS-2 (天河-2)"}, {"22": "Tianhe-2 天河-2"}, {"23": "Sony Playstation 4"}, {"24": "Manchester Baby (SSEM)"}, {"25": "BBC Micro"}, {"26": "Sinclair ZX Spectrum"}, {"27": "Commodore Amiga 500"}, {"28": "Samsung Q1 Ultra"}, {"29": "Blackberry Bold"}, {"30": "Samsung Galaxy S10"}, {"31": "Alienware Area 51 Threadripper Edition"}]

random_card = random.randint(0, len(all_computers))
```

■ *Pinus nigra* trees advance across the landscape in Canterbury, New Zealand. Photograph by Sarah Wyse.

EXPLORING THE INTERFACE OF ECOLOGY, MATHEMATICS, AND DIGITAL MAKING

Get closer to the natural world while honing your maths and computing skills, and take part in real scientific research, too

Connectedness to nature (as measured by the Nature

Connection Index: read more about that at bit.ly/2XagQ2B) is currently the lowest in young people aged 16–24, with everyone aged 8–34 reporting lower connectedness, compared to the 35+ age groups.

Although there is some positive correlation between individuals living in the same households, parents are now less likely to raise their children where they grew up themselves, and as such they may be less knowledgeable about local

species. Connecting with nature does not have to mean a trip out into the wilds: urban ecology is increasingly popular in research, and even the most determined of city dwellers is likely to pass a municipal tree or two during their day.

The positive association between connectedness to nature and wellbeing should encourage us all to appreciate and explore our local environments. However, being at one with the natural world doesn't preclude an abundance of enjoyable science and technology. For example, the authors'

overriding memory of GCSE maths involves triangles – a lot of triangles – combined with frequent musings over how this could possibly ever be useful in the real world. Fast forward 20 years, and we've spent more time than we'd like to count surrounded by triangles, chanting 'SOH CAH TOA' in the name of ecology.

Calculating the terminal velocity of winged seeds

The Seed Eater project arose from research (bit.ly/32AhgA4) into how fast winged seeds (samaras) fall, in order to predict how far they might travel across a landscape, and hence understand how quickly populations of invasive trees might spread.

In the past, ecologists have measured the terminal velocity of seeds using stopwatches and lasers, but stopwatches are inaccurate, and lasers are expensive. Enter stage left, Pieter the Seed Eater; a

TPARENTS ARE NOW LESS LIKELY TO RAISE THEIR CHILDREN WHERE THEY GREW UP THEMSELVES, AND MAY BE LESS KNOWLEDGEABLE ABOUT LOCAL SPECIES



PEN HOLLAND AND SARAH WYSE

Dr Pen Holland (@Anaspene) is a lecturer in ecology, and RPi certified educator at the University of York. Pen is a quantitative ecologist whose interests range from using simple models to understand complex ecological problems, to developing novel ways to teach, disseminate research, and engage people in the biosciences.

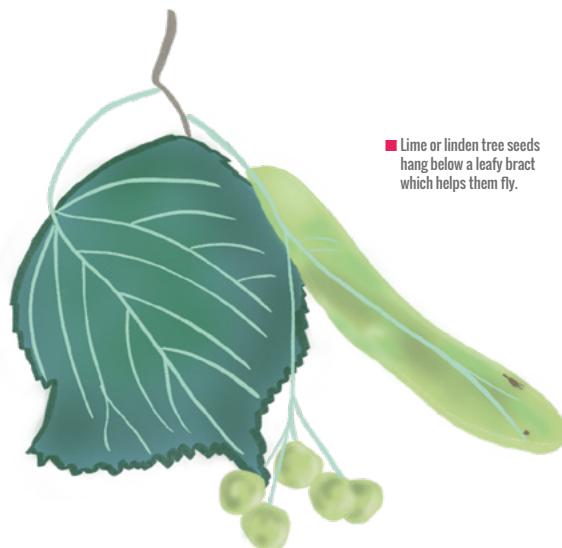
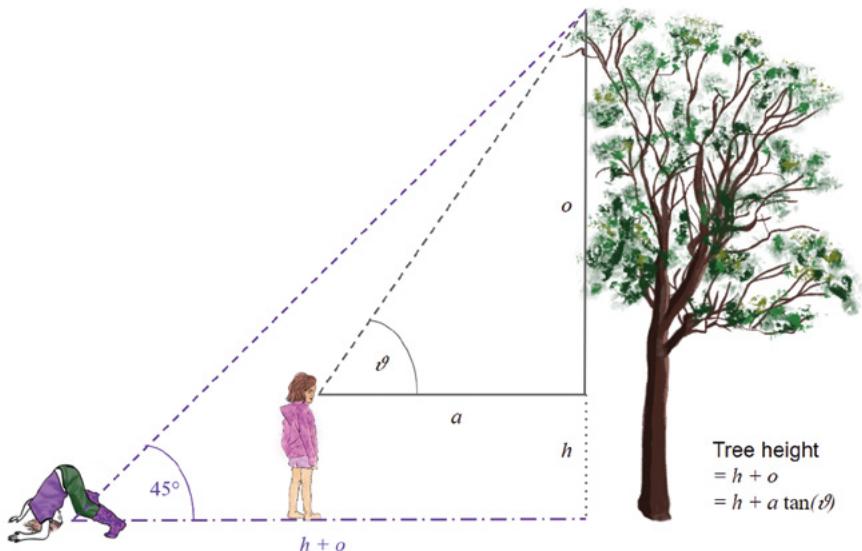
Dr Sarah Wyse (@SarahTheWyse) is a postdoctoral research fellow at the Bio-Protection Research Centre, based at Lincoln University, NZ. Sarah is a plant ecologist whose current research focus is on quantifying seed dispersal potential to model the invasion risk of introduced conifer species in New Zealand.

low-cost device fitted with a Raspberry Pi computer and camera that captures a sequence of images, assesses which timestamped images contain a falling seed, and then calculates how far the seed fell, and hence how fast it was travelling. We introduced him in the last issue of Hello World, and if you missed that, you can download a free PDF copy of the magazine from the website (helloworld.cc).

Pieter the Seed Eater was designed to measure the terminal velocity of pine (*Pinus* species) seeds from invasive trees in New Zealand, with a particular interest in the variation in falling speeds among seeds from the same cones, between different cones on the same tree, between trees in the same population, and between populations across the landscape. His diet is now expanding to take in a whole range of pine species, but there are many other species of tree around the world that also have winged seeds, in a variety of fascinating shapes.

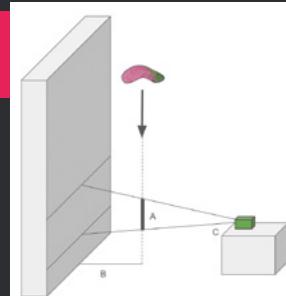
MEASURING TREE HEIGHT

There are several ways to measure tree height, which can be a stimulating discussion and activity. Fire arrows attached to string over high branches, go exploring on Google street view, or use trigonometry, making measurements in a variety of simple or sophisticated ways. Are they all equally accurate? Would they all work on isolated trees and in a dense forest?



SEED SPEED CALCULATIONS

Timestamped images in which the seed appears tell us the time taken for it to fall through the field of view (A). The distance at which the seed lands from the wall (B) and the viewing angle of the camera (C) are used to calculate distance travelled by the seed while in view. Finally, the speed at which the seed is travelling can be calculated as distance/time.



Introducing teaching resources

To help emphasise the connections between nature and STEM, and because Pieter doesn't have time to eat all the seeds, we are making cross-curricular resources available to support teaching activities. These range from tree identification and seed collection, through seed dispersal experiments and Seed Eater engineering, to terminal velocity measurements and understanding population spread.

These draw on links from elsewhere (for example, the tree identification keys provided by the Natural History Museum, and helicopter seed templates hosted by STEM Learning UK), as well as new material designed specifically for Pieter the Seed Eater, and more general cross-curricular activities related to ecology. In addition, participants can contribute their data to an online database and explore questions about their data using visualisation tools for dispersal equations and population spread.

The teaching resources fall into four main categories:

- Neighbourhood trees
- Dispersal
- Terminal velocity
- Population spread

Each section contains background information, suggested activities for groups and individuals, data recording sheets, and stretch activities for students to carry out in class or at home. The resources are provided as Google slides under a Creative Commons license so that you can edit and adapt them for your own educational needs, with links to the National Curriculum highlighted throughout (thanks to Mary Howell, professional development leader at STEM Learning UK) and interactive graphics hosted online to help understand some of the concepts and equations more easily. Python code for the Seed Eater can

be downloaded or written from scratch (or in Scratch!), so that you can set up the device or let students engineer it from first principles. It will need some calibration, but that is all part of the learning experience, and the resources come with some troubleshooting ideas to get started.

How can you join in?

Relevant resources are available from btle.york.ac.uk/seedeater. These are currently aimed at Key Stage 3 (age 11–14) and 4 (14–16), but will be developed and

extended as time passes, feedback is incorporated, and new requests are made. Ultimately, we would like to reach Key Stage 1 to sixth form and beyond, and develop the project into a citizen science collaboration in which people around the world share information about their local trees and seeds with the global community. We welcome feedback and engagement with the project from anyone who is interested in taking part – get in touch via Twitter or email [\(HW\)](mailto:pen.holland@york.ac.uk).

“ PARTICIPANTS CAN CONTRIBUTE THEIR DATA TO AN ONLINE DATABASE AND EXPLORE QUESTIONS USING VISUALISATION TOOLS



Hornbeam seeds hang in catkins and have wings that make them spin as they fall.

Maple seeds act like little helicopters when they fall.

WIDENING PARTICIPATION FOR SEED EATERS

We are able to provide a Seed Eater hardware kit (including an RPi 4, camera module and cable, power unit, case, and LED lights) for up to 50 school-age groups, thanks to the University of York's Departmental Widening Participation Fund. To find out if your group is eligible and to apply, go to btle.york.ac.uk/seedeater.



CAMBRIDGE WOMEN IN TECH

Events are free, and attracting sponsors too

What do you do when you feel all alone?

The battle for inclusion in all industries is widespread and ongoing, with many groups working towards what has been summed up quite nicely by the International Women's Day campaign; #BalanceForBetter. Yet there are still many people who feel isolated in their role due to their gender, race, or age. Does this sound familiar to you?

Some years ago, I was at a tech focused conference in London organised by one of 'The Big Four'. I was part of an otherwise all-male team, presenting and demoing software to attendees.

However, back on the booth, people started flocking around my male counterparts (I was the only female) and upon my approaching them, they would simply tell me they were waiting for the guys to 'talk tech'. This was a relatively regular occurrence for me, but as I went for a break a moment later, I stepped back and realised there was a huge line for the male bathroom, but empty female bathrooms. I've never seen that at any public event in my

life before, and it came as something of a shock (or maybe an epiphany!) Where were all the women?

This was the start of my journey, and I am sure it will resonate with many of you who are reading this. You can accept things as how they are, or you can try and do something about it. Could you be the person who stops another feeling alone in their industry?

What's the problem and how can we fix it?

Working at a large Cambridge-based software company with a notorious culture of toxic masculinity, I had endured for years what many women working in the sector will recognise as common problems: being the only woman on an all-male team, managing all-male teams, workplace harassment, bullying, and discrimination. I had seen many of my female colleagues experience the same toxic and exclusive culture, and decided that women in tech needed a network of like-minded individuals

to help create relationships locally and provide opportunities, support, and insight to one another.

Whichever under-represented minority you are a part of, the solution is universal: everyone deserves an open and supportive place to speak about the challenges faced. It's an incredibly empowering and uplifting experience to know you are not alone, which provides both confidence and encouragement to carry on in the face of adversity.

This is evident through recent feedback surveys, as members of CWIT recently shared.

"This group is the very reason I didn't quit and go back home, you quite literally changed my life!"

"Not only have I built work 'connections' within this group, but friends for life too."

This was how I tried to make a difference to others in my area. I called it Cambridge ➤



■ Don't be scared to get a discussion going!

► Women in Tech (or CWIT for short). Its aims are twofold:

- To advance women in all STEM roles, from the classroom to the boardroom and beyond.
- To provide a network for interested and proactive people to meet locally, to discuss topics relevant to women in the technology sector and the wider world in the 21st century.

How can I do something similar?

Since those initial ideas, our membership is now over 3000 humans strong and growing, with no signs of slowing down. That's how important these networks are. However, this is just in the Cambridge area and there are people feeling isolated all over the country, and even the globe. Here is how I got started:

■ Decide the initial format

I chose a 'Lean In' Circle inspired by Sheryl Sandberg who suggests women

OUR MEMBERSHIP IS NOW OVER 3000 HUMANS STRONG AND GROWING, WITH NO SIGNS OF SLOWING DOWN

need to regularly share and learn together. While this was the initial format our meetings took (it was a convenient model to use for our first time), they quickly morphed into something else once we had a group going.

■ Reach out to people in your area

I put a call out on LinkedIn and Twitter for people (but mainly women) in tech that were interested in meeting and networking locally, and left it deliberately vague. I invited local women in tech to come along and discuss exactly what was needed to foster a supportive and active community with the goal of being strong advocates for inclusion, spreading the message balance for better,

and creating empowerment among our contemporaries.

■ Don't panic - you are not alone!

What if no one turns up? I remember checking replies obsessively, thinking at worst I would be on my own drinking coffee and eating all the biscuits, at best I would have six people show up who wanted to chat about what they felt was needed to start creating more balance in the industry locally. 58 people replied.

■ An introduction is all you need

A week later at my office, I hosted the very first CambridgeWIT. After an intro about the reasons I created the meet-up, I shared some horrifying statistics of the

current plight of women in tech and then simply asked the question 'why are you here?' From there, the floodgates opened, and I knew then that we could really make a difference.

■ Decide the needs of your community together

Our first discussion uncovered what we soon decided were the main branches of support we could begin to provide our members. We came up with; Personal Development, Career Development, Shared Experience, Networking Opportunities, Peer Mentoring, and Community and Social Outreach.

■ Find a manageable model

To achieve these aims, I built a model that focuses on one large quarterly event (always free) for which I invite speakers to participate and share, with other smaller, more targeted events in-between.

The format of our quarterly events is always networking and drinks on arrival, then presentations and questions, with networking and discussion time at the end. They are always subscribed to capacity.

To fund them, I seek sponsorship from local tech companies such as Raspberry Pi, Amazon, Microsoft Research, Arm, Redgate, Speechmatics, Citrix, and more. (We're always looking for more support from partners like these!) In between these events, I arrange smaller workshops with facilitators and experts who can come and impart skills and wisdom to our members. For example, our next session is on presentation skills and how to pitch. Our facilitator is an ex stand-up comedian turned communication coach (Jon Torrens, look him up), who will run a 90-minute intro workshop.

■ Reflect as you grow

It is important to our community that the vast majority of CambridgeWIT events and access remains free. To support our community we have a very active Slack instance, a Facebook group, a LinkedIn page, and many of us regularly meet socially through our internal 'coffee

matching' service. To be effective in its mission, CambridgeWIT must remain accessible and open to all. It is also crucial that people understand that we are staunchly advocates for inclusion and empowerment – it's not just about women. Although they are our target audience, it's all about balance for better: a growing proportion (now around 15%) of the community are men.

Is that it?

Born as a result of a lack of networking channels, events, and development workshops in the local area for women working in STEM roles, Cambridge Women in Technology has evolved over time into an active network reminding anyone who needs it that they are not alone.

The biggest challenge for CambridgeWIT now is that I am not sure where to take it and how to grow it! There are so many avenues we could follow, and more and more of our members are highlighting areas we can support them in. If you'd like to join in the conversation, attend an event, or get involved, you can join our Slack channel at bit.ly/CWITSslack and find us on Facebook, LinkedIn, or Twitter. We'd love to hear from you! Conversely, if you want to create your own movement aimed at achieving 'Balance



KATHERINE CODLIN

Kat Codlin is the founder of Cambridge Women in Tech, and a working mum to two boys. She is committed to 'balance for better', fighting the gender pay gap, and believes the best things in life are not things.

for Better', then go for it! I was honestly stunned at the breadth of desire from others who felt the way I did to create a shared space – be brave, find like-minded others, and start a discussion!

You never know where your tiny group could end up making a big difference! (HW)



A successful event about to get started

AGE RANGE

11-13 years

RESOURCE TYPE

- Physical computing
- Project-based learning

REQUIREMENTS

Each pair of learners requires:

- Laptop / desktop computer with a USB port
- Modern web browser (e.g. Google Chrome)
- Access to makecode. microbit.org
- 2 x micro-bits (with USB cable and battery pack)

TEMPERATURE RECORDING

Utilise the micro:bit's radio and built-in sensors and help teach physical computing

Many schools have invested in micro:bit devices, and are increasingly using them to develop learners' understanding of programming concepts. That, and making engaging physical computing projects too. During this lesson, learners will further their understanding of the micro:bit's capabilities by producing a range of programs to send data between devices. That data includes text, numbers, and readings from sensors.

The lesson was effective at engaging learners who had prior experience of the micro:bit, especially those who had previously undertaken extended projects using the device (such as producing a step counter or fairground ride). In particular, the use of the radio enables learners

to examine how digital devices can communicate and facilitate the sharing of information.

Prior to this lesson, learners should be familiar with implementing the programming concepts described for Key Stage 2 learners within the English Computing National Curriculum (sequencing, selection, repetition, and variables) and how to produce code utilising these concepts

using the micro:bit's MakeCode editor (makecode.microbit.org).

Note that the temperature readings provided by the micro:bit are for the device's CPU temperature, rather than the ambient temperature. Despite this, moving the device to a hotter or colder location will impact on the temperature reading accordingly, which is adequate for this lesson's outcomes. (HW)

HEALTH AND SAFETY REQUIREMENTS

The health and safety guidance provided with the micro:bit should be adhered to, particularly as the electronics are exposed, as outlined here: microbit.org/guide/safety-advice

Learners should also be regularly reminded of how to use the device safely, along with your setting's Acceptable Use Policy (or similar).



TEMPERATURE READINGS ARE FOR THE DEVICE'S CPU TEMPERATURE

LEARNING OBJECTIVES

- ✓ To send text between one or more micro:bits using the radio
- ✓ To send temperature data between one or more micro:bits using the radio
- ✓ To send data from a range of sensors between one or more micro:bits using the radio



NEIL RICKUS

Neil is a Senior Lecturer in Computing Education at the University of Hertfordshire and the founder of Computing Champions. He is a CAS community leader and a Raspberry Pi, Google, and Microsoft Certified Educator.



STARTER ACTIVITY: MICRO:BIT FUNCTIONALITY 10 minutes

Ask learners to discuss programs they have previously developed with the micro:bit, which could include scrolling text, animations, triggering events with buttons, using the sensors to detect movement, storing data with variables, and producing extended projects such as a step counter, fairground ride, score board, or burglar alarm.

Show learners a number of blocks they have previously used, and ask them to discuss the functionality and inputs/outputs of each block of code. Check for understanding and clarify any misconceptions as appropriate. If required, remind learners how to download their program and transfer it to the micro:bit.

► ACTIVITY 1: SENDING TEXT WITH THE RADIO 20 minutes

Explain to learners the micro:bit has a built-in radio, which can be used to send and receive data between micro:bits.

Explain that a radio which can both send and receive is known as a transceiver, and we could send text, numbers, or even information from the micro:bit's sensors, between devices.

Highlight to learners that we need to ensure groups of micro:bits send and receive data using the same channel, or all micro:bits in the vicinity will receive the data. Put learners into pairs and allocate each pair a unique number between 0 and 255. Each pair should be given two micro:bits, along with USB cables and battery packs, and reminded of the setting's health and safety guidance.

Show learners the radio send string block and explain how this can be used to send text, or strings, using the radio. Ask learners to download these instructions on to their first micro:bit, which will be known

as micro:bit 'A'. Highlight to learners that the 'radio set group' block should include their unique channel number.

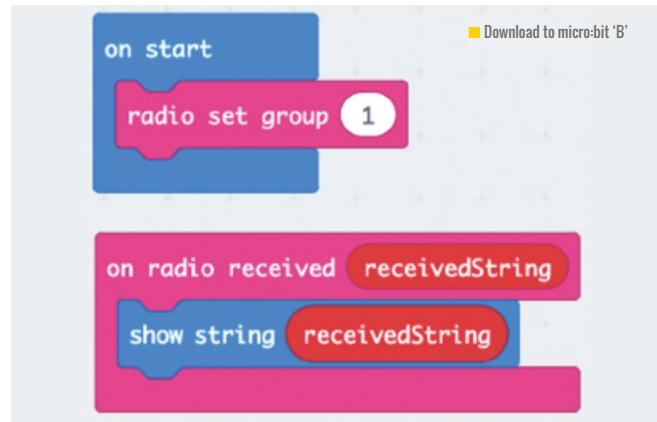
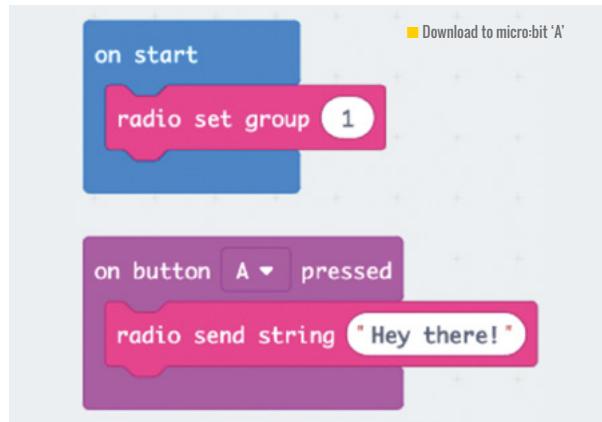
Once complete, explain we can display the messages received using the on radio received block with a show string block. Emphasise to learners that 'receivedString' is a variable and therefore is used to store data. Ask learners to download these instructions on to their second micro:bit, which will be known as micro:bit 'B'. Remind learners that the 'radio set group' block should contain their unique channel number.

Learners should ensure their micro:bits are disconnected from the computer and subsequently connect a battery pack to each device. Pressing button A on micro:bit 'A' will display the text from the 'radio send string' block on micro:bit 'B'.

Once the basic functionality is working successfully, challenge learners to undertake a number of follow-up tasks:

- Make micro:bit 'A' also able to receive messages
 - Make micro:bit 'B' also able to send messages
 - Send different text depending on the button pressed
 - Send (and receive) numerical values, not text (Hint: use 'radio send number' on micro:bit 'A' and 'on radio received receivedNumber' on micro:bit 'B')
 - Program Button A to select and display a random number, then Button B to send the selected number
 - When shaken, program the last two numbers received to be added together and displayed on the screen
 - When a button is pressed, make both micro:bits display a countdown (from 5 to 0), then show rock, paper, or scissors
- Assist learners as required, and encourage them to share work with their peers.

■ Code for sending text from micro:bit 'A' to micro:bit 'B'



DIFFERENTIATION

During each activity, learners can undertake the challenges most suitable to the next stage in their learning, with support provided through additional discussion or giving learners suggestions of blocks to use in order to solve the required task. Learners may also wish to experiment with sending data to more than one micro:bit at the same time.

Depending on learners' prior knowledge and ability, the lesson could be undertaken using a text-based programming language, such as the micro:bit's Python editor (python.microbit.org) rather than MakeCode.

The micro:bit's MakeCode programming environment includes translations of each code block into around 30 different languages, which can be used to support EAL learners.

RELEVANT LINKS

This lesson formed part of a workshop during the 2019 European Scratch Conference. Links to the slides used during the session, which can be modified for use in the classroom, can be found here: computingchampions.co.uk/scratch2019.

Further micro:bit lesson plans and resources can be found here: mb4ps.co.uk.

ACTIVITY 2: REMOTE TEMPERATURE SENSING 20 minutes

Explain to learners that a scientific organisation (e.g. NASA) wants to develop a cost-effective, remote temperature sensor, to use in an extreme environment (e.g. the North Pole). Outline how it wishes to determine whether micro:bits could be used for this, such as by using the device's temperature sensor and radio. For example, one micro:bit could be outside as the temperature sensor, with another inside a building to display the temperature outside.

Ask learners to discuss what features would be essential for a temperature sensor to meet the scientific organisation's requirements. Also, what other features would be desirable? Record learners' ideas, which could include, but are not limited to:

Essential:

- Show the current temperature on a different micro:bit

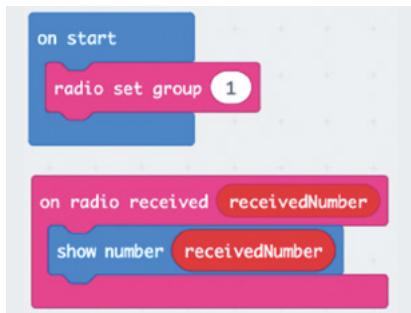
Desirable:

- Only show the temperature when a button is pressed
- Show if the temperature has increased / decreased / stayed the same (since last checked)
- Show previous temperature(s)
- Show the number of seconds since the temperature was last checked
- Show the lowest / highest temperature recorded
- Show the mean (average) temperature recorded
- Show emergency messages / play sounds when the temperature goes above / below a certain temperature

For the essential functionality, ask learners to discuss how it could be implemented, including the required code blocks. Share their thoughts and, if required, show them



■ Download to micro:bit 'A'



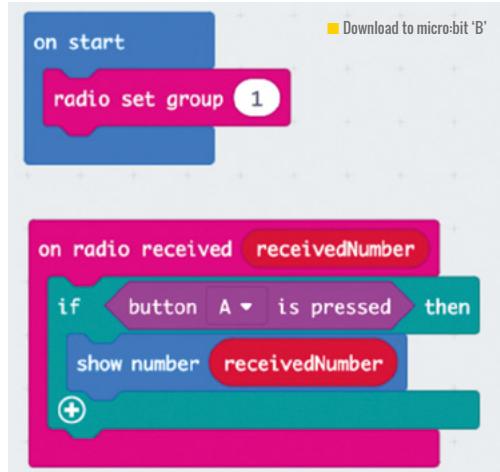
■ Download to micro:bit 'B'

a possible solution. Remind them their 'radio set group' should contain their unique channel number. Ask them to implement the essential functionality on their devices.

Once complete, remind learners of the desirable features and discuss possible methods for implementing some of the

required functionality. Share learner's thoughts and, if required, show the code for a possible solution to how to 'only show the temperature when a button is pressed'. Then ask learners to implement some desirable features and support them as required.

“ ONE MICRO:BIT COULD BE OUTSIDE AS THE TEMPERATURE SENSOR



■ Download to micro:bit 'B'



■ Attendees at the 2019 European Scratch Conference making their own temperature sensors using the micro-bit radio

ACTIVITY 3: PLENARY 10 minutes

Ask learners to share their remote temperature sensor with the class, including any desirable features implemented and how they achieved the functionality. Learners should save their work and share it with the teacher as appropriate.

ASSESSMENT

Examine learners' code and look for evidence of a range of programming concepts implemented to achieve the required functionality. Learners could be asked to explain what each part of the program does - through discussions with the teacher, presenting to the class, or commenting their code.

AGE RANGE

14-16 years

LESSON TYPE

Visual / block-based coding

REQUIREMENTS

- Modern web browser
- Internet connection

ANALYSING DATA USING BLOCK-BASED PROGRAMMING

When teaching topics from the field data, rich data sets are often necessary. Twitter data, one of the richest data sources on the internet, can be used in school

Fostering data-orientated competencies is more and more often considered an important goal for school. Students should learn what can be done with data and – at best – should be able to conduct simple data analyses by themselves. In this lesson plan, we present a simple approach for introducing this topic in school. By analysing data

using the easy-to-start block-based programming language, Snap!, students will gain first insights into how data analyses work and what can be done with data, while also discussing the validity of different analysis approaches.

For this lesson, we selected Twitter as a data source. Although at first glance, Twitter data mainly

seems to consist of only short texts, it is actually a rich data source as each tweet brings with it up to 160 meta attributes, containing not only information about the tweet itself, but also about the user who wrote the tweet.

To make it easy for students to use Twitter as a data source in school, we extended the block-based programming language Snap! so that data can be retrieved from the Twitter API. To use the tool, students do not need to register with Twitter. In addition to accessing Twitter data, we also allow the use of CSV files as additional data sources, and provide map and chart functionalities for visualising data. (HW)

“TWITTER IS A RICH DATA SOURCE, AS EACH TWEET BRINGS WITH IT UP TO 160 META ATTRIBUTES”

ACTIVITY 1: NAME AND TIMING 20 MINUTES

Give students the most simple task to get started with Snap!Twitter:

“How many meta attributes does a tweet contain in addition to its text? What can you find out about the user who wrote a tweet?”

As this task can be mastered using just two blocks, ‘tweet as table’ and ‘single tweet’, from a technical perspective it fulfils the goal of letting students explore the tool and the data source, ‘Twitter’.

The results of this activity should be summarised in plenary.

A	B
created_at	Mon Jul 29
id	[redacted]
id_str	[redacted]
text	@ [redacted] Some
display_text_range	[redacted]
source	<a href="http://twitte
user	[redacted]
geo	[redacted]
coordinates	[redacted]
place	[redacted]
contributors	[redacted]
in_reply_status	[redacted]

 tweet  single tweet  as table

OBJECTIVES

- ✓ Recognise the value of metadata
- ✓ Conduct simple data analysis
- ✓ Estimate the validity of data analysis

ACTIVITY 2: PEOPLE USUALLY TWEET IN THEIR MOTHER TONGUE – DON’T THEY? 25 MINUTES

An interesting task for getting into data analyses is to analyse the distribution of languages over the globe. Thus, give your students the task of checking which of the most common languages (such as English, Spanish, or German) are used, and where.



This can be done by visualising tweets on a map, distinguishing the different languages using different colours.

Obviously, the native language is not the most common language on Twitter, in most countries. Instead, English is the primary language – at least according to the 'lang' attribute.



DIFFERENTIATION

In the lesson plan described, we've focused on students who have basic experience with block-based programming. If this isn't the case, then students will need more detailed tasks at the beginning. Experienced students should then be able to explore the tool further.

In the main activity, students can follow their own interests, either by selecting a research question that is interesting for them or by pursuing a question of their own. Since most questions at this stage cannot be fully answered in the short time available, there is always room for further improving the analyses, so even confident students have something useful to do, while those who struggle a little can at least get some basic results.

ACTIVITY 3: LET'S ANSWER A RESEARCH QUESTION... 40 MINUTES

As the students now have some basic experiences using Snap!Twitter, accessing tweets and their attributes, and also using the map tool, they can now conduct more complex analyses. Hence, we propose to give them several questions or statements, of which each pair of students should select and investigate one. For example:

- People in Japan have fewer 'real' social contacts but are better connected in virtual life than people in the United States.

- While people in Europe typically like the colour blue, in the Asian countries people prefer green.
- Do people use more Android or Apple devices?
- In some countries, relatively few people use Twitter, while in others the usage is much higher. Which are the countries in which Twitter is most popular?

Of course, students can also follow their own ideas here!

RELEVANT LINKS

The Snap!Twitter tool is available at: snapwitter.dataliteracy.education.

As this is released as open source software, you may set up your own server or use our server. However, for legal and technical reasons, we have to restrict access to the tool. Therefore, to get access to the Twitter area, please contact us via e-mail (see the website above).

ACTIVITY 4: WRAPPING UP FLEXIBLE

As a last step of this lesson plan, students should think critically about the analyses they have conducted. For this purpose, all student pairs (grouped by questions, if multiple pairs worked on the same one) should briefly present their analysis, with its goals and

the way it works, to the others. In order to come into discussion about the validity of the analyses, the other students are requested to call into question whether the analysis seems reasonable, comprehensible, and if there are any weaknesses.

DR. ANDREAS GRILLENBERGER

Andreas Grillenberger is a research fellow at Freie Universität Berlin in Germany. Since 2013, he has worked on data, data management, and data literacy topics, and investigates these from a computing education perspective, particularly with focus on secondary education.

AGE RANGE

7-11 years

LESSON TYPE

- Physical computing
- Robotics

REQUIREMENTS

- Crumble starter kit
OR included components (controller board, battery box, and croc clips)
- PC (running Windows or Linux), Mac, or Chromebook
- Crumble software (bit.ly/2WTv4)
- Mini DC gear motors

GET MOVING WITH CRUMBLE

Get things moving using the Crumble controller robotics board and DC gear motors to teach and learn physical computing, and get children making!

Following on from the 'Get Sparkling with Crumble' in issue 8 (download a free back issue at helloworld.cc), this article will move beyond the wonder of your first Crumble light show and set things in motion using small DC gear motors and wherever your imagination can take them!

For anyone new to the fabulous Crumble, it's an easy-to-use, low-

cost robotics controller board that you can use to connect and code all sorts of components such as LEDs, motors, servos, and all manner of sensors.

The Crumble connects to a PC, Mac, Chromebook, or Linux computer so you can transfer your Blockly code to run on whatever wonderful creation you make. Once the Crumble has the code,

it can be disconnected from the computer and will run the code using battery power.

We are going to look at connecting and coding small gear motors. Any project in this article can be taken and adapted for any project you can think of using motors, and you can even add some lights and sensors when you are ready to challenge yourself further. **(HW)**

The challenge

- Connect up a Crumble controller.
- Connect a gear motor.
- Code a motor to control speed and direction.
- Use a random block to code random movement.
- Use variables to code a gradual speed change.

'Take it further' challenges

- Code a motor to turn in a random direction.
- Code a slightly random acceleration or deceleration.
- What else could you make using motors?

Getting connected

Okay, let's get started! If you haven't already done so, you will need to download and install the Crumble software. This is an intuitive Blockly coding app, custom-made by its creators.

Connect the Crumble controller to your computer using a USB-to-micro USB cable. The computer is where we'll write our code and transfer it to the Crumble board. You can check that your Crumble is detected by opening up the software and clicking the green arrow play button. You will get the message, 'programming successful' if the Crumble is properly connected.

Power up!

Most components, including motors and servos, will need some power to the Crumble controller board. The Crumble starter kit comes with a fantastic 3 x AA battery pack that has a switch and 'Crumble-friendly' croc clip connectors, just like the ones on the Crumble controller. These battery boxes are great for young learners because they make connecting everything up so simple,

and they can concentrate on the task at hand instead of trying to join ultra-thin wires together. Just make sure that you connect positive to positive (4.5v to 5v) and negative to negative (ground or GND). I have used the red and black cables respectively to make things very clear but any colour cables will work just the same. The electric current really doesn't care what colour the plastic coating is.

The battery box will supply power to the board when disconnected from a computer but also gives a constant output to be used with external components such as Sparkles, motors, and servos.

About gear motors

Gear motors are far more useful for most robotics than standard DC mini-motors that you usually find in schools. The gearing slows the motor's rpm and gives it much more

program start

```
motor 1 FORWARD at 75 %
wait 300 milliseconds
motor 1 STOP
```

■ Turn motor on, wait 300ms then turn motor off.

torque, needed for actions like a robot buggy moving from a standing start. A search for 'gear motor Arduino wire' should link you to some sellers of relatively cheap yellow gear motors with wires already attached to the motor terminals, which makes things much easier. Your best option of all for a gear motor for use with the Crumble is, not surprisingly, made and sold by Redfern Electronics. The creators of the Crumble sell gear motors with crocodile leads attached, so connecting them is an absolute breeze.

go to the Input/Output palette and get a 'motor 1 FORWARD at 75%' block. This block will set your motor running and 75% is a good speed to start at. If your DC motor is a 3v motor, then anything over that level will be giving it a higher voltage than the motor was intended to take.

If you ran this code as it is, the motor would start but there is no code to tell it to stop! If the motor is sitting on a table with a wheel attached, there's a good chance that it will wrap itself up in a tangle with its own wire. Add a short

going to be making the same thing? A variation of the same? Or perhaps each person can make something completely different?

There is always a robot buggy to be made using two gear motors, but there are so many possibilities to explore! How about a helicopter? A lifting bridge mechanism using the motor as a winch? A boat with rotating oars? Or a motorised toy with a cam and follower mechanism?

"What do you want your motor to do?" can be a powerful question

■ There is life beyond the humble robot buggy.



that opens up countless possibilities and gives agency to learners. Giving children some time and space to fail and explore will help in learning valuable lessons that teachers cannot give.

Cam and follower mechanism

To start making a cam and follower toy, use a recycled box or make your own base from cardboard, wood or anything else to hand. Stick your gear motor to the base so that the rotating shaft is roughly ▶

Time to get moving!

You're connected and powered up, so now it's time to add our first gear motor. Whatever gear motor you use, you'll be connecting from the motor's two terminals to the Crumble board's motor 1 terminals, located in the bottom left corner. It makes sense to connect positive to positive, but if using a motor without wires already attached and you cannot tell which motor terminal is positive, then don't worry. If you connect positive to negative, in this case the motor will simply turn the opposite way.

With a motor connected, let's write some code to get moving. With the Crumble software open, drag out a program Start block from the Basic block palette. This is the block that starts all Crumble code. Now

pause, something like 'wait 300 milliseconds', and then 'motor 1 STOP'. Click the 'FORWARD' window in the motor control box to toggle between forward, reverse, and stop.

Click the green play triangle in the Crumble software window and see your motor move for a moment. Play around with the wait time and run your code again. Do the same with the speed percentage, and change forward to reverse. Remember to always end by turning the motor off.

Motor's running... what now?

It's good to see the motor running and how the code changes the movement before you start your build, but now it's time to think about what to make with it. If you are working in a group, is everyone

FURTHER READING

Redfern Electronics, the makers of Crumble controllers, has a website with project ideas and a downloadable 'getting started' guide: redfernelectronics.co.uk

Phil Bagge has produced a range of resources for the Crumble, and has even published a Crumble Creations book full of Crumble STEM projects to get stuck into: code-it.co.uk/csplanning.html.

» halfway up the side. The motor could be inside or outside the box, as long as the shaft is exposed to the inside. Hot melt glue is perfect for this job.

Stick a dowel through the opposite side (with a cam already on the dowel, but not yet fixed in place) and glue it to the end of the gear motor rotating shaft. I found that having a short length of straw to slide over the join with a bit of glue was great for getting a strong joint.

Stick a second dowel through the top of the base box and fix the

'follower' wheel on the inside. The example here uses a standard MDF wheel, but you could easily make one out of stiff cardboard. Once the follower is in place, fix the cam in a good position in contact with the follower, to the side but not too close to the edge.

Building another level on top of the base for the vertical dowel to run through stops the dowel from flopping around and putting a large stress on the cam. This is particularly important when you're using a cardboard cam and follower.

Finally, make whatever you want

to go on top to be moving around and fix it to the vertical dowel. I made a little white fish from some old packing foam.

Swim, fishy, swim!

The test code we made earlier will only make your toy twitch. Change the wait time and run your code to let it move properly. Now, add another short wait after the 'motor 1 STOP' and put all that code in a 'do 10 times' repeat loop. Execute your code.

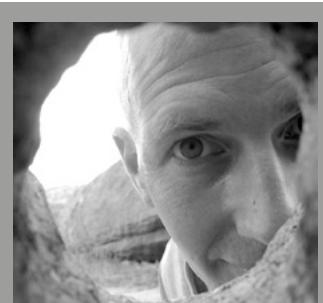
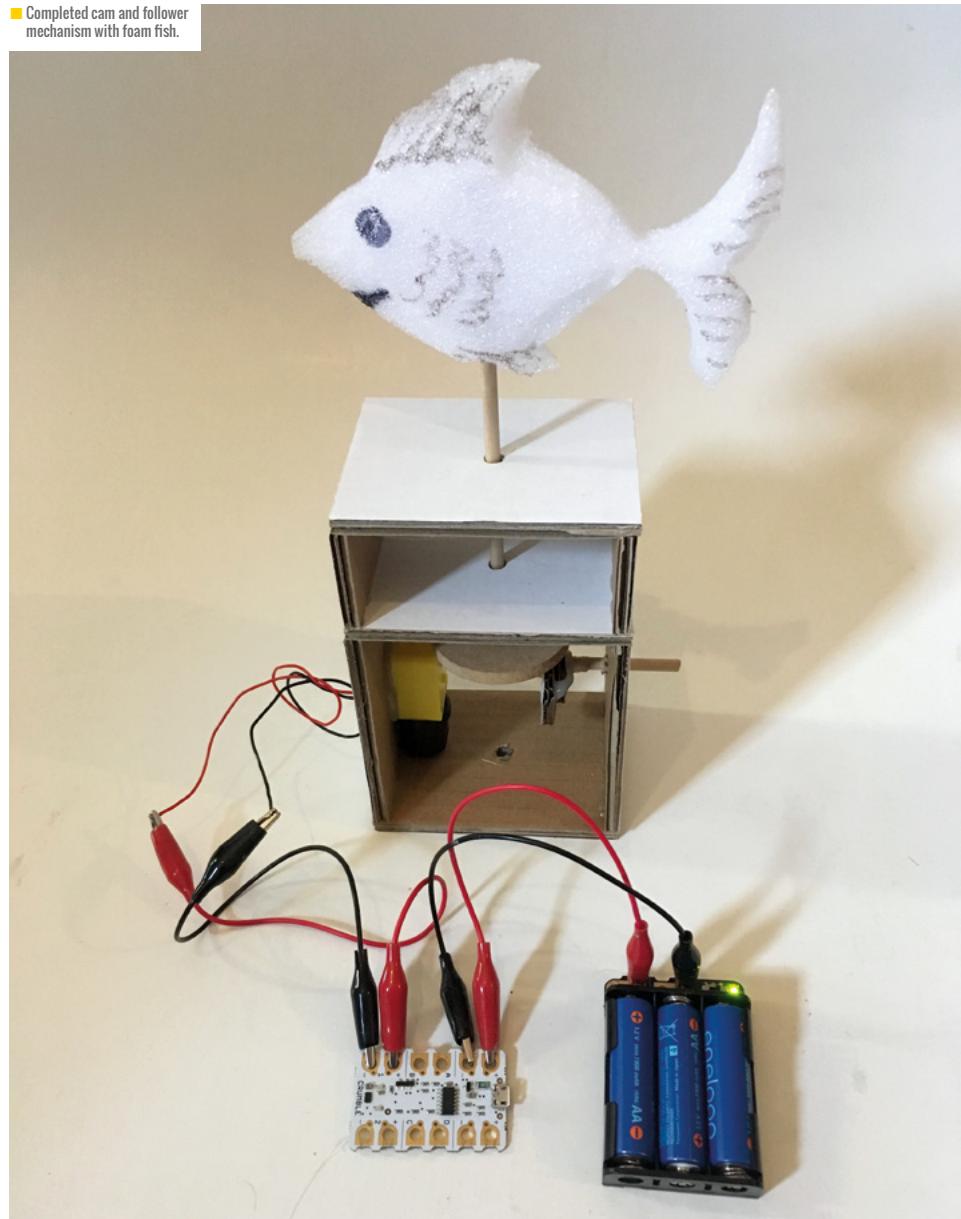
Let's change up the direction a little. Right-click on the top motor control block and click duplicate. This will copy all four blocks inside the 'do 10 times' loop. Place the duplicated blocks under your existing code but still inside the repeat loop. Run your code again to see your toy go backwards and forwards.

Random movement

The code we have just written works great as a starting point but adding a little randomisation usually helps make things a little more lifelike. You can try randomising as little or as much as works best for your project.

Starting with our previous code, grab a 'random 0 to 10' block from the Operators palette. Change the values to 50 and 100 and place it in

Completed cam and follower mechanism with foam fish.



PABLO JOYCE

Primary computing, STEAM, and outdoor learning teacher at The Devonshire Hill Primary School, RPi Educator, and compulsive maker.

Twitter: @pablisch

program start

do 3 times

```
motor 1 FORWARD at 75 %
wait 1000 milliseconds
motor 1 STOP
wait 300 milliseconds
motor 1 REVERSE at 75 %
wait 1000 milliseconds
motor 1 STOP
wait 300 milliseconds
```

loop

■ This code will make your toy turn forwards and backwards three times.

the speed value box of the forward motor block so that it reads 'motor 1 FORWARD at random 50 to 100 %'. Duplicate the random block and place it in the reverse motor block. Run your code and see how the speed will vary each time.

Duplicate the random block four times and place them in the 'wait blocks' delay field. Change the ranges to suitable amounts, e.g. 700 to 1500 for after moving, and 200 to 500 for after a stop. You can choose your own amounts, run your code and play around with them.

Can you think of a way to randomise which direction the motor will turn in?

Acceleration and deceleration

Next, you're going to put together a variable to make the motor gradually speed up and slow down. Add a new variable and name it 'speed'. Add a line of code before the 'repeat loop let speed = 25'. Throw most of the existing code in the repeat loop away leaving only the first move and wait block. Add a speed variable block to set the 'move speed motor 1 FORWARD at speed %'. Change the wait time to 100 milliseconds and then add the line increase speed by 1. This last line will add 1 to the speed variable each time the loop repeats. You want speed to start at 25 and go

up to 100 so change the number of repeats to do 75 times.

Almost there. Now duplicate that whole repeat loop and change the motor direction to reverse. You want speed to go from 100 to 25, so replace the increase speed block with one that says 'decrease speed by 1'. Lastly, below both repeat loops, finish with 'motor 1 STOP'.

You can increase or decrease the rate of acceleration by changing the amount speed increases or decreases each time, or by changing the wait time. If you change the increase rate, make sure you also change the number of loop repeats, e.g. 75 repeats of +1 is the same as 25 repeats of +3, is the same as 15 repeats of +5, etc.

Can you think of how to make the acceleration and deceleration a bit more random and erratic?

Weird fish, and what comes next...

The cam and follower Crumble project has a huge amount of room for variation and creativity in code, design, and construction. My next step was to add flapping wings to my fish!

Of course, you don't need to start with a cam and follower. What would you use your motor for?

You can also explore other Crumble project with resources at bit.ly/34HdNBh. Enjoy! (HW)

program start

do 3 times

```
motor 1 FORWARD at random 50 to 100 %
wait random 700 to 1500 milliseconds
motor 1 STOP
wait random 200 to 500 milliseconds
motor 1 REVERSE at random 50 to 100 %
wait random 700 to 1500 milliseconds
motor 1 STOP
wait random 200 to 500 milliseconds
```

loop

■ This code will make your toy turn at random times and random speeds.

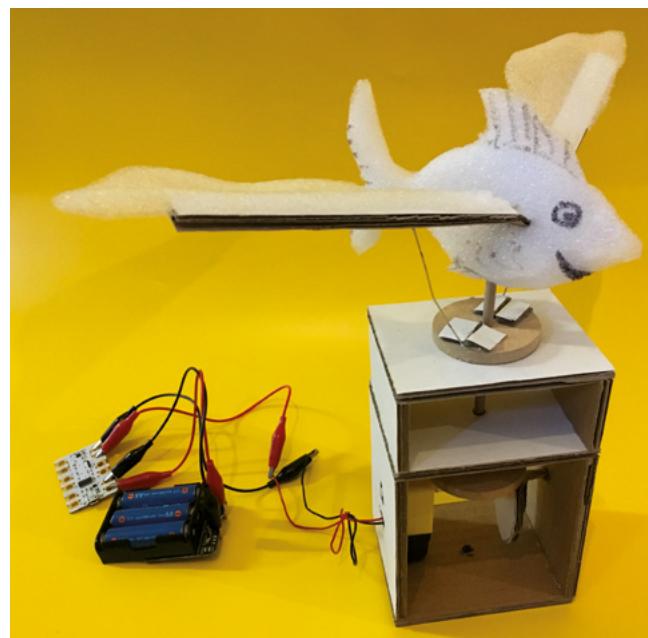
program start

let speed = 25

do 75 times

```
motor 1 FORWARD at speed %
wait 100 milliseconds
increase speed by 1
loop
do 25 times
motor 1 FORWARD at speed %
wait 100 milliseconds
decrease speed by 3
loop
motor 1 STOP
```

■ This code will make your toy turn speed up and then slow down.



AGE RANGE

11-13

LESSON TYPE

- Text-based programming

REQUIREMENTS

- P5.js Javascript library
- P5.js Web Editor

TEXTURING 3D SHAPES WITH 2D GRAPHICS

Using p5.js, explore the idea of combining 2D and 3D to create amazing artwork, and bring it to life by infusing it with the power of interactivity

P 5.js has its origin in Java-based processing which has been around for 20 years. As such, there are many learning resources, and a thriving community which develops, shares, and appreciates each other's work. It's a beginner-friendly, text-based programming

library, and a perfect tool for children and beginners to experiment with.

I have observed, while teaching students using the p5.js library, that they get the grasp of concepts more quickly and gain a great deal of enjoyment from using it. This tutorial is one of my endeavours to

teach the basics of coding, while engaging students in creating digital art. It's a combination of 2D graphics textured on a 3D shape, while adding interactivity to the whole experience, giving learners the freedom to express their ideas and make their own patterns.

ACTIVITY 1: 2D SHAPE 10 MINUTES

Let's start by creating a new project using p5.js Web Editor. It has the following two life-cycle functions: the `setup()` function, which is called only once at the start of the program execution, and the `draw()` function, which is called repeatedly, clearing the canvas every time.

Create your first circle by using an `ellipse` function, which takes four parameters x-axis, y-axis, width, and height. Give some properties to the ellipse.

```
noFill()
stroke(255,0,0)
strokeWeight(5)
ellipse(200 , 200 ,50 , 50)
```

Next, make the circle expand. To do this we need to control the width and height of the circle, and for that we need a global variable. A global variable is a variable which is declared outside of functions, but can be accessed from within any function. Let's put the global variable named `radius` above the functions and initialise it to 0.

```
let radius = 0
```

Then replace the width and the height in the `ellipse` with the variable `radius` and increment the value of the variable `radius` by 0.4 within the `draw()` function.

This will make the circle seem to be increasing in size until it reaches the maximum width of the canvas, and then seems to disappear. This is because the canvas gets cleared every time the

`draw()` function runs. What appears is the single circle increasing in size. It's finally disappearing simply because it's bigger than the size of the canvas.

```
radius += 0.4
ellipse(200, 200, radius, radius)
```

To make the circle reappear, use the simple check that if `radius` becomes greater than the maximum width, then reset the `radius` to 0.

```
if (radius > width){
    radius = 0
}
```

Now the circle should appear to be pulsating.

Without repeating the code, we are going to use a 'for loop' to create more circles. Here, the variable '`i`' inside the for loop is initialised to 0, the condition is set that '`i`' is less than `width-50` and update '`i`' after every 50 until the condition is met.

```
for (let i = 0 ; i < width-50 ; i += 50){
    noFill()
    stroke(255,0,0)
    strokeWeight(5)
    radius += 0.4
    ellipse(200, 200, radius, radius)
    if (radius > width){
```

ACTIVITY 1: CONTINUED

```
radius = 0  
}  
}
```

The next step is to replace the first two parameters of the ellipse (x, y, width, height) with the variable 'i' of the for loop. This will repeatedly change the x and y-coordinate of the ellipse centre. Adding an 'i' to the last two parameters, will repeatedly change the size and every new circle in the loop is 50 pixels bigger than the previous one.

```
ellipse(i, i, radius + i, radius + i)
```

You can now add your 2D shape code inside push() and pop(), which will keep your code from being affected by any other code. You should also now be able to see that multiple circles are now appearing diagonally across your canvas.

Challenge:

- Replace the stroke colour with the variables 'i' and 'radius' to make a colour combination of your own. The 2D shape rect(x,y,width,height) also takes the same parameters as the ellipse(). Try replacing it and see what will happen.

ACTIVITY 2: 3D SHAPE 10 MINUTES

Add WEBGL parameter in the createCanvas() in function setup().

```
createCanvas(400,400,WEBGL)
```

Make a 3D box(width,height,depth) inside another push() and pop(). Since in WEBGL the origin is changed to centre, both 2D and 3D shapes appear in the centre.

```
push()  
box(200,200,200)  
pop()
```

Make another global variable of angle and initialize it to

0. Inside the push() and pop() for the 3D box, increment the angle.

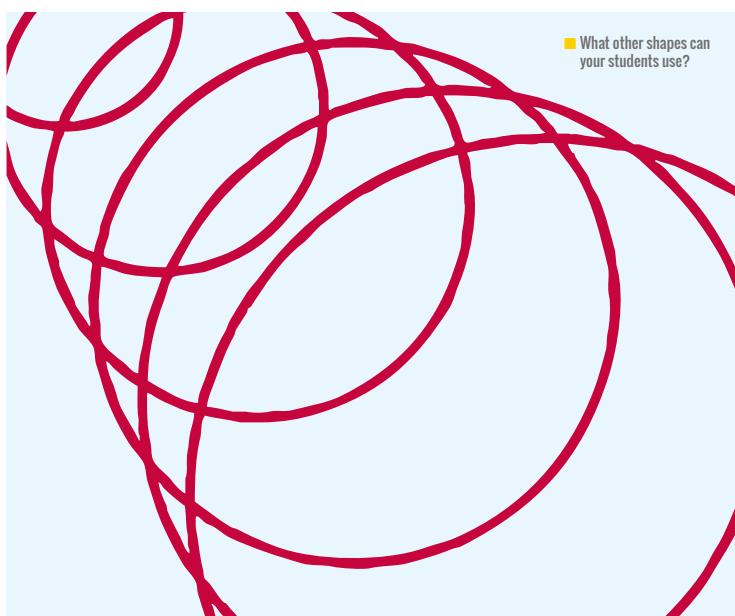
```
angle+=0.3
```

Give the angle variable inside the function rotateX() as a parameter. This will make the box rotate on the X-axis.

```
rotateX(angle)
```

Challenge:

- Try rotating it on the Y-axis and Z-axis using the same method.



What other shapes can your students use?

PERFECT FOR CHILDREN TO EXPERIMENT WITH

OBJECTIVES

- ✓ 2D Shape
- ✓ 3D Shape
- ✓ Texturing graphics
- ✓ Mouse interaction

ACTIVITY 3: TEXTURING GRAPHICS 5 MINUTES

To make the 2D appear on the 3D as its texture or wrapping, make the global variable art.

```
let art
```

Use the variable art to call the createGraphics(width, height) function within the setup() function. The width and height parameters correspond to canvas width and height.

```
art =
```

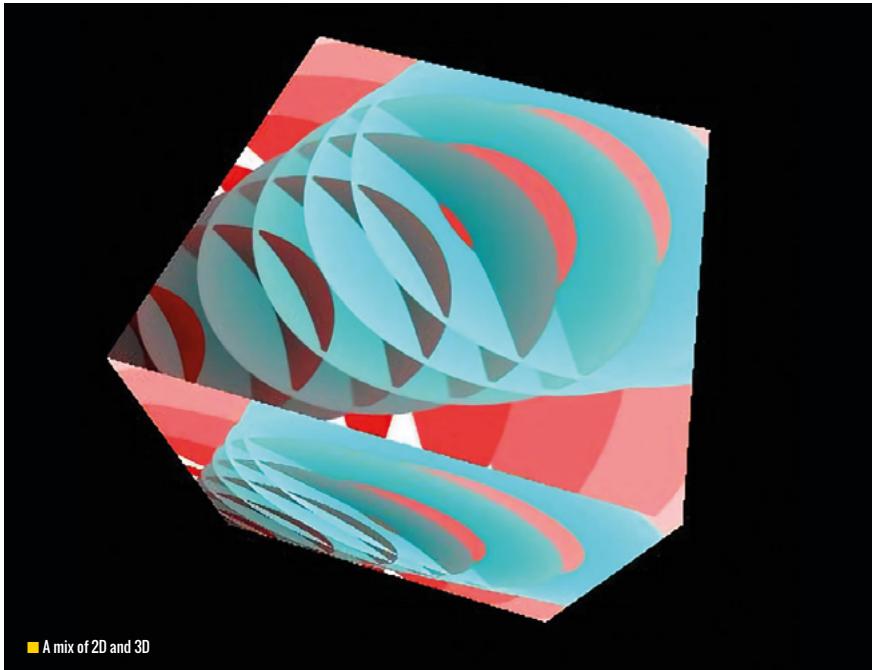
```
createGraphics(400,400)
```

Now in the 2D shape, add the variable art to ellipse() and each of the properties of ellipse, in this manner.

```
art . noFill()
```

Finally, within the 3D shape add the variable art to the texture() of the box.

```
texture(art)
```



A mix of 2D and 3D

ACTIVITY 4: MAKE IT INTERACTIVE 2 MINUTES

Try adding mouseX in the stroke() of the 2D shape.

Now as you move your mouse across the shape horizontally along the x-axis, the colours will start to change.

```
art . stroke(radius, i +  
mouseX , i)
```

Challenges:

- Try adding the mouseY in one or all the parameters of the stroke().
- Also try adding the mouseX or mouseY in the 3D box as a parameter.



NAZIA FAKHRUDDIN

NZ@NZAmbience is Royal Institution Computer Science Masterclass Speaker and Code Club UK Volunteer for the past six years in the local Library in London Borough of Hounslow. Author of the book *Superfun P5.js Projects*, and free learning resource contributor on bytesizecoding.com, and digital magazine *Medium*.

ASSESSMENT

- Ask the pupil why the ripple effect is appearing.
- Can they use some other 2D shapes and loop them?
- What is the importance of global variables?

RESOURCES

p5.js Reference - p5js.org/reference

ByteSizeCoding Tutorials - bytesizecoding.com

DIFFERENTIATION

Support:

Get students to draw different 2D shapes, for instance a rectangle, square, ellipse etc. Add the mouseX or mouseY in one of their parameters. Give stroke() and fill() colour.

Stretch and Challenge:

Can students make a global variable and increment to use in the 2D shape? Use the variable in the fill or stroke.

AGE RANGE

11-13

LESSON TYPE

- Text-based programming
- Physical computing
- Project-based learning in science and geography

REQUIREMENTS

- Raspberry Pi 3
- Sense HAT emulator on Trinket
- Sense HAT or Sense HAT emulator

CRASH-LANDING - PART TWO

Help navigate around the jungle using a Raspberry Pi and Python

These activities can be used in both computer science lessons or in a cross-curricular science project. The activities will give students opportunities to take real-world measurements with the Sense HAT.

Activity 1: takes measurements and compares them to real-world values of air pressure to predict the weather.

Activity 2: takes compass measurements from the Sense HAT and is used to build a basic compass and then a more complicated one.

THE ACTIVITIES WILL GIVE STUDENTS OPPORTUNITIES TO TAKE REAL-WORLD MEASUREMENTS



SPENCER ORGAN

Physics and KS3 computer science teacher from the West Midlands. Certified Raspberry Pi educator with a passion for developing cross-curricular approaches to computer science in schools with no CS teachers. NCCE GCSE subject knowledge certificate. [@makercupboard](https://twitter.com/makercupboard)



ACTIVITY 1: IMPROVING THE BAROMETER FROM PART 1 25 MINUTES

In the first part of this guide (Hello World, issue 10), we made a very simple barometer that used the pressure measurement on the Sense HAT to make a simple prediction about the weather. In this activity we will improve the accuracy of our barometer. Don't worry if you didn't do part 1 – you can dive straight in here.

If you don't have access to a Sense HAT you can use the Sense HAT emulator on the Raspberry Pi. You can also use the Trinket Sense HAT emulator here: trinket.io/sense-hat.

If you are using the physical Sense HAT on a Raspberry Pi or with Trinket, start the code with:

```
from sense_hat import SenseHat
```

If you are using the Sense HAT emulator, you will need to start the code with:

```
from sense_emu import SenseHat
```

We learnt in the first lesson plan that measurements of the pressure can be easily obtained using:

```
sense = SenseHat()
pressure = sense.get_pressure()
print (pressure)
```

The Sense HAT can measure a wide range of pressures and we are only interested in a small range of pressures when looking at the weather.

970 - 990	990 - 1000	1000 - 1020	1020 - 1030	1030 above
Stormy	Rain	Normal	Fair	Very dry

We can now use if ... statements to look at the pressure.

```
if pressure >=970 and pressure <991:
    print ("Stormy weather")
```

This can be repeated for each range of pressures.

```
if pressure >=970 and pressure <991:
    print ("Stormy weather")
if pressure >=991 and pressure <1000:
    print ("Rain on the way")
if pressure >=1000 and pressure <1020:
    print ("Normal")
if pressure >=1020 and pressure <=1031:
    print ("Fair")
if pressure >=1031 and pressure <=1060.9:
    print ("Very dry")
```

Putting this together, you now have a simple barometer which can be used to tell you the current weather. If we now add a loop, we can monitor the pressure over a period of time.

```
from sense_hat import SenseHat
from time import sleep
sense = SenseHat()
while True:
    pressure = sense.get_pressure()
    if pressure >=970 and pressure <991:
        print ("Stormy weather")
    if pressure >=991 and pressure <1000:
        print ("Rain on the way")
    if pressure >=1000 and pressure <1020:
        print ("Normal")
    if pressure >=1020 and pressure <=1031:
        print ("Fair")
    if pressure >=1031 and pressure <=1060.9:
        print ("Very dry")
    sleep(60)
```

Code the Sense HAT in Your Browser!

New from Trinket and the Raspberry Pi Foundation: Explore Your World with Sensors and Python

The screenshot shows the Trinket web-based Python editor interface. The code editor contains a script named 'main.py' with the following content:

```
# Import Sense HAT
import sense_hat
# Set up the Sense HAT
sense = SenseHat()
# Print a message
print("Hello World!")
# Get the current pressure
pressure = sense.get_pressure()
# Print the pressure
print(pressure)
```

Below the code editor is a preview window showing the Sense HAT board with its various components like LEDs and sensors. At the bottom of the page, there are links to other examples: Sensors!, Rock Paper Pi, Flappy HAT, and Astro Bug.

Programming the Sense HAT

OBJECTIVES

- ✓ To be able to take real-world measurements using the Sense HAT
- ✓ To be able to present data in a useful way
- ✓ To be able to analyse data to make predictions

ACTIVITY 2: FINDING NORTH 30 MINUTES

Now we are able to predict the weather, it is time to try and find our way around the island. We can use a chip on the Sense HAT called the IMU (inertial measurement unit). This has three sensors: a gyroscope, an accelerometer, and a magnetometer (a compass).

Start a new file.

```
from sense_hat import SenseHat  
from time import sleep  
sense=SenseHat()
```

Don't forget to change `sense_hat` to `sense_emu` if you are using the emulator.

In the last project, we took pressure measurements; this time, we are going to collect data from the magnetometer sensor by using the `sense.get_compass()` function.

```
bearing = sense.get_compass()  
print (bearing)
```

When we run this function it will return the value of your bearing. This is the angle you are facing away from magnetic north.

If you are using the Sense HAT emulator, try rotating the angle of the Sense HAT and running the code again.

If using the physical Sense HAT, try moving it to different positions and running the code again.

If you are using the physical Sense HAT, you may want to calibrate the magnetometer to make sure your results are accurate.

Are we facing north?

We want to know when we are facing north, so by using an if... statement we can change the display colour when we are facing the correct direction.

```
while True:  
    bearing = sense.get_compass()  
    print (bearing)  
    if bearing >= 355 or bearing <=5:  
        sense.clear(0,255,0)  
    else:  
        sense.clear(255,0,0)
```

Improving our compass

We can refine the compass to give us accurate directions by using if-then statements to compare the measured angle with the compass bearings. With the precision of the Sense HAT, it is unlikely that we will get the compass spot-on to the true value, so we should use a range that's a little either side of the true value. [\(HW\)](#)

```
while True:  
    bearing = sense.get_compass()  
    if bearing >= 355 or bearing <=5:  
        print ("N")  
    if bearing >=40 and bearing <=50:  
        print ("NE")  
    if bearing >=85 and bearing <=95:  
        print ("E")  
    if bearing >=130 and bearing <=140:  
        print ("SE")  
    if bearing >=175 and bearing <=185:  
        print ("S")  
    if bearing >=220 and bearing <=230:  
        print ("SW")  
    if bearing >=265 and bearing <=275:  
        print ("W")  
    if bearing >=310 and bearing <=320:  
        print ("NW")
```

N	NE	E	SE	S	SW	W	NW
0	45	90	135	180	225	270	315
355 - 5	40 - 50	85 - 95	130 - 140	175 - 185	220 - 230	265 - 275	310 - 320

HOW TO CALIBRATE THE MAGNETOMETER

Download the required files...

```
sudo apt-get install octave  
cd  
cp /usr/share/librtimulib-utils/  
RTEllipsoidFit ./ -a  
cd RTEllipsoidFit
```

Now run the calibration software, following the instructions on the screen.

RTIMULibCal

Finally, copy the generated file and remove the local copy.

```
rm ~/.config/sense_hat/RTIMULib.  
ini  
sudo cp RTIMULib.ini /etc
```

ASSESSMENT

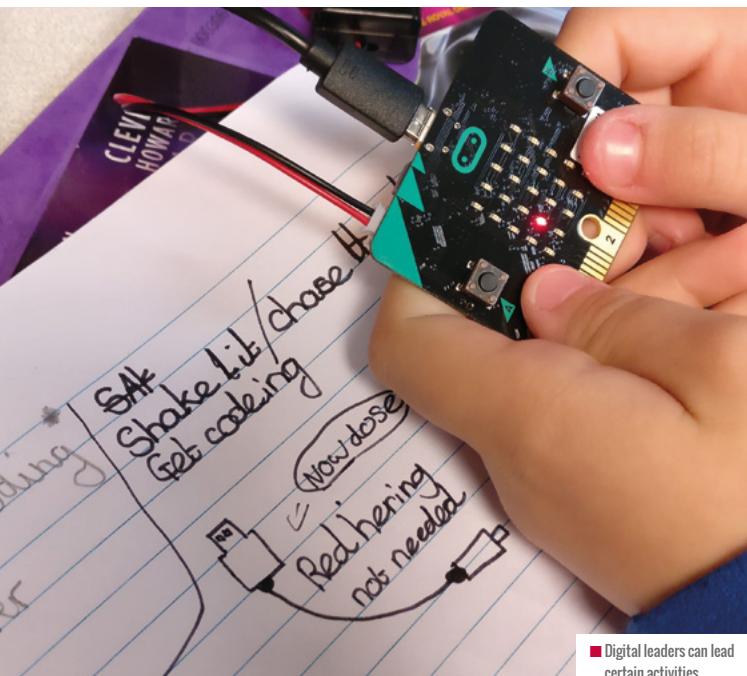
Imagine you want to head in a certain direction across the island. How would you change the code to measure the direction you are going, and then to change the colour of the display when you are heading in the correct direction?

MAKE DIGITAL LEADERS WORK FOR YOU

Having a suitably qualified team of digital leaders in your school can help lighten the workload of computing teachers. In the first part of this guide, **Alan O'Donohoe** of exa.foundation describes how DLs can reduce some problems teachers encounter – and suggests examples and tips for recruiting, rewarding, and training

Defining precisely what a digital leader does is not easy, since it varies from school to school and by individual. In simple terms, digital leaders are learners who have been assigned additional roles and responsibility to develop and maintain the school's digital resources, content, and environment. This may extend to include providing curriculum support to other users or leading extra-curricular activities such as clubs.

Although there are some commercial DL packages available, those are outside the remit of this guide. Some schools say they've looked into digital leaders but the costs of the commercial schemes are prohibitive. Instead, this guide describes a DIY approach to setting up a programme in your school at zero cost.



A DIY digital leaders scheme involves initially recruiting ideal candidates for the role, perhaps through some interview-style tasks, and a training programme that may include some rudimentary maintenance like troubleshooting printers, clearing paper jams, and tidying tasks. As they develop confidence, they may suggest activities they can lead, including clubs. Some schools aim to have at least one DL in every class to provide some teacher assistance when required.

Why do you even need digital leaders?

Before deciding to embark upon any exciting new initiative or programme, it's always prudent to pause and ask: "Why? Why are we doing this? Why do we even need this?" If you have a really compelling answer to the 'why?' question, every challenge or obstacle that follows is surmountable. If you can't easily answer the question, then maybe you don't need DLs, or haven't yet recognised what the advantages are in having them.

In one school I taught at, a pupil named Anthony with an interest in computing had developed a massive amount of knowledge and experience in networking and network security outside of school, through following online courses. It was a constant source of frustration for Anthony that he was placed in a lower set due to his English grades. To compound matters for him, his computing lessons were led by a non-specialist teacher who didn't acknowledge Anthony's interest or expertise; not knowing how to see this as an opportunity, the teacher instead saw Anthony as a persistent nuisance. Out of boredom, Anthony sought to exploit weaknesses in network security and tried to win friends by informing other students how they could circumvent various restrictions in place. This escalated to a point where Anthony and his group of 'hackers' faced permanent exclusion from the school.

There is a happy ending to this tale, since Anthony eventually realised that he could earn more respect by working alongside the network administration team in the school, by advising them of



potential loopholes. Taking it further, a junior technician had an interest in Linux servers and together with Anthony they were able to offer lunchtime activities to others on a sandbox network. Anthony later went on to further study in computer science, and I hope that he is now enjoying a successful career as a cyber security consultant.

While we would hope that Anthony's story is more the exception than the norm, I regularly hear tales of schools suffering DDoS attacks orchestrated intentionally by their own students seeking revenge or just to see what happens when they do. Having a digital leaders programme won't guarantee your school immunity from a DDoS, but it will go a long way towards providing a more positive outlet for those students who might be tempted otherwise.

When you are too busy

If you're reading this article thinking "it sounds marvellous to have digital leaders, but the reality is we're just too busy," you may very well be right. Sometimes in life, people find themselves too busy to fix that leak that later develops into a flood, or too busy to refuel the tank of the car that eventually runs out of fuel on the motorway. Even if you start with some small steps, you've already started on the journey towards making your teaching workload a little more manageable.

Maybe establishing a digital leader programme appears to be a luxury you can't afford, but by recruiting the best candidates as DLs and having in place a programme of training and activities for them, it has real potential to make life easier for you and your colleagues in your school, reducing workload and providing additional learning experiences. Besides, who says the computing teacher has to be the one to lead the programme? It might be led by a network manager or technician under guidance from a teacher.



ALAN O'DONOHUE

Alan (@teknoteacher) has more than 20 years' experience teaching and leading technology, ICT, and computing in schools in England. He runs exafoundation.org, delivering professional development to engage digital makers, supporting the teaching of computing, and promoting the appropriate use of technology.



■ Can young learners help other young learners?

► I started this guide by explaining that the concept of 'digital leaders' means different things to different people. In some primary schools, digital leaders are managed by classroom assistants; in some secondary schools, they work very closely with the school's network team. Opinions are mixed, so your mileage may vary. Some teachers say they have made a massive impact in their schools, particularly in terms of supporting other teachers. However, there are some teachers who say that despite trying a few times it just hasn't worked for them.

There have been instances where having DLs has not worked well – this could be down to selecting unsuitable candidates, the wrong year group, or not being clear enough in your expectations of them. A few thoughts and ideas, then.

Recruitment and retention

Get DLs to assist with interviewing, appointing, and training the next generation of DLs.

Daily DL activities

- Make sure they can use hardware such as interactive whiteboards, BeeBots and visualisers. Make sure they are competent in the main software used in school. Provide them with training in new technology as it comes into the school.
- Keep technology spaces clean, tidy and serviced. Report broken or malfunctioning equipment.
- Offer homework help or help out at a lunch club.
- Write instructions for different pieces of software or apps.

Rewards and recognition

Some teachers have organised reward trips specifically for their DLs. Martin Bailey planned a trip to Bett Show; Lara Lowe organised a DL trip to Raspberry Pi HQ in Cambridge; and Julie Shaw recommends taking them to an Apple store if they have one near you – they do great workshops for free (she has taken her digital leaders to the Apple Store in Liverpool).

Some case studies

- Anne Marggraf-Turley's Repair Café – a group of students run a Friday lunchtime helpdesk facility, where staff and students can bring in devices from home that need repairs.
- Lara Lowe's DLs established a Raspberry Pi club called 'Mary Mags Pi Club'. They maintained a blog charting their progress and adventures, and organised a huge Saturday festival at their school called 'Makersphere'.

" SOME TEACHERS SAY DIGITAL LEADERS HAVE MADE A MASSIVE IMPACT IN THEIR SCHOOLS "

Suggestions from computing teachers

Nikie Arthurs: A really good use of digital leaders in school involved them helping to create interactive wall and corridor displays, and involving them too at open evenings and GCSE option talks. They loved helping to set up the digital challenge competitions and prizes, and also working on changing the homework policy to be more fun. My personal favourite was working with the University of the Third Age; we travelled to a CLC once a week and led community project work. It was really great seeing old people's opinions changing of the local teenagers when they were helping them set up Skype and internet shopping.

Steve Hewlett: Use DLs as content managers for school websites.

Teresa Boag: Get DLs to write 'how to' support guides for younger learners.

Sway Grantham: DLs can check/repair resources, compare software, create WAGOLL (What A Good One Looks Like), lead assemblies, offer tech support in lessons, train staff, and lead clubs.

Vikki Hawkins: Our DLs are brilliant. They learn how to use apps so they can support in class, make resources, lead online safety assemblies, provide technical support, help with the physical bits of new iPads (unboxing, labelling, putting cases on), and create the school news. It's been a very popular initiative with other staff.

Jessica Rose: Our DLs take photos in assemblies to share on social media and school newsletter

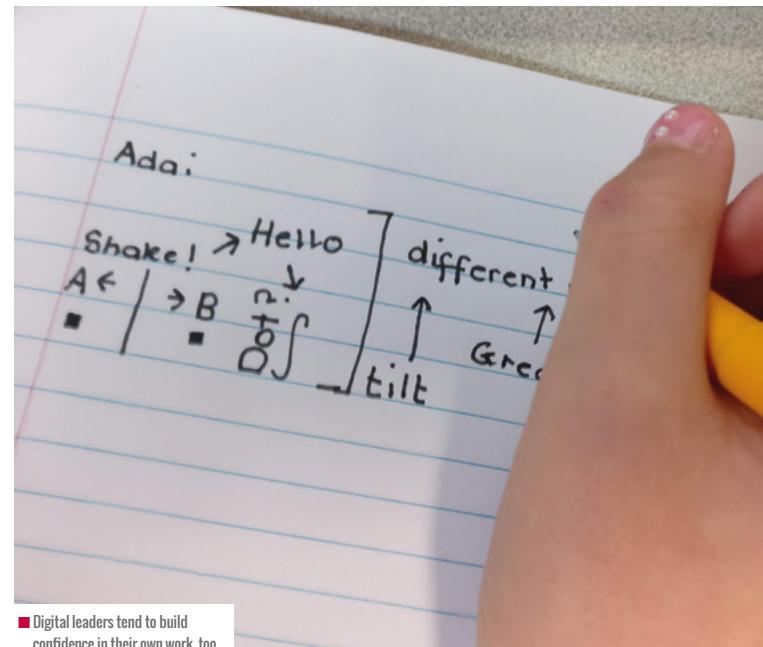
Katie Vanderpere-Brown: This year, I'm exploring joining a DL role with existing systems that work using dedicated teacher time and a paid TLR. I hope we will make digital leaders a subset of our vibrant student voice and student leadership team. The students are led by a TLR holder; the kids are keen and confident in that group and there are already structures around communication and meetings in place to communicate with all students, but also to get feedback from them in what they're interested in knowing about.

Brett Laniosh: Brett cited an example of a Worcestershire secondary school he worked with, which used its digital leaders working alongside the curriculum leader for computing and an external supplier to review a range of hardware. It was a very valuable and worthwhile activity.

Sarah Zaman: Meetings involving DLs seem to be more popular. I would keep my DLs after school doing some of the latest projects and then ask local teachers to bring their own digital leaders to join in some of the activities. The teachers could speak to the children, see new ideas in action, and chat to other teachers.

FURTHER READING

- Hello World, issue 2: Sway Grantham's 'Children teaching children (and teachers)', page 68.
- Mary Mags Pi Club: marymagspiclub.wordpress.com
- Louise Stone - having worked out a list of all the things we wanted to do, we signed our agreement to show our commitment to the role rrisdigitalleaders.primaryblogger.co.uk/digital-helpers/signing-our-job-agreement-rris-3
- Article in Headteacher Update: headteacher-update.com/best-practice-article/what-are-digital-leaders/82465
- Chris Sharples has written a very comprehensive guide here: gr3computing.com/dlroadmap, and also a few blog posts tagged DL: gr3computing.com/category/digital-leaders
- Enamel badges, for those who don't want to design and make their own: schoolbadgesuk.co.uk/products/digital-leader-shield-badge
- Pixel badges: schoolstickers.com/en-gb/digital-leader-pixel-lapel
- Government Digital Services - set out what they think makes a good digital leader. Not intended for school use, but serves to show how the role is relevant to work in government and industry: gds.blog.gov.uk/2018/06/21/what-makes-someone-a-good-digital-leader
- Digital leaders Facebook group, with strong emphasis on online safety: facebook.com/groups/PDLNUK
- Digital classrooms: digitalclassrooms.co.uk/using-primary-aged-digital-leaders
- Martin Bailey blogpost: animate2educate.co.uk/web/bett_show_blog_day_4/262091



Claire Buckler: We have a digital leader programme that gives students real useable skills for real situations. The majority of them are not taking GCSE CS.

Ceri Cook: Our digital leaders look after equipment, make sure it's all put back in the right place, and leave stern posters when it isn't. They troubleshoot any problems, ready to pass on to our tech people. They 'train' children and staff in apps etc, such as younger children wanting to use the green screen. I dithered for ages about setting them up, I really thought it would be a hassle but I was wrong; I have a mix of Year 5 and 6 so each time a year group leaves there are already established digital leaders in place. They are really on the ball now – they even stood up in assembly last week and explained how to look after the equipment.

Martin Bailey: This year, my DLs will be presenting in one of the Bett arenas alongside me. I think pupils have a lot to offer to events like Bett.

Dee Chamberlain: We use ours to support the younger children when they are learning to log on to our server. They work with them at lunch or break, and it makes a huge difference. They download photos from iPads as well as being responsible for taking them. They set up the hall computer ready for assemblies and ensure laptops and mobile technology are charged and ready for use. They also help staff and pupils by troubleshooting, making information videos so parents can see, for example, how we teach multiplying by 10 etc. Everyone appreciates them and they do a great job.

Nat Jey: I get mine to run a lunchtime club for the little ones, which they love doing – they plan all the sessions, send [relevant] letters out and take a register.

Mandy Nash: Start the digital leaders off just doing small jobs, checking on iPads, providing PowerPoint help for assemblies.

For more free and friendly advice about making the most of digital leaders, contact Alan O'Donohoe via alan@exafoundation.org or on Twitter: [@ExaFoundation](https://twitter.com/ExaFoundation). (HW)

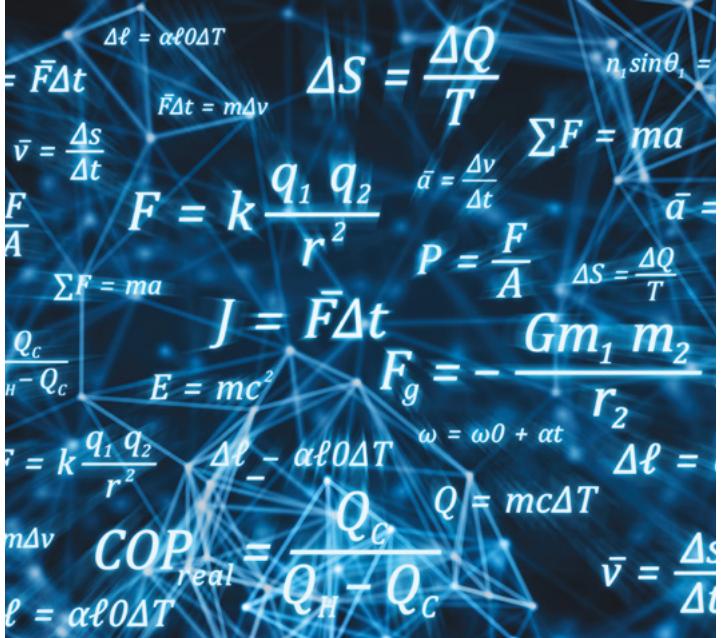
YOUR QUESTIONS

If you have a question you'd like the Learning Team at the Raspberry Pi Foundation to answer, contact us on Twitter via [@HelloWorld_Edu](#). Alternatively, email us with 'Question' in the subject line (contact@helloworld.cc).

Q HOW DO YOU ENABLE STUDENTS TO LEARN THE BOOLEAN IDENTITIES AND RULES FOR SIMPLIFYING EXPRESSIONS IN AN ENGAGING AND ACCESSIBLE WAY?

VIA TWITTER @SJHSICT

A **Laura Sach:** There is a cheat sheet page for the Boolean identities and laws on Isaac Computer Science: isaaccomputerscience.org/concepts/sys_bool_boolean_laws?topic=boolean_logic. The site contains several worked examples for simplifying equations (isaaccomputerscience.org/concepts/sys_bool_simplifying_expressions?topic=boolean_logic)



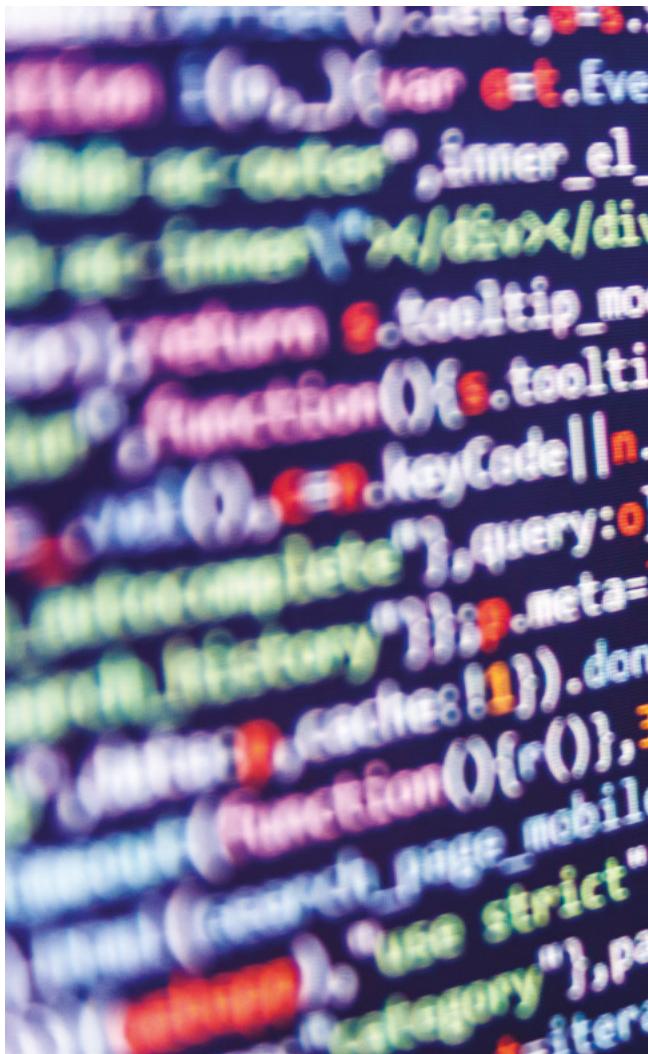
isaaccomputerscience.org/concepts/sys_bool_simplifying_expressions?topic=boolean_logic) and you can then use self-marking questions to test the applications of these rules. If students get stuck, helpful hint videos made by Craig Sargent and Dave Hillyard (craigndave.org) show them how to start off their working and give them confidence when learning how to choose which rule to apply.

Q WHY IS PSEUDOCODE SO IMPORTANT TO EXAM BOARDS?

VIA TWITTER @AMAZINGICT

A **Marc Scott:** Exam boards tend to allow teachers to choose the programming language the students will use in the classroom. For this reason, language-specific questions can't easily be included in examination questions, as different students will have used different languages. Additionally, examiners would need to be recruited with expertise in a wide range of languages, in order to be able to properly assess a student's answers. The solution is to use a generic language that can be taught to everyone, such as pseudocode or flowcharts.





Q WHAT FACTORS
USUALLY DETERMINE
THE SHIFT FROM BLOCK-
BASED TO TEXT-BASED
CODING PLATFORMS IN A
K-12 SETTING?

VIA TWITTER @SKRISH2017

A **CARRIE ANNE:** In England, it's typically the National Curriculum that dictates the transition at Key Stage 3 (between the ages of 11 and 13). Outside of curriculum confines, I find that the limitations of block-based programming often lead to frustrations that can be easily overcome with a text-based language. It can be quite tricky to get components working how you want them to when you are limited by the blocks you have, which abstract the functionality you need to access and use. I've worked with young people who want to build a project, and when I show them how to turn a motor in Python they make the switch very quickly.

Q WHAT IS THE BEST WAY TO
TEACH SORTING ALGORITHMS?

VIA TWITTER @ANGELCINDY12

A **ALLEN HEARD** I always found the best way to teach these was using playing cards (the bigger, the better) so learners can visually see what is happening and step through the algorithms slowly.

It also helps if you have a pseudocode version of the algorithm and a dry-run/trace table, potentially to keep track of positions. Examination boards often ask learners to complete sorting algorithms where they omit lines of code, or alternatively ask what the end result would be on a data set, given a specific algorithm. As such, it's really important that learners can conceptualise and visualise what's going on. Once learners understand the individual characteristics of an algorithm through a practical task they have control of, I find they're

more successful in transferring this over to a code-based problem.

MATT HOGAN: I play this clip: bit.ly/2WWTj4N and use these resources: bit.ly/2qzn7IR.

ALEX PARRY: I use the VisuAlgo website (bit.ly/32u1HdI) to demonstrate specific sorting algorithms visually with random sets of data. There are options to speed up, slow down, and pause the algorithm, which I find great for talking through certain parts or asking questions. It also has a pseudocode interpretation of each algorithm that highlights current variable values and conditions that are being checked.

Q HOW CAN YOU BRING AWARENESS TO THE CLIMATE CRISIS THROUGH COMPUTING LESSONS?

VIA SALLY BERRY (ICT AND COMPUTING TEACHERS GROUP)

A **MARC SCOTT:** It very much depends on the level of your students. For more advanced learners, a little bit of data science might be the way to go. Have a look at openclimatedata.net, which provides huge data sets related to global emissions and local plans to limit emissions. For younger learners, some of these Scratch projects might provide you with some inspiration: scratch.mit.edu/studios/490237/.

KATHARINE CHILDS: For primary-aged pupils, Scratch is a great tool to use for expressing and synthesising information about important issues. For example, if you want to cover selection as a programming construct, then an example would be creating a climate change quiz based on some facts they have learned or researched for themselves.



Q WHAT IS YOUR ADVICE FOR ANY TEACHER LOOKING TO TEACH CODING WITH THEIR CLASS FOR THE FIRST TIME?

VIA TWITTER @CASCHAT_UK

A **ALLEN HEARD:** Look out for the Programming units coming soon to the National Centre Resource Repository (teachcomputing.org/resources). As with anything, be clear about what you want to achieve, and allow lots of time for exploration. Make it relevant using real-world problems, and treat it like a superpower!

KATHARINE CHILDS: Find out if your school has a digital leaders scheme. Peer support in lessons can be great for learners. Remember that you don't have to be able to solve every problem that comes up in your class. Have a few key questions and prompts that you can use to help your learners find and fix their own problems.

YOUR LETTERS

Our letters page is a place for you to join our conversation. If you've got a comment, a question, or an announcement to share, contact us on Twitter via [@HelloWorld_Edu](#). Alternatively, email us with 'Teacher Letter' in the subject line (contact@helloworld.cc).

EARLY FOCUS

Dear Hello World,

I very much appreciated the article in issue 10 of *Hello World* magazine from Amanda Hubball and Amy Stancer that looked at establishing good practice when teaching computers to early years pupils. I've found so many good resources that have given me lots of ideas to use in my own classroom, but the emphasis tends to be on slightly older users. I'm looking to engage my class as early as possible, and I greatly appreciated their article.

Can I ask if *Hello World* can always keep an eye out for those of us teaching five and six year-olds? I'd love more articles regarding the specific challenges we face teaching computing to that age group.
K D Cooke

We're glad that you enjoyed the article, and we appreciate too Amanda and Amy taking the time to write it. To answer your question, yes: we're keen to cover more early years ideas. If anyone reading too has an idea for an article, don't forget our door is open. Email us at contact@helloworld.cc, and we look forward to hearing from you.



PROS AND CONS OF DIGITAL LEADERS

Dear Hello World,

I'm just curious, and I wanted to throw this open to your readers: how do people feel about digital leaders in their school? I can't help feeling that this is one of those ideas that ultimately becomes more trouble than it's worth, as much as I really adore the foundation principle behind it.

We've looked in my school at tasking students with becoming digital leaders, and whilst there have clearly been some benefits for a few of them, in my case the overall project became a time drain and a time strain. I found I was putting in a lot of work, for not much in the way of results. Speaking to colleagues from other schools, they've had mixed experiences too. I fully appreciate, of course, that one size doesn't fit all, and it's not an idea that's going to work with all students. But I've had a taxing few years for students, and I found that the students the leaders

were trying to help weren't bought in – despite our best efforts – and the leaders themselves struggled as a consequence.

I'd love to give such a scheme another go, but am very keen to hear a broader range of viewpoints before jumping back in.
Chris James

Thank you for your letter and thoughts, Chris. We've got a big article with lots of tips that starts back on page 88, and in that piece, Alan O'Donohue acknowledges the debate. But we're interested too in what other readers think: sometimes, is it best to leave the idea of digital leaders if a programme just isn't working? Or, are there ideas out there to make progress with a group who aren't fully bought in? As always, we're keen to hear your thoughts.

On page 6 of the last issue of *Hello World* (10), a misspelling of the National Centre for Computing Education acronym NCCE was published. We apologise for any confusion this caused and endeavour to ensure that this doesn't happen again. If you spot any errors in this, or future, issues of *Hello World*, please do let us know via contact@helloworld.cc

#GOLDILOCKS

A modern-day retelling of a classic tale: how will Goldilocks cope in a world of sharing, hashtags, and likes?

INFO

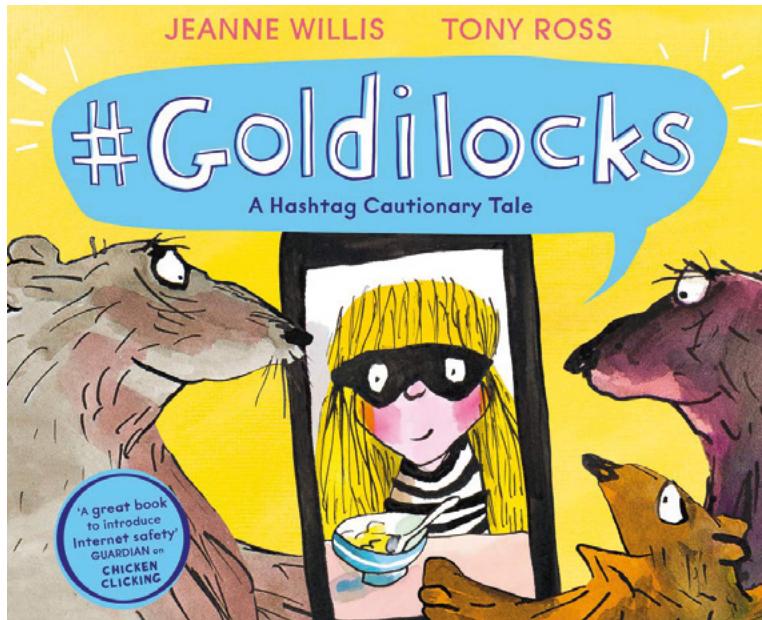
BY Jeanne Willis and Tony Ross | PUBLISHER Anderton Press Ltd | PRICE £ 6.99 | ISBN 978-1-78344-717-6 | URL andertonpress.co.uk

I have a real passion for using picture books and graphic novels across the curriculum and #Goldilocks combines so many fantastic opportunities, learning experiences, and moments for reflection on the world we live in, that it's perfect. It is a fun, modern-day retelling of the three bears classic tale, introducing us to Goldilocks who just loves to share her life online. Soon, however, she is sucked into a world of needing more and more likes to stay relevant, and this leads to her breaking into the three bears' house - I'll let you find out how that ends!

For an easy read at the end of the day, a book to recommend to parents who want to start having more relevant conversations at home, or a place to start developing a unit of work, #Goldilocks is a great resource. This rhyming picture book does not come across as condemning the use of technology, or placing judgement on those that enjoy it – instead it offers an opportunity to reflect on how technology can sometimes change our behaviour and the long-lasting consequences of those choices. All the while, the story remains upbeat and fun – not an easy feat!

What age group is it most suitable for?

One of the things I love about picture books, is how accessible they make content, whilst still being



able to cover challenging topics. The language and rhyming pattern used ensure that most confident readers over the age of 7 could read this book independently. However, I feel that the book really shines when read together. Here you can follow up on thoughts and conversations, you can discuss the choices that Goldilocks makes without pointing blame at any 'real' people, and you can share your own experiences of life online.

If I truly had to pick an age group most suited to this book, I would go for ages 10 to 14. Not because the content is difficult to understand, but because the story revolves around sharing content online, and making those choices around what

is and isn't appropriate to share, and personal experience will make a difference to how easily you relate to this. That said, even with adults, this is a great conversation starter.

In the classroom

This book is a great read, just for the fun of it, and nothing further needs to be done. However, it can also help you explore online safety content such as social media usage, sharing content, what hashtags are (and how they work with privacy settings), and the impact of a digital footprint (both positive and negative). You can also have great fun using it as a stimulus to get children writing their own modern-day fairy tales with an online safety twist. **(HW)**

TROLL STINKS

TWO BILLY GOATS SEND HORRIBLE MESSAGES TO THE TROLL, BUT THAT'S OK BECAUSE THEY'RE A TROLL, RIGHT?

INFO BY Jeanne Willis and Tony Ross | PUBLISHER Anderton Press Ltd | PRICE £6.99
ISBN 978-1-78344-569-1 | URL andertonpress.co.uk

Troll Stinks is another beautiful picture book from the same authors as #Goldilocks. This time they tackle the subject of online bullying using the traditional tale of the Billy Goats Gruff. Follow the tale as a young billy goat finds a phone, and he and his friend decide to use it to send messages to a horrible troll that they've heard someone talk about. Behind the phone they feel they are doing everyone a service, but when they meet the troll in-person, things are not as they appeared.

I enjoy reading this book with younger children (aged 7 and up), as they often go on the same journey as

the characters. Of course, it's fine to send a troll horrible messages, they're not a nice person!

The revelation that even people who may have been mean have feelings can often be profound. Adding the next step, that the person online may not be horrible at all because we don't know who is behind a screen, and this is an adventure to go on together.

A great way to start conversations about the things we say both online and offline, and a chance to challenge the next generation of keyboard warriors while they're still young. **(HW)**



CHICKEN CLICKING

WHEN THE FARMER'S AWAY, CHICKEN CLICKING COMES OUT TO...SHOP ONLINE AND MEET NEW FRIENDS - WHAT COULD POSSIBLY GO WRONG?

INFO BY Jeanne Willis and Tony Ross | PUBLISHER Anderton Press Ltd | PRICE £6.99
ISBN 978-1-78344-161-7 | URL andertonpress.co.uk

Chicken Clicking is the original online safety picture book, written by Jeanne Willis and Tony Ross. It's not centred around a traditional tale, but still takes an animal character who explores the online world. Chicken Clicking sneaks into the house to use the farmer's computer, but the ending

may not be happy!

This book can start conversations



with even our youngest learners, many of whom know you can buy things online. It shows them that, whilst there are many other things to discover online, it's important we know how to do them safely. If Chicken Clicking had told an adult, they could have enjoyed exploring the online world together.

We've had lots of fun throughout school retelling the story, from drawing pictures of what happens, to writing different endings for the choices the chicken made. **(HW)**

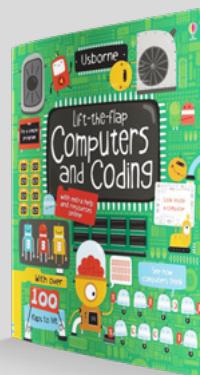
ESSENTIAL READING

Here are some other books to get primary-aged children exploring other aspects of the computing curriculum:

LIFT-THE-FLAP COMPUTERS AND CODING

BY Rosie Dickins
PUBLISHER Usborne
PRICE £9.99
ISBN 978-1-4095-9151-1
URL usborne.com

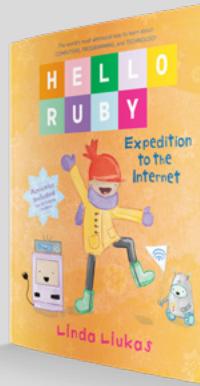
Children can explore what's inside a computer, how they work, and what computer programs are with this lift-the-flap exploration book. Great for curious minds!



HELLO RUBY - EXPEDITION TO THE INTERNET

BY Linda Liukas
PUBLISHER Feiwel and Friends
PRICE £14.99
ISBN 978-1-250-19599-9
URL us.macmillan.com/publishers/feiwel-and-friends

Find out how the internet works in this lovely and accessible story of a curious girl named Ruby. Read the story, and then have a go at the activities, making the fun last longer!



BEAT THE GAME

BY James Floyd Kelly
PUBLISHER QED Publishing
PRICE £7.99
ISBN 978-1-78171-559-8
URL quartoknows.com/QED-Publishing

For those children that are interested in programming and algorithms, use the book to complete the quest. Each answer takes you to a new page and a new challenge. Will you make it all the way through?



“HELLO, WORLD!”

Everything you need to know about our computing and digital making magazine for educators

Q WHAT IS HELLO WORLD?

A Hello World is a magazine for computing and digital making educators. Written by educators, for educators, the magazine is designed as a platform to help you find inspiration, share experiences, and learn from each other.



Q WHO MAKES HELLO WORLD?

A The magazine is a joint collaboration between its publisher, Raspberry Pi, and Computing At School (part of BCS, The Chartered Institute for IT). Hello World is supported by Oracle.

Q WHY DID WE MAKE IT?

A There's growing momentum behind the idea of putting computing and digital making at the heart of modern education, and we feel there's a need to do more to connect with and support educators inside and outside the classroom.

Q WHEN IS IT AVAILABLE?

A Your 100-page magazine is available five times per year.

IT'S FREE!

Hello World is free now and forever as a Creative Commons PDF download. You can download every issue from helloworld.cc. Visit the site to see if you're entitled to a free print edition, too.

WANT TO GET INVOLVED?

There are numerous ways for you to get involved with the magazine.

Here are just a handful of ideas to get you started:

● Give us feedback

Help us make your magazine better – your feedback is greatly appreciated.

● Ask us a question

Do you have a question or a bugbear you'd like to share? We'll feature your thoughts and ideas.

● Tell us your story

Have you had a recent success (or failure) you think the wider community would benefit from hearing about? We'd like to share it.

● Write for the magazine

Do you have an interesting article idea or lesson plan? We'd love to hear from you.

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