(Hello World)

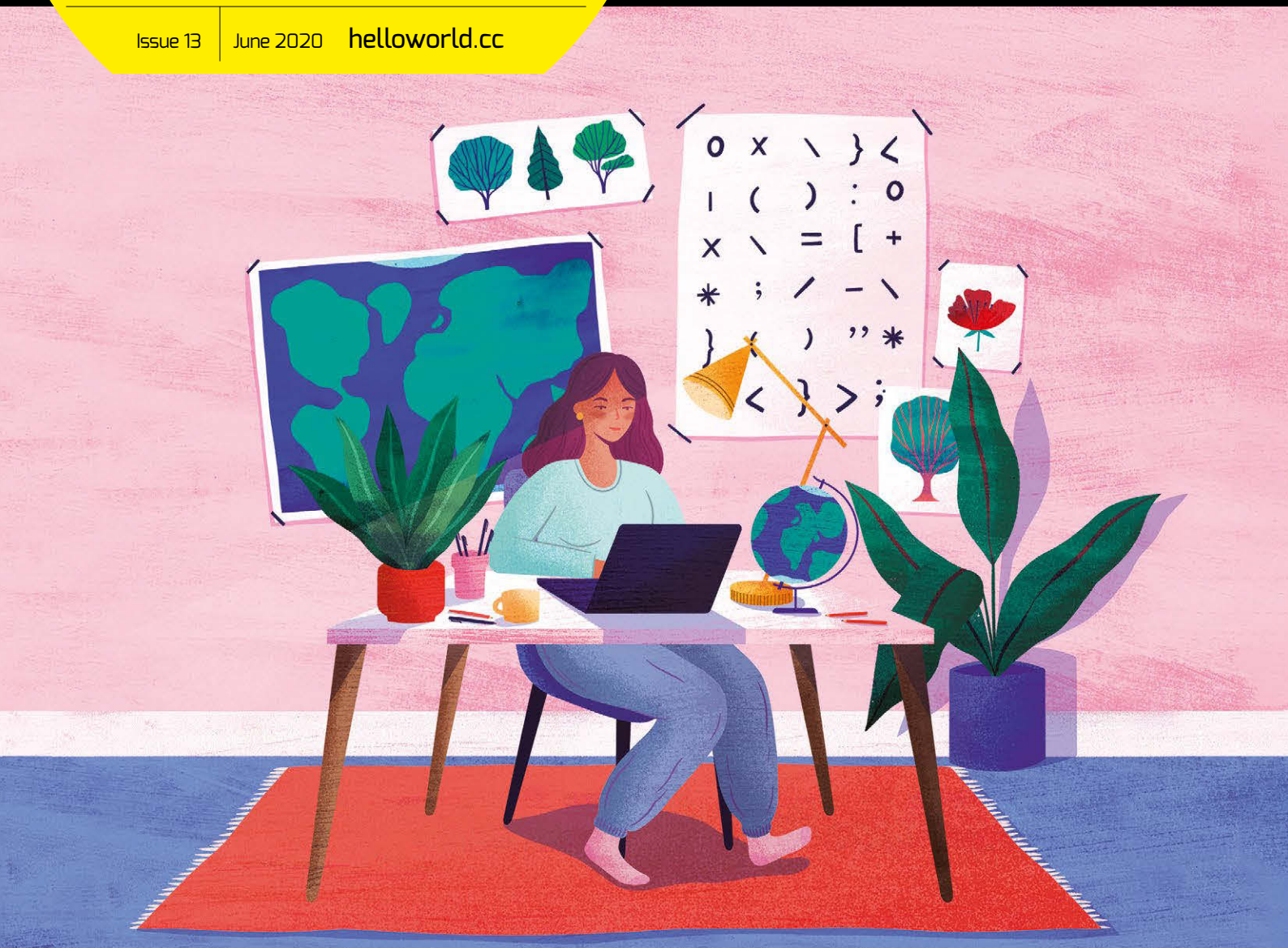
THE MAGAZINE FOR COMPUTING & DIGITAL MAKING EDUCATORS

BRITAIN'S STRICTEST HEAD
Katharine Birbalsingh on plans to reopen

RESOURCE ROUND-UP
Support to teach computing from home

SCREEN TIME
How much is too much?

Issue 13 | June 2020 helloworld.cc



LEARNING UNDER LOCKDOWN

TWENTY TEACHERS SHARE THEIR STORIES

PLUS CODE CLUBS GO ONLINE • **DEBUGGING IN SCRATCH** • COMPUTATIONAL THINKING AT PRESCHOOL • **EDUBLOCKS** **COMPUTING SEMINARS** • HACK A WINDOW • **SAFEGUARDING GUIDANCE** • COMPUTING COLOURING BOOK

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HELLO, WORLD!

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TURN TO PAGE 36

When we began planning this issue of Hello World eight weeks ago, it was unclear what life would be like for teachers and students today. Nearly every submission we received for this issue began with the words 'as I write this,' which is understandable when the world has never seemed so in flux.

In this issue, we share stories and resources that will help computing teachers in these extraordinary times. For our cover feature, we spoke to more than twenty teachers to hear about how they are working, the challenges they are facing, and any successes they could share with other teachers. It was humbling to hear such varied stories—some teachers were mostly in school, others were at home, some were teaching live lessons, others could only communicate via WhatsApp—but what shone through each interview was a consistent drive to support young people through this crisis.

Organisations and charities have been incredibly quick to provide high-quality resources to help teach computing while children are at home. My colleague, Amy O'Meara, who has helped edit this issue of Hello World, has collated many of them on page 39.

We've also got some brilliant resources directly from teachers. From Nikki Cossey's students' creative 'hack your window' games (page 84) to William Lau's computing colouring book (page 74), there's lots to get your students stuck into.

As ever, please do get in touch with feedback and ideas for features and lesson plans we can include in the magazine at **contact@helloworld.cc**. We look forward to hearing from you!

Sian Williams Page
Editor (@swilliamspage)

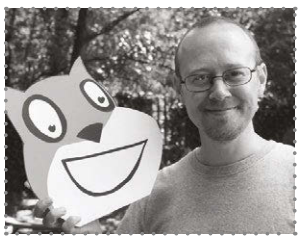
FEATURED THIS ISSUE

JOSHUA LOWE

Josh is a 16-year-old student who has spent the last four years developing EduBlocks, a program that makes the transition from Scratch to Python easier for young people around the world. He shares his story on **page 67**.

NIKKI COSSEY

Nikki is Computing Subject Leader at Thomas's Clapham, a prep school in southwest London. On **page 84** she shares a Scratch project that lets children reimagine what they see through their windows.



SEAN MCMANUS

Sean is a copywriter and author specialising in business and technology. On **page 70**, he explains some of the most common mistakes students make in Scratch, and tips to cultivate good debugging habits.

(HW)

EDITORIAL

Editor
Sian Williams Page
sian@helloworld.cc

Assistant Editor
Amy O'Meara

Subeditors
Joanna Garbutt and Louise Richmond

Subscriptions
Joshua Crossman and Thom Kunkeler

Social Media
Lizzie Jackson

DESIGN

criticalmedia.co.uk
Head of Design
Lee Allen

Designers
Harriet Knight, Sam Ribbits

Photography
Jonathan Howard, Brian O'Halloran and Fiacre Muller, Raspberry Pi Foundation, Adobe Stock Photo

Cover
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CONTRIBUTORS

Mac Bowley, Philip Colligan, Nikki Cossey, Valerie Critten, Jonathan Dickins, Diane Dowling, Catherine Elliott, Ben Garside, Paul Gerrie, Katie Gouskos, Sway Grantham, Hannah Hagon, Aimee Hainsworth, Thom Kunkeler, William Lau, Hayley Leonard, Joshua Lowe, Sean McManus, David Messer, Tilman Michaeli, Alan O'Donohoe, Amy O'Meara, Claire Penketh, Carrie Anne Philbin, Stewart Powell, Claire Rawlinson, Neil Rickus, Chris Roffey, Stefan Seegerer, Sue Sentance, Richard Smith, Victoria Temple, Jane Waite, Sian Williams Page

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Illustrations © Amy Grimes

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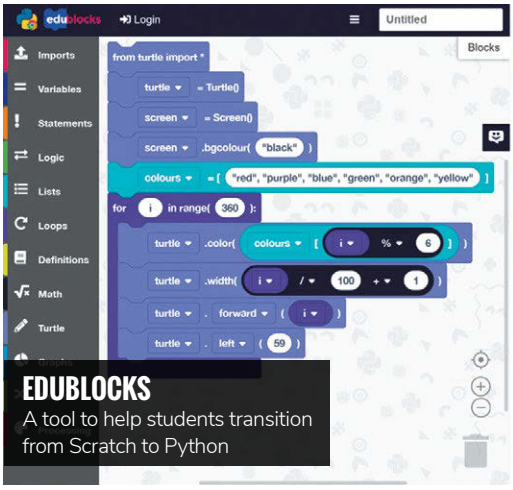
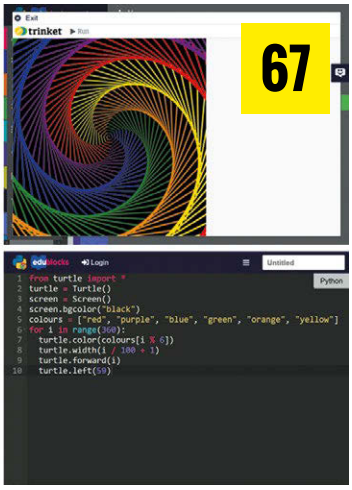


EDUBLOCKS
A tool to help students transition from Scratch to Python



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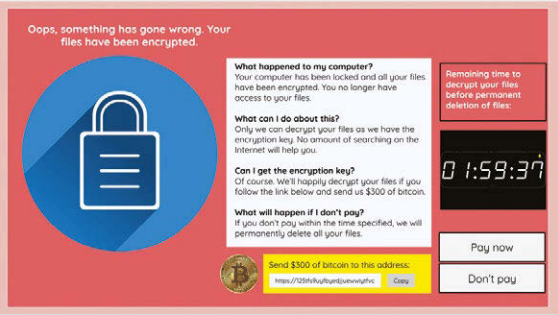


COMPUTING TEACHERS LEAD THE WAY AS SCHOOLS GO ONLINE

Computing teachers are providing invaluable support to staff and students

Claire Penketh

One of the most difficult challenges that schools have had to cope with during the coronavirus crisis has been adapting quickly to remote learning—and computing teachers have found themselves in demand, with colleagues seeking guidance in the use of technology.

For some schools, the use of online systems in lessons was already in the pipeline—but the emphasis quickly changed from something that would be nice to have, to a vital component of regular teaching during the lockdown.

Profound consequences

At William Hulme's Grammar School in Whalley Range, Manchester, the Head of Computing, Alan Harrison, said he had already became the first port of call for his colleagues.

"Over the last 18 months or so, I'd been helping everyone to get online as we rolled out Microsoft 360, including Microsoft Teams. This is something that we were going to do in the summer, but now all the teachers have had to learn how it works. What's happened in my schools is that I've become the go-to person for IT, the teacher champion for staff."

Being the Head of Computing meant that Alan's pupils were already ahead of the game, because he was already piloting the scheme with them beforehand.

This move will, he says, have profound consequences for the way teachers in schools across all sectors view the use of technology in the classroom. "With the support of computing teachers, teachers in general can help them build up confidence to use these digital solutions."

Training sessions

Meanwhile, the lead computer science teacher at Calday Grange Grammar School in West Kirby, Nicola Mounsey, has seen her role expanded as she's helped to set up a virtual learning environment for the school in response to the coronavirus crisis.

"For our students and the computer science team, our online teaching is really not too far from our normal way of working," said Nicola, who leads the computer science team at the grammar school with around 1,100 boys and a mixed sixth form. "We use Google Docs and Google Classroom normally—so we were well set up for the switch. The biggest difference has been adapting the Year 12 (age 16–17) research for the Non-Exam Assessment (NEA) coursework element of their A-level."

"We've also utilised online programming environments lower down in the school than we would normally do, but the students are able to email us for support. So far, it's working well. We have had to put more detail into our online guidance though, because we've missed the face-to-face element."

The school itself already has a good record in this area, as Computer Science GCSE is regularly oversubscribed. Nicola added that her fellow teachers have risen to the challenge of remote teaching. "For many of our staff, this means developing a lot of new skills: screen-sharing, using Google Hangouts. I have suddenly become the expert and the school has asked me to run training sessions for staff."

The invaluable skills and knowledge of computing teachers during school closures was an emerging theme in the interviews Hello World carried out with computing teachers (this issue, page 24). (HW)

LAUNCHING THE CAS VIRTUAL SHOWCASE

CAS is going virtual with a packed two-week schedule of exciting summer events for the whole community

Victoria Temple

Over the last few months, Computing at School (CAS) has been responding to the needs of the education community and supporting community leaders in adopting new approaches. In the past, CAS, a community of teachers, academics, and professionals with an interest in computing, has hosted face-to-face regional events during the summer. Previous attendees and newcomers alike will be happy to hear that these events are going ahead in 2020—in a new format. This summer they will be able to enjoy the CAS Virtual Showcase, a two-week packed programme that will run from Monday 22 June to Friday 3 July.

The CAS Virtual Showcase will bring together the CAS community, experts, and guest speakers to offer over 50 free online events and webinars. Themes will range from computing in the early years to secondary computing, robotics to machine learning, and much more. The showcase will open with an update and welcome from Beverly Clarke, National CAS Community Manager at BCS, the Chartered Institute for IT, and will later feature a keynote speech from Simon Peyton Jones, Chair of the CAS Board. There will be an opportunity to find out more about Barefoot Programming, courses from the NCCE, Isaac Computer Science, and updates to AQA's GCSE Computer Science specification. There will also be plenty of fun and innovative ideas to inspire the CAS teaching community.

Attendees will have the opportunity to learn about a variety of computing education topics

Exciting events in store

Highlights of the CAS Virtual Showcase will include (all times BST):

- Barefoot Programming workshop, Jon Chippindall (Tues 23 June, 10am to 10.45am)
- Mental Health Matters, Cat Lamin (Fri 26 June, 1pm)
- The Inclusive Computing Classroom, Catherine Elliott (Thurs 25 June, 2pm)
- Unplugged Activities for Teaching Computing at Key Stages 1 and 2 (ages 5–11), Martin Bailey (Thurs 25 June, 11am)
- Preparing leaders for an Ofsted Deep Dive, Nick Templeton (Tues 30 June, 10am)
- Fake News Detectives: Developing Pupils' Critical Digital Literacy, Elli Narewska (Mon 29 June, 11am)
- Machine Learning for Kids Key Stage 3 (age 11–14), Dale Lane (Fri 3 July, 1pm)

"I am delighted that we have been able to respond to the pandemic by offering the first ever CAS Virtual Showcase. The teaching community has responded well in delivering emergency remote teaching and through this showcase we hope to continue supporting teachers to gain value CPD in challenging times," Beverly Clarke told us.

To find out more and book a place, please visit **community.computingatschool.org.uk**.

A full list of events can be downloaded at: **helloworld.cc/events**.

Follow the event on Twitter using the hashtag **#CASVirtual20**. (HW)

CODING CLUBS TAKE THEIR SESSIONS ONLINE

Many coding clubs around the world are finding new ways of learning and connecting, overcoming roadblocks presented by the global lockdown

Amy O'Meara

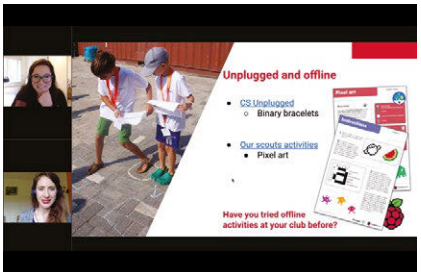
On top of widespread school closures the world over, the coronavirus pandemic has led to the temporary cessation of many extracurricular programming clubs. Global programmes such as CoderDojo and Code Club, and national initiatives such as Girls Who Code, are typically outlets for young people to learn to code and socialise within informal settings. The social aspect of these programmes is a key focus, so not being able to meet in person presents a significant challenge.

Exploring new avenues

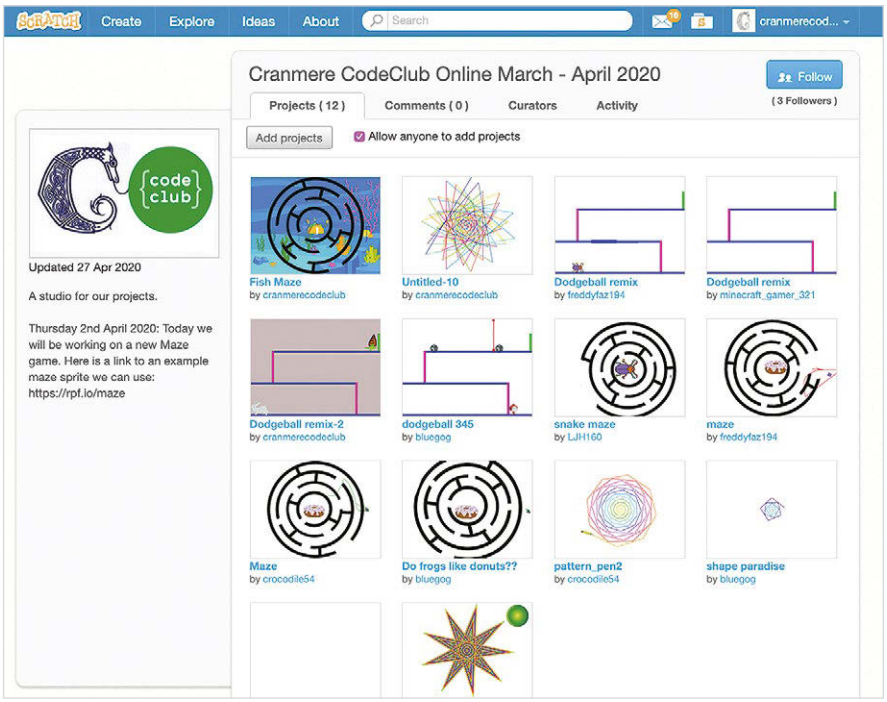
With the health crisis unfolding at different rates across the world, club volunteers began responding in new and innovative ways to the challenge. Some approaches—such as running club sessions online using video conferencing—have become particularly popular. A network of CoderDojo clubs in Northern Italy has banded together to create a series of large-scale online events where over 100 regular attendees at a time can meet, code, and collaborate. One of the organisers, Samuele Vecchi, shared some group learnings from setting up one of these events: "We opened the virtual rooms at 3pm in order to give all participants the chance to test their set-up and become familiar with the tool. We encouraged the Ninjas (CoderDojo attendees) to present themselves using the microphone in order to do some icebreaking. The mentors were aided by co-mentors and we shared detailed instructions in advance for accessing the online tool."

While coordinating an online event of this scale involves considerable preparation, it is evident from Samuele's example that giving young people the chance to meet and find some sense of normalcy makes it all worthwhile. As his co-volunteer Vanessa puts it, "When the going (out) gets tough, CoderDojo gets going". This was seconded by another co-volunteer, Amanda: "Not

CoderDojo volunteers from across Italy meet to arrange a series of online events



Moving clubs online has helped to bring many communities closer together



Attendees from the Cranmere Code Club share Scratch projects they have created online

even quarantine can stop CoderDojo and the children's desire for coding".

On a smaller scale, clubs making the move online are providing a sense of continuity for children and parents alike. Richard Hayler, who runs the Cranmere Primary School Code Club, shared: "I've been continuing to run my Code Club online using a Google Hangout. Feedback from parents has been that this is very welcome and provides a nice way for the children to connect with their friends."

Other clubs have met their attendees' needs by sending out coding projects and activities, setting competitions, and creating homemade tutorials. Michael Madden, of CoderDojo Athenry in Ireland, shared how two of their volunteers have been creating a repository of video tutorials: "Even though online tutorials can't reproduce the fun of gathering together in a school hall to program collaboratively and figure things out together, they are allowing us to keep connected with our mentors and of course share our mentors' knowledge with the wider world." Michael's sentiments echo feelings that several club volunteers have shared—that the human element cannot be replicated online, but that online activities are nonetheless an important and valuable way to connect at this time.

> "IT'S CLEAR THAT NOT EVEN QUARANTINE CAN STOP CODERDOJO AND THE CHILDREN'S DESIRE FOR CODING

Clubs making the move online are helping to provide much needed continuity for children and parents alike

Formal support from organisations

Organisations that run club programmes are supporting new ways of working and providing tools and resources to their communities of volunteers. Girls Who Code is making educational activities available to download for free, as part of their new #CodeFromHome curriculum. The Canadian non-profit Kids Code Jeunesse have likewise moved much of their resources online, with weekly virtual hangouts to support young people, caregivers, and educators. The Raspberry Pi Foundation launched guidelines and community calls to support club volunteers with running online activities, and also a content series, Digital Making at Home, whereby young people can code along to videos from home.

Looking ahead

While it is impossible to predict when clubs will return to their normal rhythm, we do know that this show of resilience will have helped bring many communities closer together and introduced new ways of learning for young people and volunteers. As Samuele from CoderDojo Pavia put it: "We would never have organised an event that unites 11 different clubs with 60 mentors and more than 300 ninjas if we weren't in this situation!" (HW)

SCHOOLS STEP IN TO PROVIDE PPE

Teachers are using their expertise and resources to provide vital equipment to health workers

Victoria Temple

As schools across the UK have shut their doors to most pupils, their design rooms and maker spaces have been quickly taken over by teachers responding to the coronavirus pandemic by making vital personal protective equipment (PPE).

Chris Hillidge is Director of STEM at the Challenge Academy Trust in Warrington and leader of the local Computing at School (CAS) community. He has been coordinating a project that has seen schools across the region make oxygen masks for the NHS, adapted from snorkels and face visors, using the school's 3D printers and laser cutters.

"We've produced medical devices in the past, mainly as prototypes for people setting up businesses, and worked with inventors and others. We have got a good track record in thinking of innovative ways of using our technology," said Chris.

"When we saw the situation developing with the coronavirus pandemic, we thought, what can we do?"

"We had seen that in Italy some makers had produced a valve that worked to convert a snorkelling mask into breathing apparatus similar to a continuous positive airway pressure (CPAP) machine."

"We made some on our 3D printer and then shared our prototype on LinkedIn and Twitter."

Schools joining forces

The response was overwhelming. Chris was contacted by Greater Manchester's Critical Care team and met with the lead consultant at Bolton Royal ICU.

"He agreed that it would be medically useful and asked if we could produce hundreds. It's not a ventilator but it will be useful, and it saved lives in Italy."

Chris has since coordinated with 15 schools and colleges across the Greater Manchester area to produce face shields as well as valves.

"From a standing start, we were soon producing 250 face shields a day, and we're coordinating production and distribution. It's been a phenomenal effort by schools across Warrington."

"We've produced over 5,000 face shields and our designs are the first to go through official safety certification processes after considerable work by our team of engineers —achieved in five weeks—it usually takes two years."

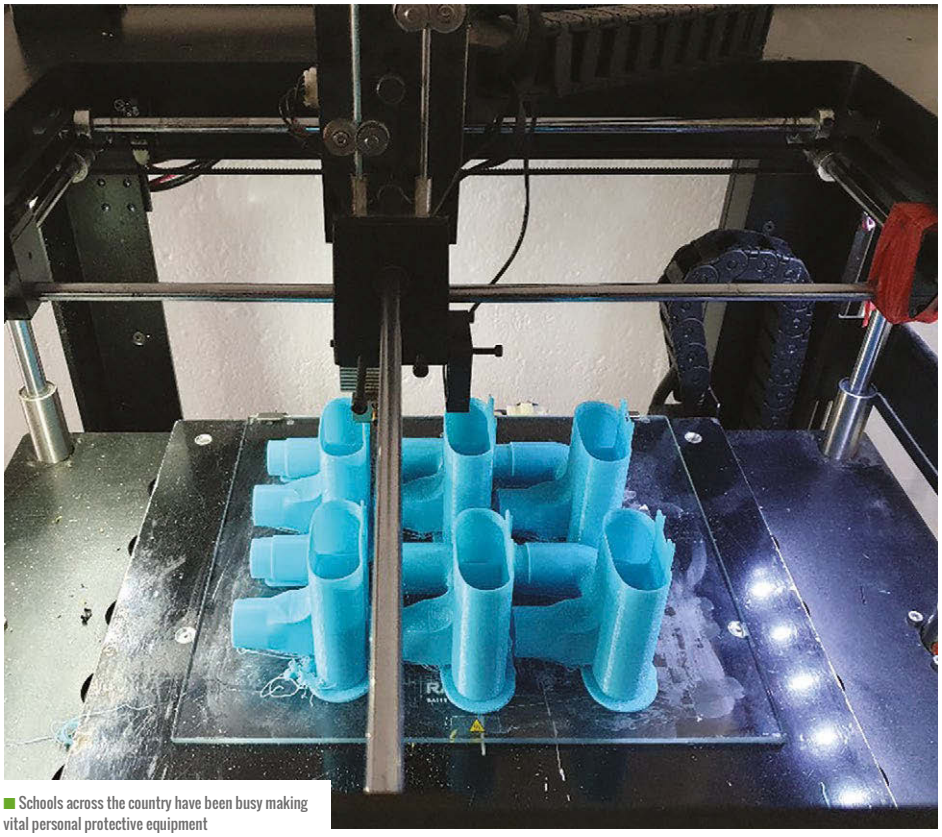
"We've all got relatives and friends working in the NHS and we know there's a real need for equipment. If we can help in any way, we will."

"We've produced 10,000 visors"

It's been a similar story for schools in other regions.

Stuart Peet is coordinator of STEM activity and pupil leadership at Ashton on Mersey School in Sale, Cheshire, where he teaches engineering, technology, science, and construction.

His school has been leading an initiative that has produced over 10,000 visors and supplied equipment to over 50 health and care organisations.



Schools across the country have been busy making vital personal protective equipment

Thousands of masks have been produced

"We started our work initially with Stockport NHS, using our 3D printer to produce around 30 visors for them. We quickly realised a laser cut visor would be quicker and at the time there were no such designs around. So I developed a new acrylic visor with their assistant director, based on a Spanish design that we modified to make it safer and more durable."

The school's department and DT team produced a further 200 visors for Stockport NHS. Word spread via social media and within ten days the school had received orders for 6,000 units.

"We've now produced 10,000 visors," said Stuart.

Most of the PPE products have been produced with the laser at Ashton on Mersey School.

"I also have three technology teachers from other trust schools in my team, who take material to their own lasers and return it cut, and a further three-person build team of non-specialists."

Stuart also has invested in a laser cutter in his own garage. "My wife has been answering emails and coordinating pickups from 7am till midnight daily."

Together they've been producing three types of visor, which are being used by GPs, district nurses, midwives, hospice staff, police officers, pharmacies, and ambulance drivers, in multiple wards in Wythenshawe, Bolton, and Liverpool hospitals, and in the intensive care unit at Trafford General Hospital.

Goggles, gowns, and scrubs

Zoe Thomson teaches design and technology at St Benet Biscop Catholic Academy in Bedlington, Northumberland.

"Since Easter, we've been making a variety of PPE items and distributing them to where there is need, including care homes, doctors' surgeries, district nurses, and more. We are using our laser cutter to manufacture face visors from polypropylene for the head straps and acetate for the visor section. We have made around 1,000 units so far. We do have 3D printers, but in terms of speed, our laser cutter gives us quicker output.

"I have managed to fit several mask buddies into the space left over on each sheet; these are used with face masks to alleviate the pressure on the ears of the wearer. In addition, we are using our DT skills to produce scrub bags, theatre caps and gowns, and scrubs for NHS staff who cannot get hold of what they need through the normal channels. These have been extraordinary times, but it's been good to be able to use our resources and skills to help."

> "IF WE CAN HELP THE NHS IN ANY WAY, WE WILL

As well as providing PPE made using their machines, staff at the Royal Grammar School in Worcester have supplied over 300 sets of goggles from their science and design technology departments for use by NHS medics.

Headmaster John Pitt said, "It is great that we are able to use some of the school's resources to support the NHS at this critical time. As well as providing education for key workers' children, the supply of the goggles and visors, I hope, will make a difference and provide much-needed support for those on the front line." (HW)

COMPUTING EDUCATION RESEARCH GOES ONLINE

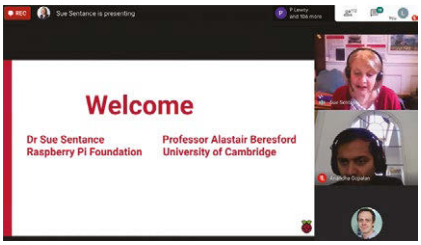
A new research seminar series on computing education gives educators and academics the chance to discuss approaches to teaching

Amy O'Meara

The Raspberry Pi Foundation is hosting a series of fortnightly online seminars on cutting-edge computing education research. Featuring presentations from researchers based in the UK, the USA, and Spain, the seminars will provide the opportunity to hear about some of the latest work in the field, make connections with researchers, and take part in discussions. Researchers, academics, teachers, and students with an interest in computing education research are invited to the online events, all of which are free to attend.

Sue Sentance, Chief Learning Officer at the Raspberry Pi Foundation, explains, "The Raspberry Pi Foundation's mission focuses on giving everybody access to the power of computing and digital making. One of our main aims is to deepen our understanding of how young people learn about computing and digital making, and to use that knowledge to increase the impact of our own work and to advance the field of computing education. As part of this focus, we are working to develop a community of people interested in computing education research and provide opportunities to learn, network, and share."

Computing is now part of the school curriculum in many countries. However, research in computing education is a young field and not much is yet known on how best to teach, learn, or assess computing. The seminar series will include talks from Dr Briana Morrison from the University of



Symposium organisers welcoming participants

Nebraska Omaha, who will discuss how to reduce cognitive load, and María Zapata, from Universidad Rey Juan Carlos, Madrid, who will introduce a method for assessing computational thinking.

An opening research symposium

The seminar series follows the first Cambridge Computing Education Research Symposium, which was held online on 1 April. The inaugural event, jointly hosted by the Raspberry Pi Foundation and the University of Cambridge, boasted a packed schedule, with much of the research presented being directly relevant to teachers.

The keynote speaker was Natalie Rusk, who is one of the creators of Scratch and an MIT Media Lab research scientist. Rusk explored creativity, invention, tinkering, and the development of ideas over time, drawing on case studies to illustrate her insights. She also revealed how the popular Scratch cat blocks, where blocks in the editor turned into moving, blinking cat blocks, were only available for the day in question: April Fool's Day.

Other themes that were explored in the line-up of paper presentations included: working with teachers on computing education research, assessment tools and techniques, perceptions and attitudes about computing, and theoretical frameworks used for computing education.

Of particular interest to educators was Lynne Blair's study highlighting female participation and perceived lack of belonging in A-level Computer Science classes, and Alison Twiner and Jo Shillingworth's piece on how school computing can respond to a skills mismatch between education and the workplace.

Another successful aspect of the symposium was the poster presentation session, with topics ranging from data visualisations in robotics to data-driven dance. Participants were divided into groups to allow for discussions.

The organisers met an unexpected stumbling block in late March, with the unfolding coronavirus outbreak prompting them to move the symposium from an in-person event to one held online. Rather than seeing this as a disadvantage, the organisers used the move as a learning opportunity that would have resonated with many educators who have found themselves tasked with delivering events online. They also embraced the chance to welcome additional participants who would ordinarily be unable to attend in person.

A supportive environment

With over 100 participants and 24 speakers attending remotely from diverse locations, implementing an online event of this size was no mean feat. Feedback from the event was overwhelmingly positive, as participants shared their enthusiasm throughout the day using the hashtag #ccers20. Participant Jonny Jackson tweeted: 'Great to see that things are on the move for Computer Science education! And my first ever online conference... Thanks @Raspberry_Pi.'

Jane Waite is a teaching fellow at Queen Mary, University of London. With two of her colleagues, she presented the paper

> THE VIRTUAL SYMPOSIUM RESONATED WITH MANY EDUCATORS TASKED WITH DELIVERING EVENTS ONLINE

> THE SYMPOSIUM GAVE EARLY-CAREER RESEARCHERS A CHANCE TO SHARE THEIR WORK IN A SUPPORTIVE ENVIRONMENT

'Semantic waves: analysing the effectiveness of computing activities'. Jane shared her feedback on the event:

"I feel very privileged to be undertaking a PhD in Computer Science Education; it's hard work, but very fulfilling. But there is simply not enough research going on in this subject area in the UK. We have a shortage of researchers and funding. The symposium gave early-career researchers a chance to share their work in a supportive environment, alongside more experienced colleagues. This kind of event is essential to grow talent, encourage others to get involved, and raise the profile of research."

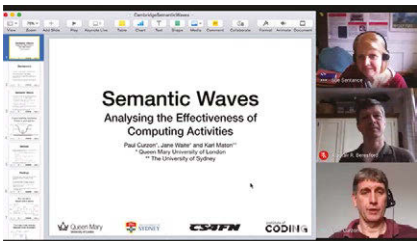
It was also reported that having the event online added an extra dimension to the learning opportunity, with participant Matthew Wimpenny-Smith sharing that, "It gave me an opportunity to record things that were really interesting and then follow them up later. The virtual element made it a great leveller and meant I was able to feel confident and ask more questions."

Get involved

The full schedule, details on how to attend an upcoming seminar, and recordings of talks that have already taken place, can be found at **helloworld.cc/symposium**.

As well as hosting events and sharing learning opportunities, the Raspberry Pi Foundation is also developing its own research. Sue Sentance explains, "We believe that research should be relevant and applicable to practice, including classroom practice, so we want to work together with educators and take forward projects that have visible and direct impact on the learning of computing and digital education".

The Raspberry Pi Foundation research newsletter will contain updates on how you can get involved in this growing programme of research. A regular research update newsletter is available at **rpf.io/research-update**. (HW)



Attendees to the symposium enjoyed a wide range of insightful presentations

COOLEST PROJECTS 2020 GOES ONLINE!

Coolest Projects, the world-leading free showcase for young tech creators, invites submissions from across the globe for its first-ever digital event

Katie Gouskos

Coolest Projects has traditionally taken place as a free, face-to-face event with thousands of young people all over the world showcasing projects they have created. After making the tough decision to cancel events in Dublin and Manchester earlier this year, the Coolest Projects team began working hard to build a solution that would allow them to host the technology showcase online in 2020. They wanted to create an opportunity to celebrate the achievements of young creators and bring a global community together to inspire each other and excite the next generation of digital makers.

A previous Coolest Projects event

Entering a project

For young people who enjoy making things with technology, Coolest Projects is an amazing opportunity to get creative, have fun, learn from others, and be part of something truly special.

Coolest Projects is free, it's open to anyone up to the age of 18, and everyone is welcome to take part: projects can be submitted from anywhere in the world. All project types at all levels of skill are encouraged, from beginner to advanced, and it doesn't matter whether the project is a work in progress, a prototype, or a finished product. Projects really don't have to be complete to be submitted: the Coolest Projects team would like to see it all!

By registering a project to take part in Coolest Projects, young makers get the opportunity to share their work with a community of fellow creators and the whole world. All submitted projects will be showcased on the new Coolest Projects online gallery, to celebrate the effort, enthusiasm, and creativity of young people who have turned an idea into reality with tech.

Help spread the word

At Coolest Projects, young people are empowered to showcase their ideas, designs, and dreams for the future, which feels so important right now. For educators, this is a great opportunity to encourage students to get involved with STEM and work towards a goal they've imagined themselves. This global digital showcase will also be a great tool for inspiring young people who aren't ready to submit their own projects yet, as they'll be able to explore all the wide variety of wonderful creations from young people just like them.

Past participants in Coolest Projects have gone on to win engineering competitions and international awards, and have been featured in national media. And the young creators who've participated in Coolest Projects always talk to us about how much joy they feel taking part. Previous participants Sofia and Mihai, creators of Friendship Saves Endangered Species at Coolest Projects International 2019, tell future young makers: "Follow your dream, put your ideas into practice, because Coolest Projects is a great opportunity!"

If you know a young tech creator, do encourage them to submit a project, whether it's an animation, website, game, app, robot, or anything else they've built with technology. Projects can be submitted in the following categories: Hardware; Scratch; Mobile Apps; Websites; Games; Advanced Programming. Coolest Projects is completely free to take part in, and anyone anywhere in the world will be able to view the submitted projects on the Coolest Projects online gallery.

Register your project before 28 June 2020 to be part of this year's Coolest Projects showcase: **rpf.io/cp-register**. (HW)

SUPPORTING STUDENTS WITH SEND IN HOME LEARNING

Catherine Elliott shares ways to ensure that every one of your pupils can learn in these extraordinary times

Distance learning is not easy to get right, and if we are not very careful, the gap will grow between those who can access the curriculum with ease, and those with additional learning or accessibility needs who cannot. This may be exacerbated further as the coronavirus situation unfolds, as students with SEND may be experiencing the loss of familiar routines and traditional support structures. This article aims to help teachers with setting home learning tasks that are as inclusive as possible for their pupils. I will outline a number of key points to consider, based on my own experience working in a wide range of SEND settings.

Creating accessible resources

Even small adjustments can make a difference to the quality of learning for students with SEND, and making resources more accessible can often be done with relative ease. A good place to start would be to check that your home learning materials are accessible for the greatest number of pupils, taking into account font size, typeface, use of colours, and layout in text-based documents and presentations.

If you are providing live lessons or video content, can these include closed captions? Some web conferencing tools provide the option for users to turn on captions (e.g. in Google Hangouts, Zoom, and Microsoft Teams). If you are using Office 365, you can record a narration for your PowerPoint and turn on captions.

When recording videos or delivering live lessons, keep your background as clear as possible, to help learners focus on the content. Microsoft Teams even allows you to blur the background. Similarly, try to maintain clear audio, without any distracting background noise.

For a summary of good digital accessibility practice, take a look at this guide from the University of Sussex: **helloworld.cc/access**.

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**).

Making use of different formats

There are many benefits to providing materials in different formats, and by allowing students to work in different formats in turn. With the addition of audio, images, and text options where possible, the materials will become accessible to more students as a result.

Give students the freedom to create work in different formats. For example, you might encourage them to record a video, make an animation, draw a picture or cartoon, build a LEGO model or fill in a worksheet. I have observed pupils with poor writing and spelling being much more engaged with creating a comic strip than writing a traditional story.

Working in multiple formats will also help to build new skills such as fine motor skills, and may provide another outlet for communication and expression. This can also help to reduce the digital divide, as not everyone has access to a digital device throughout the day or the basic IT skills to access resources effectively, so do provide an offline activity too.

It is also worth considering whether your students know how to use some of the accessibility features:

- Tablets come with a number of inbuilt accessibility tools, for example enabling users to magnify text, read text aloud, use dictation, or add colour filters. Find out more: iPad Accessibility Options: **helloworld.cc/appleaccess**; Android Accessibility Options: **helloworld.cc/googleaccess**.
- In Word documents, you can enable 'Speak selected text' in the Quick Access Toolbar to read aloud any text. Pressing the Windows button + H (in Windows 10) will allow dictation into any document or application.
- The Immersive Reader from Microsoft is wonderful for supporting weaker readers, pupils with English as an additional language, and pupils with dyslexia. This is available in Office 365, but there is also an extension for the Microsoft Edge browser, plus an unofficial one for Chrome.
- Bear in mind that a Word or Google document is easier to format, and can be read by a screen reader more easily, than a PDF.

There are a number of short videos for teachers and parents on these features at **sheffieldclc.net/remote-learning**.

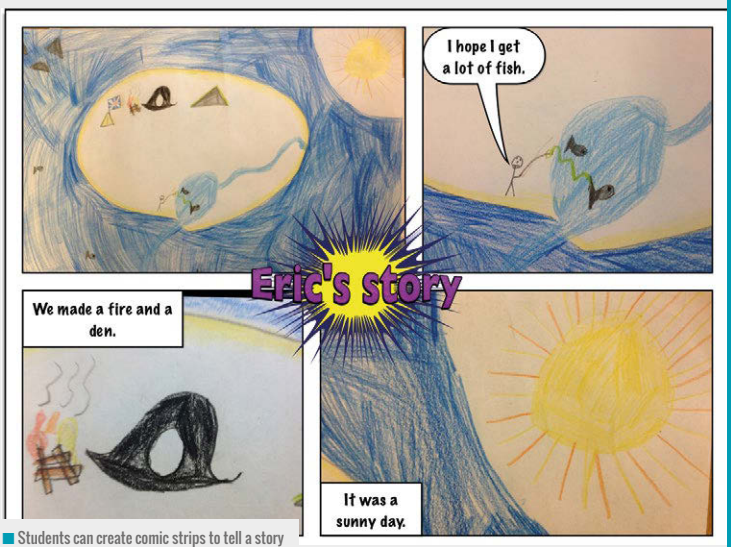
Synchronous vs asynchronous instruction

Synchronous activities (live online lessons) can be very demanding on a learner with poor working memory or processing ability. These may also present challenges to students with sensory impairments, as they may miss out on key information due to the absence of the usual cues. Keep synchronous interactions to discussion around a resource, checking in on pupils, and class chats for morale.

If you are expected to deliver live lessons, make them short and try to record the sessions so that they are available for students to revisit later on. Establish clear expectations: for example, everyone keeps their microphones muted unless answering a question. Ask for answers via the chat facility, to allow everyone the opportunity to participate.

Support and scaffold

While educational institutions remain closed, it is essential that teachers continue to support and scaffold their students' learning. There are many ways to provide this support to your students remotely, for example, by providing a key vocabulary list and some worked examples to refer to, and encouraging lots of practice in different contexts to consolidate learning.



Students can create comic strips to tell a story

In terms of computer science concepts, you could provide working code for your students to adapt and modify, or create parson's problems for students to work on: see for example **helloworld.cc/parson**. These puzzles provide parts of a working program for students to put in the correct order, and so don't require the students to write any code themselves.

Free online tools such as Hour of Code or Rapid Router are also useful for learners to work through independently with immediate feedback.

Well-being and morale

This is a very stressful time for many families and young people. Personal contact will be invaluable for our most vulnerable learners, whether it be a quick phone check-in or a whole-class virtual chat. It's important that any home learning tasks set shouldn't add to the anxiety and stress of the situation.

Clear expectations and structure are crucial in allowing students with special educational needs and disabilities to focus on the learning. My advice would be to stay realistic about the demands you are placing on the learner and their parents. Provide fun activities that may be carried out as a family, and allow for creative computing tasks that can incorporate your students' own personal interests (see box).

These are remarkable times and the use of remote teaching can provide a great range of benefits to learners, who can access material at a time and duration and using a method best suited to themselves. Bear in mind that the most valuable experiences for our most vulnerable pupils will involve continuing a sense of community and contact while they are away from school. (HW)

CREATIVE COMPUTING RESOURCES

- Digital Making at Home with Raspberry Pi: **helloworld.cc/pigames**
- Make Code Tutorials: **helloworld.cc/makecode**
- Bradford Innovation Service Techaway Challenges: **helloworld.cc/bradford**
- Remote learning with Minecraft: **helloworld.cc/eduminecraft**

KATHARINE BIRBALSINGH

"THE WAY TO CATCH THESE KIDS UP IS TO GIVE THEM HIGHLY DISCIPLINED ENVIRONMENTS"

Katharine Birbalsingh leads one of the most successful state schools in England. The high standards expected of her students will serve them well when schools reopen, she tells **Sian Williams Page**

Katharine Birbalsingh has long been an advocate of no-excuses discipline in schools. In 2014, she established Michaela Community School in Brent, London. The school is renowned for its silent corridors, watertight uniform policies, and assigned seating at lunchtime. Birbalsingh's view, expressed in her book, ***The Power of Culture***, is that students from chaotic upbringings need clear boundaries to thrive.

Her school's successes seem to be proving her right. In 2017, Ofsted rated Michaela 'outstanding' in all areas, praising the high expectations staff have of all pupils and the impressive progress made by pupils from poorer backgrounds. The school's first set of GCSE results, received last year, were impressive. Over half of all GCSEs awarded to Birbalsingh's students were graded 9–7, which is equivalent to an A or A*. In maths, students made more progress than their counterparts in any other state school.

I meet Birbalsingh, 47, just days after the announcement that English schools will begin to reopen in June. The task of navigating the next few weeks is clearly weighing heavily on her mind. But she explains that she feels in a stronger position than most to reopen, thanks to a student body that is used to complying with strict rules.

"You're more likely to succeed at social distancing in a school that's highly disciplined," she says. "The public don't realise just how out of control some classrooms can be. Teachers at other schools, where the discipline is less tight, they will be genuinely worried."

When it comes to when exactly her school will be open, and what form teaching will take when it does, she is in the dark. "I'm quite happy to do what I'm told. It's just that I don't know what that is right now. We're being told there may be face-to-face teaching at secondary from 1 June; well, what does that mean? I genuinely don't know what it means."

"And if a head teacher needs to open up the school and needs to get the staff in, but the staff are being told not to go in by the unions, what's a head meant to do? And if you have to leave everyone at home who has an underlying issue, then how many teachers do you actually manage to get in? I don't know if all the practicalities have been thought through. It may be that the government has decided we don't need to socially distance, because children don't pass on the virus to adults. Certainly our local authority is telling us that."

> "SOME PARENTS DON'T RECOGNISE WHAT EDUCATION CAN DO

While her school has been closed, teachers at Michaela have been providing a mix of live learning and offline tasks. "It's incorrect to think that the best type of online teaching is done live. It depends on who your intake is, so we've thought very strategically. For our sixth form, it will work. For the rest of the school, it won't. It would be a waste of time; the kids would just spend their time trying to figure out how to get around it." Her teachers are reporting that around ninety per cent of students are completing the work set for them, she tells me.

One of the main arguments behind reopening England's schools is concern around a widening disadvantage gap between children from poor and rich families. Birbalsingh's students demonstrably receive a better education than most state school students, but come from some of the poorest families. They surely are likely to be among those worst affected by school closures.

"Lots of our families won't necessarily be able to support them with their work at home. Some of the parents are engaged, and some of the parents aren't; some of them have had terrible school experiences themselves. Some of them don't recognise what education can do for you. Some of them just want the kids to look after the grandparents. Some of them have five or six children in the house and aren't able to look after them, and frankly are quite happy for them to sit on their phones all day on Snapchat and Instagram."

It's perhaps surprising, then, that Birbalsingh thinks concerns around a widening disadvantage gap have been overblown. "What bothers me is this myth that we've got in our heads that everything was brilliant before, and now everything is a disaster.."

"There's no question that if they were in school, children would be learning more, but I think the same goes for private school kids. I know that all these Zoom lessons are happening in private schools, but that doesn't mean that real learning is going on. I really don't believe it is. I know kids. I don't care if you're rich, I know those kids trying to get away with doing as little as possible, because that's what kids do. We know that the top ones are working all the time, but the vast majority of them can sit in a Zoom lesson and look like they're working, and not really do much."

"You know, those private school kids, the world is their oyster. Kids from more challenging backgrounds have a more challenging life. That has always been the case. I'm not sure the coronavirus changes it that much."

"Children will go back to what they used to be doing very soon, and that's what worries me. It's not schools being shut right now. What are children going to be doing for the next three years? What are they going to be doing for the next ten years? What kind of schooling are they going to access? Because the way to catch these kids up is to give them highly disciplined environments with the teacher standing at the front and leading the learning. And that isn't going to happen all over the country, because that's not what many schools do." (HW)

The Power of Culture is edited by Katharine Birbalsingh and published by John Catt Educational Ltd on 12 June
helloworld.cc/michaela

#INSIGHTS

A NEW FRAMEWORK FOR ENGAGING STUDENTS IN ONLINE LEARNING

STORY BY Jonathan Dickins

A new framework for online learning from Jered Borup and colleagues has emphasised the importance of both academic and personal support for learners. Academic Communities of Engagement (ACE) focuses on different types of student engagement with online or blended learning, and how the support received from both the course community and a student's personal community can impact engagement. At the time of writing, UNESCO estimates that 1.5 billion learners have been impacted by school closures to curb the spread of coronavirus, so the framework comes at a particularly relevant time for educators who must now facilitate online learning.

THE THREE TYPES OF ENGAGEMENT

TYPE OF ENGAGEMENT	RELATED SUPPORT BEHAVIOURS
Cognitive Cognitive engagement describes the extent to which students are willing and able to engage with the course material.	**Instructing**, either from teachers, parents, or peers with more knowledge, and **collaborating**, either with peers or instructors.
Behavioural Behavioural engagement describes the behaviours that support learning, including attending class or completing assignments, but that do not apply directly to learning.	**Troubleshooting and orienting**, such as familiarity with the course platforms, tools, and procedures. **Organising and managing**, such as managing time among the distractions that online learning can bring, and **monitoring progress**.
Affective Affective engagement describes the value that students perceive in completing the course and applying what they have learnt in a wider context.	**Facilitating communication**, either with peers or instructors, developing relationships with others in the course community, and **installing excitement for learning**.

The importance of a student's course community and personal community

The authors suggest that a student's ability to engage with online or blended learning increases with the support of others, and in particular from both the course community and their personal community.

Who are the people that make up these two communities in a student's life? The authors define the course community as anyone associated with the online course, including peers and educators, with whom the student will probably not interact before or after the course. A student's personal community can be those they engage with in person or online, including their family and friends, typically outside of the context of the course.

The three types of engagement

The authors suggest that a student's course community and personal community can influence engagement with online learning. They identify three key dimensions of engagement: cognitive engagement, behavioural engagement, and affective engagement, all of which support learning. Through case studies and a review of prior literature, the authors also suggest a number of behaviours that support each type of engagement (see table).

How can we apply the ACE framework?

The authors suggest that students are more fully able to engage with online learning when they are scaffolded

BLENDED LEARNING

Blended learning is a combination of traditional classroom teaching, online learning, and independent study. It gives students greater control over the time, pace, and style of their learning.

through the support of both their course community and personal community, and make several suggestions following the development of the ACE framework. Here are some examples of how educators might implement these suggestions.

- Teachers could help facilitate student-to-student relationships that can last beyond the end of the course
- Teachers can provide resources to support involvement from learners' personal communities, including parents
- In higher education, providers should develop models for support from both instructors and subject experts

In the context of teaching computing, the Scratch community is one example that can be said to incorporate some of these approaches, in particular the facilitation of student relationships through sharing projects. For educators, finding a balance between students' course and personal communities may prove to be a particularly worthwhile exercise at this time. (HW)

> "SCAFFOLDING HELPS STUDENTS TO ENGAGE WITH ONLINE LEARNING

FURTHER READING

Borup, J., Graham, C. R., West, R. E., Archambault, L., & Spring, K. J. (2020). Academic Communities of Engagement: An expansive lens for examining support structures in blended and online learning. *Educational Technology Research and Development*, 68, 807-832.

DOES THE PRESENCE OF INSTRUCTORS IN ONLINE VIDEOS AFFECT LEARNING?

STORY BY Hayley Leonard

The widespread closure of educational institutions due to the coronavirus pandemic means that learners are now relying more than ever on online courses and instructional videos, and understanding more about the factors that affect the success of learning from these online sources is important.

While there is an increasing number of online learning platforms available, there are many differences between them in terms of how the content is presented and how learners engage with them. Online courses often include prerecorded videos that aim to engage the viewer, but the success of these videos in the development of knowledge will depend on a number of factors. One factor that was considered in a recent study by Wang and colleagues was whether an instructor was visible on the screen when the content was being presented.

> "HUMANS CAN'T HELP BUT RESPOND TO THE SOCIAL CUES OF ANOTHER HUMAN

What's in a face?

There's a lot of evidence from several decades of research that humans are attracted to faces in our environment. This suggests that having an instructor present in an online video might distract the viewer's attention away from the content, resulting in less efficient learning.

On the other hand, social agency theory suggests that having an instructor visible encourages the learner to approach the situation as they would a face-to-face interaction with another human. This means they try to make sense of the information at a deeper level, which could positively affect learning. This is particularly interesting if we consider the presence of instructors in prerecorded videos, rather than in real-time interactions: the learner is still programmed to respond to the voice, body language, and other social cues of another human, despite it being in the form of a recorded image.

Measuring engagement in prerecorded videos

The study by Wang and colleagues aimed to understand whether the instructor's presence affected memory of content and transfer of learning, as well as how learners viewed the videos. It also used eye tracking technology to measure where learners were looking during the videos, to help understand how the instructor's presence affected their attention. An eye tracker is a device attached to a screen that records where people look and how they move their attention between different parts of an image or scene. In this study, it allowed the researchers to test whether the presence of the instructor attracted the learners' attention and whether this affected their learning of the content presented in the video.

Learners watched prerecorded instructional videos on statistics, classified as either easy or difficult, in which the instructor was either present or absent. They were tested on the retention and transfer of their learning after the videos using multiple-choice tests. They also reported how they felt about their learning and about the videos.

Improved learning and satisfaction

The presence of the instructor was generally viewed positively. Learners reported greater satisfaction and interest after the videos where instructors were visible than the ones without an instructor. In terms of learning, the instructor's presence was most important for the difficult topic: it improved transfer of knowledge as well as learners' own perceptions of how much they had learnt, and of how easy it was to learn from the video.

Interestingly, the eye tracking analyses showed that learners did spend more time looking at the instructor than the materials, but this did not seem to distract them from learning the content. In fact, some learners suggested that the instructors improved their focus, and that the instructor's gestures helped them understand the content better than in the videos where the instructor was absent. This links back to social agency theory, which suggests that information shared during human interaction is processed at a deep level. It suggests that even a proxy for human interaction, such as a prerecorded instructor in a video, can trigger this response and help learners understand a difficult topic.

Why are these findings important for educators?

This type of study is important to help us work out why some online videos work better than others, and what factors you should consider if you are producing your own videos to support learners. It seems that, rather than being a distraction, a visible instructor can help to engage learners and focus them on the content. Increasing the social nature of online learning may therefore be important and could encourage learners to complete courses and develop their knowledge, in contrast to providing information in a non-social context. Learners have a diverse set of needs and preferences, and so incorporating a wide range of activities into any online video or course is likely to allow the most people to access the content. (HW)

FURTHER READING

- Wang, J., Antonenko, P., and Dawson, K., 2020. Does visual attention to the instructor in online video affect learning and learner perceptions? An eye-tracking analysis. *Computers & Education*, 146, Article 103779.

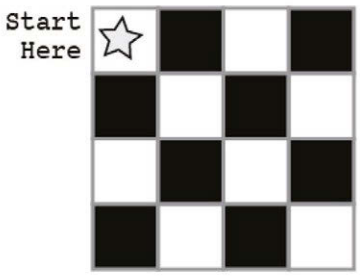
GO UNPLUGGED FOR BETTER COMPUTATIONAL THINKING

STORY BY Thom Kunkeler

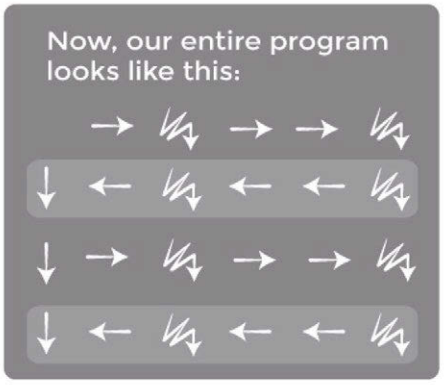
Unplugged activities are a great option for students who do not have access to computers at home, and new research shows the benefits of such activities for computational thinking. Many of these can be done with only a pen and piece of paper, an instruction sheet, and a partner—such as a parent or guardian, sibling, or remote classmate.

A group of researchers from the University of Castilla-La Mancha in Spain, led by Javier del Olmo-Muñoz, were interested in the relationship between unplugged activities and computational thinking. They found that students who start out in computing education with unplugged activities before switching over to computer activities show a significant advantage in computational thinking skills compared to their peers.

Jeannette Wing defined computational thinking, widely considered an important aspect of computing education, as, "the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer—human or machine—can effectively carry [them] out". However, it may not be obvious to educators that developing computational thinking doesn't need to take place in a classroom, and it can be taught without the use of computers. This will be particularly useful for students who fall ill for long periods of time, or need to stay at home for other reasons, such as the current coronavirus pandemic. An additional bonus is that these activities do not require computers, and have been found to be great for learning computational thinking skills such as abstraction, algorithmic thinking, decomposition, evaluation, and generalisation.



Follow along with your finger and see if you can figure out how to get this image from the program to the right.



An example of an unplugged activity from Code.org

For this study, the researchers designed eight 45-minute lessons for an unplugged classroom, as well as lesson plans for a plugged-in group. Unplugged activities were chosen from the computing education resources website **Code.org**. In the first session, students were asked to pair up for the Graph Paper Programming exercise, in which students 'program' one another to draw pictures by giving each other instructions for drawing on a 4x4 grid, such as 'move a square to the right' and 'fill the square with colour'. Another example of an unplugged activity is My Robotic Friends, where students adapt the set of symbols from the first exercise and take turns participating as a robot, acting out the algorithm defined by their partner.

> "COMPUTATIONAL THINKING DOESN'T HAVE TO BE TAUGHT IN A CLASSROOM

Throughout the research intervention, students from one group engaged in three unplugged activities, followed by two plugged-in ones, and another group engaged only in plugged-in activities. Using tests before, during, and after the activities, students were assessed on their computational thinking skills, and they also completed a motivational survey for the activities. Besides the higher learning gains for the unplugged group, the findings indicate that these students were more motivated about their instruction. For parents, guardians, and educators, these findings illustrate the benefits of experimenting with unplugged activities from home. **Code.org** activities are free to access. (HW)

FURTHER READING

Del Olmo-Muñoz, J., Cózar-Gutiérrez R., & González-Calero, J.A. (2020), Computational thinking through unplugged activities in early years of Primary Education. *Computers & Education*, 150.

Illustrations © Amy Grimes

“LIFE HAS CHANGED DRAMATICALLY”

We asked teachers what their lives have been like over the past few months, and they shared stories of determined support for their students

INTRODUCTION BY PHILIP COLLIGAN
Philip is Chief Executive of the Raspberry Pi Foundation

In just a few short weeks, the coronavirus pandemic has had a profound impact on every aspect of life, not least education. With 1.2 billion young people affected by the closure of schools, teachers have joined health and care workers, and the many others who are on the front line of the fight against the virus.

As Chair of Governors at a state school here in Cambridge, I've seen first-hand the immense pressure that schools and teachers are under. The abrupt transition to emergency remote teaching, caring for the most vulnerable students, supporting families who are experiencing the health and economic devastation wrought by the virus, and doing all of this while looking after themselves and their loved ones. The word heroic doesn't feel nearly sufficient to describe the efforts of teachers all over the world.

At the Raspberry Pi Foundation, we wanted to learn about how different schools have responded: what's working, what are the challenges, and crucially, what is happening to computing education. We spoke to teachers at primary schools, secondary schools, and further education colleges. Most were based in the UK, with a few in India and the USA.

Even from this small collection of interviews, we saw incredible innovation and resilience, coupled with a determination to ensure that all young people could continue learning during the lockdown.

Most of the teachers that we spoke to were specialists in computing. Their expertise with technology has put them at centre stage, with many stepping into leadership roles, supporting the rapid roll-out of online learning and providing invaluable support to colleagues and students alike. We hope that this leads to schools giving greater priority to computing education. Digital technologies are keeping the world connected and working. Equipping all young people with the ability to harness the power of computing has never been more vital.

We've also seen profound challenges. The digital divide has never been more apparent. Far too many young people

lack access to a computer for learning at home. This is a problem that can be fixed at a cost that is trivial compared to the long-term economic impact of the educational disadvantage that it causes.

But we're also hearing first-hand how educational disadvantage isn't just about access to technology. Many families are struggling to support home learning, whether because of the condition of their housing, their work or caring responsibilities, or the struggle to put food on the table. Teachers have responded compassionately, offering practical support where it's needed most, and planning now for how they will help students catch up when schools reopen.

> "EDUCATIONAL DISADVANTAGE ISN'T JUST ABOUT TECHNOLOGY: MANY FAMILIES STRUGGLE TO SUPPORT HOME LEARNING

We know that school closures disproportionately impact the most disadvantaged students. If we are going to reduce the long-term economic and social impact of the virus, there needs to be a huge global effort to invest in addressing the educational impact that it has caused.

As we start to figure out what a post-lockdown world might look like, the only thing that feels certain is we are facing a long period of disruption to formal education. We need to find new ways to combine online learning, classroom and remote teaching, mentoring, and non-formal learning experiences, to ensure that all young people, whatever their backgrounds, are able to thrive and fulfil their potential. The stories we've heard from these educators give me hope that

© Amy Grimes

we can, but they will need the support of government, industry, and non-profits. The Raspberry Pi Foundation is committed to playing our part.

Interviews by Josh Crossman, Amy O'Meara, Carrie Anne Philbin, James Robinson, and Sian Williams Page. Responses have been lightly edited by Sian Williams Page.

LEADING THE WAY

As the coronavirus crisis unfolded, schools quickly put in place plans to change fundamentally the way they supported students. Computing teachers have been leaders in this change.

Four weeks before Easter, the world situation was changing on a daily basis. We were watching what was happening in Italy. My Head sent me an email and said, "I don't want to panic you, but I do feel like schools might close. Can you have a plan ready?"

Our leadership team went into crisis management mode. In early discussions, we had said that teachers would be able to manage working from home however they wanted. But then I'd read about the educators in Italy and the cognitive overload of them trying to manage their teaching by email and how awful that was for them. So I pushed very strongly, and luckily my colleagues were fully supportive, that we should actually move everything to our online platform and be really consistent in that respect.

As the lockdown approached, there were fewer and fewer teachers in school, and fewer students too. We were having to put whole year groups into our cinema to watch a film to manage them, because we didn't have enough staff to supervise them in classes.

Those weeks before Easter were so intense. They were just crazy. It took me a week to get the adrenaline out of my system.

Katie Vanderpere-Brown Assistant Headteacher at Saffron Walden County High School in Essex

Our department has been at the forefront of this. We spent the week before the school closed pre-empting that happening. We trained the students how to use our online system in huge whole-year groups in the sports hall, with teachers demonstrating what to do, and going around showing them how to access it using their phones. And after the school closed, but before we were properly in the lockdown, the staff were in school, but social distancing. So we were all two metres apart from each other. We did a big training session on how to set up our classes and resources online, and how to use the video sessions as well.

Pippa Lewty Head of Department for Computer Science at Reigate Grammar School, an independent school in Surrey

We sort of suspected that distance learning was coming, but we only had a week's heads-up. There was a lot of me trying to train the teachers and the students right before we went out. I went into all the fourth and fifth grade classes (ages 9–11) and I did a video calling mini-lesson with all of them. I taught all the kids how to get on a call right in the class, so that they would be prepared and know how to do that.

So when we first were at home it was basically me on calls all day, with the teachers going over features and then going over different platforms of how they could take their teaching digital. It was less about my actual curriculum and more about how I could be there to support other teachers that don't have the awareness of how to make learning come to life technologically.

Alexis Cobo Technology and Computer Science Specialist, Pine Crest School, Boca Raton, Florida

As part of my role as Head of Computing, and increasingly taking on the whole school responsibility for our digital strategy, the last-minute staff training for remote learning largely came down to me. Our staff engaged with the training really well, but it was a steep learning curve for all of us. During the first couple of weeks of remote learning, before Easter, I was responding to over 200 emails daily, from staff, pupils, and parents.

Peter Collins Head of Computing at Yarm School, an independent school in North Yorkshire

PRACTICAL CONSIDERATIONS

Some schools have encouraged students to use mobile phones to access resources, while others have been providing printed worksheets.

A lot of young people at home, particularly in our community, they're not necessarily going to have one device per pupil. Just before we closed, I spotted that another school had tweeted about using Xbox and PS4 to access resources. Students could log in and basically do their homework on the Xbox. And so we passed that on to parents. I don't know how thrilled some of the pupils were that we pointed that out.

Fraser McKay Computer Science teacher at St John Ogilvie High School, a comprehensive school in Hamilton, Scotland

What we're doing for the students without internet access is printing out things and actually creating a paper-based version of it. But obviously in the online version, you've got the contact with your teacher, you

can talk to people, you can find the answers out. If you haven't got that, then you're basically just doing something potentially from your own memory or problem solving. So it's a little different.
Jim Green Head of Technical and Vocational, Consett Academy, Durham

Maybe five per cent of the children we work with have computers, but that could be logging either to their father's or their elder brother's or something like that, not something that they can access all the time. So the only option we have to use is WhatsApp via parents' phones.
Rinsa Perapadan Gyanada Foundation, Mumbai, India

We've realised that the breakdown of learning is not at the student understanding level. It's more limitations in terms of access, or the systems not providing the right sort of access. These are systemic challenges rather than learning challenges. We are just facing a massive digital divide. There's a segment of India that's moving very rapidly and they are getting access to all kinds of learning. But there's a segment of the student population that doesn't even have cell phones.
Shoaib Dar Pi Jam Foundation, Pune, India

There are some students in most year groups who don't have access to the internet. The devices in school are used by the children of key workers, so we're preparing printed packs for children who need them. Teachers arrange work for the start of the week, so that packs can be printed off for those families who don't have internet access, and then they can pick those up from the school office.
Jen McCulloch New Brighton Primary School, Wirral

> **"THERE ARE SYSTEMIC CHALLENGES, RATHER THAN LEARNING CHALLENGES, AS WE FACE A MASSIVE DIGITAL DIVIDE**

PROVIDING HARDWARE

Some schools have provided laptops and internet access to students who needed them.

Early in March, we quickly surveyed the whole student body on their access to the internet from home and the availability of a device to access and complete their schoolwork. It became apparent that many students had their own smartphone, but laptops or computers were not as common. To ensure the students were set up to complete their virtual learning, we agreed to loan our banks of laptops to any student who needed one, ultimately loaning out over 120, and even home-delivering some to those already in isolation. We additionally provided each student with two blank exercise books, a pen, and pencil, to ensure they were all equally prepared to work from home.
Sam Hankin Head of Computing at The Priory School, a comprehensive school in Hitchin, Hertfordshire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Most of our students have access to the internet, but it's more a question of what type of device they use for access. We've shared printed workbooks with students and we're hoping to purchase some computers for students who currently have access via a phone or tablet. It's possible to access the resources using these devices but it's so much harder to write and debug code if you don't have a keyboard.
Pete Dring Head of Computing at Fulford School, a comprehensive school in York

Before schools shut, we had a five-day window. We took a survey of students who did not have access to devices or the internet and we gave out devices to those who needed and we purchased a prepaid WiFi router for those who didn't have the internet and sent them home with that. And then, once we actually were working from home, we gave another opportunity for those who felt like they needed something extra a chance to come back to the school and pick up an extra device.
Alexis Cobo

When we've had students without any internet access, we've sent them 4G wireless hotspots to their house to make sure that they can access content.
Steven Rich Computer Science teacher at Ada, the National College for Digital Skills in Tottenham, London

ADDITIONAL NEEDS

Some schools are providing food and clothes to their students.

We are delivering food to families. That was part of my role when I was in school for my two weeks on the rota. We're accepting donations of food; people who are on their daily walk drop it inside our school foyer's double doors. We have to say thank you from the other side of the door. And then

the teacher who's in and the teaching assistant, we sort it all out. Whoever needs it will phone and speak to the head teacher. Then the teacher will go and deliver it.

Some parents might not have had free school meal vouchers. There's a lot of parents out there that would have been fine in the normal world, if their partner is working they might have been a stay-at-home mum and they would have been ticking by fine. But then all of a sudden this comes along, the partner has stopped working, and they find themselves thinking, "I haven't got any money."

We've also been delivering clothes. So because obviously children are still growing, but their parents can't afford to get them new clothes and nowhere is open. Primark was the cheap place to go for children's clothes and it's not open at the moment.

Our head teacher has said we will be doing these deliveries once a week until it isn't needed anymore.

Katie Johnson Year 1 teacher (ages 5–6) at St Mary's the Mount Catholic Primary School, Walsall

STUDENTS' CONFIDENCE WITH THE TECHNOLOGY

Even when students have devices and internet access, barriers to learning remain.

Everybody completely overestimates children's confidence with technology, because they can use social media and things that have been very carefully designed to be very easy to use. But they've lost, or they've never had, any functional skills.

So yesterday, for example, I was teaching a Year 7 (age 11–12) who was really struggling. In the end I said, "If you've got a parent there, I'll call you and then you can show me your screen." She didn't realise you could click on the assignment and type. So she'd been screenshotting everything to Word and typing it out.

So that was like a light bulb moment for her, and she'll be fine now, but there are 300 Year 7s. And so it's very difficult, we have to teach them how to do the work. I think we have to readdress digital literacy because they don't have the skills at all.

Katie Vanderpere-Brown

I worry about the children whose parents cannot speak English at all. They can't access what we're sending.

Katie Johnson

MANAGING EXPECTATIONS

Some schools have responded to parents' demands to provide live lessons and individual support to students.

Parents want us to justify why they're paying fees when we're not in school teaching. In comparison to some state schools, we're doing a lot more. We're doing live contact with every class once a week for 30 minutes.

Pippa Lewty

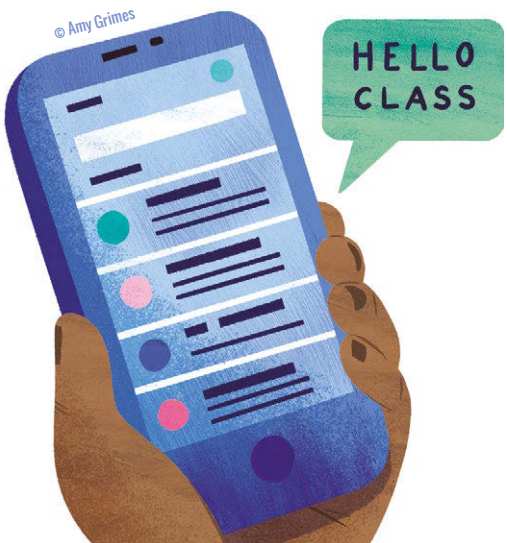
I teach at a private school. And I know that the parents want live teaching and individual support, so the kids are reaching out for private sessions and I make myself available to them. You know, no matter whatever's going on with my own family, I get on the Zoom with a student, because if a student wants me, that's the priority.

Alexis Cobo

Some of the expectations of the parents and what their children can achieve remotely have been a little too high. Therefore as a leadership team, we have been trying to get across to some of the parent body the need to not try and replicate school completely from the home setting. Some parents have been expecting the school to be running their children's timetable with full synchronous remote lessons at the exact time as it is on their timetables. Realistically this has not been possible yet. Although moving forward, we might be able to do some of these in a blended approach.

Matthew Wimpenny-Smith Leader of Digital Strategy and Computing teacher at Headington Prep School, an independent girls' school in Oxford

I know quite a few teachers that are being paid to tutor while the schools are shut, as parents are so scared of children falling behind. But they're doing more work, and you will always have concerned parents. So I think that when we go back, the achievement gap will be greater and I can't even imagine how a lot of schools will address that. I think we're in a slightly more fortunate position being a grammar school that we tend to have those parents that have pushed hard, but that's not to say



that we won't have any of those students that will come back having done nothing.
Claire Buckler Devonport High School for Boys, a state-funded grammar school in Devon

If you are interacting with the students, they work. They work more effectively. They feel more like they're actually in an environment where they're with the teacher in the lesson. That is what they're telling us they like.
Dave Hartley Head of Computing at Steyning Grammar School, a secondary and sixth-form college and state-funded boarding school

LIVE LESSONS VS ASYNCHRONOUS LEARNING

While other schools have been reluctant to provide live lessons due to safeguarding concerns, there is a fear of leaving some students behind, or the concerns of constraints on parents' abilities to support learning.

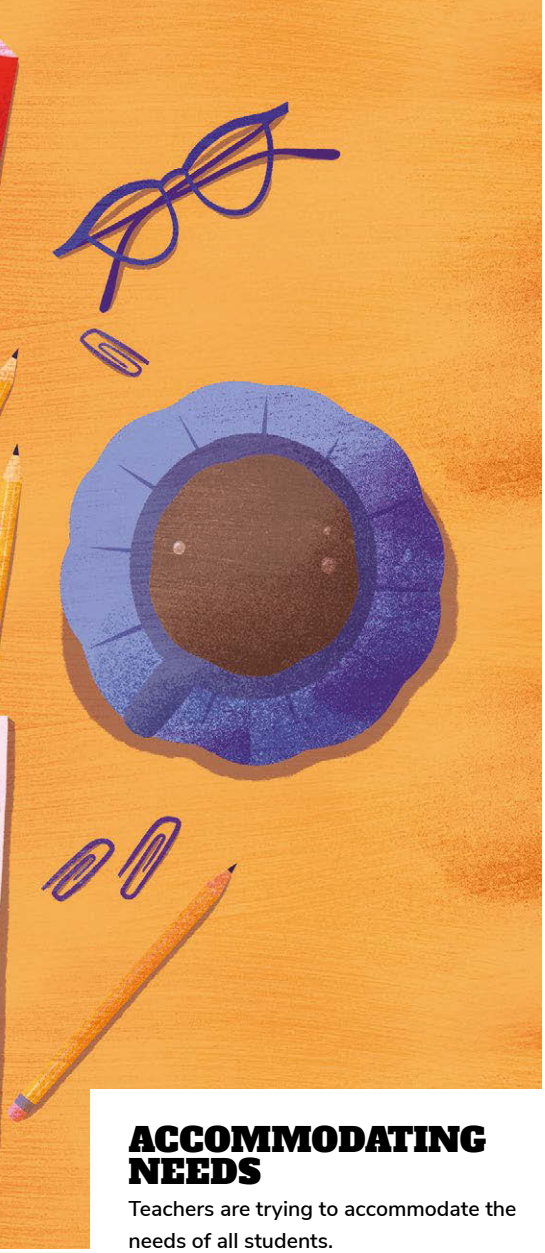
There are horror stories, where people have been jumping in and dropping websites in and videos in, and then you hear about apps being hacked. E-safety is constantly in your head, thinking, 'What's the easiest and safest way we can do this?'

> **"E-SAFETY IS CONSTANTLY IN YOUR HEAD; YOU'RE ALWAYS THINKING, 'WHAT'S THE EASIEST AND SAFEST WAY WE CAN DO THIS?'**

We did think of doing a call with little group of the kids, but then we were worried that we will exclude three or four of the class who won't be able to do it. I am just trying to keep everything the same for everyone as best as we can, so everybody feels they are getting the same.
Tom Bromwich Year 3 teacher (ages 7–8) at Cooper and Jordan C of E School, a state primary school in Walsall

Before the start of lockdown, we decided to avoid live lessons and opted for an asynchronous model. Aside from the potential safeguarding issues, we were aware that many of our families would be working flexibly to enable them to manage parental and pupil workloads. Therefore, we were not confident that all our pupils would be able to have access to lessons delivered at fixed points in the school day. Instead, we've been working hard on providing high-quality recorded screencasts and personalised formative feedback for each pupil.
Peter Collins

We do often get a lot of feedback that the parents are saying, "I can't do the homeschooling, the children don't want to do the homeschooling, I can't do it, the children don't want to do it," and we're just giving the advice that don't worry about it and we'll catch up when we come back in September. It's not going to be the be-all and end-all; don't force them to do it. Their mental health is more important than that. So on the newsletter that the head teacher sends out every week by email, she's encouraging family time and having fun in the garden, and not forcing anything and not causing arguments.
Katie Johnson



ACCOMMODATING NEEDS

Teachers are trying to accommodate the needs of all students.

We had some Year 7 students (ages 11–12) who were really, really not coping and feeling completely overwhelmed. Their head of year created a class with about 20 students in it that were really struggling at home. And for those children, they got removed from all the other online lessons. She is taking the assignments that are being set for the other students, adapting them, and setting them for this small nurture group.

Katie Vanderpere-Brown

We've been encouraging pupils with accessibility needs to use built-in accessibility tools, and a variety of other easy-to-use apps and extensions, like an amazing screen-reading extension that our pupils use to support them with reading, writing assignments, and online research. Some of these tools are expensive, but lots of companies are doing extended free trials due to the lockdown. These tools are helping our teachers meet the diverse needs and abilities of our pupils, so they can fully engage with the curriculum like they would in the classroom.

Peter Collins

I've got a child in my class who wouldn't be able to access anything that I would be able to put up on online. So I made up a box for him. I've put balls in there and colouring crayons, and games that he can play with his mum. So it's taking turn games and things like that, and obviously sterilised and everything before I delivered to his mum so that he still got something that he can do at home, but it's not the same as the other children.

Katie Johnson

USING ONLINE TOOLS

Adapting methods to teach computing remotely is proving challenging, but there are online tools to help with programming tasks.

There are lots of things that we were doing in class that are quite hard to manage online. We do a lot of pair programming, but we can't really; we haven't really worked out how we could really do that online and match people. Then we thought about it; if you match people up, what happens if they don't speak to each other? And how do you do all of that matching up? It's not as easy as sitting two people next to each other in a classroom. I have been breaking out people into small groups to work on tasks, though.

We've been doing a mixture of multiple-choice questions and quizlets, and things like that. I think it's still an area that we're still trying to develop; how we can move the techniques that we would use in the classroom into the online world. I think it's fair to say there's still development we can do there.

Steven Rich

> **"WE'RE STILL LEARNING HOW WE MOVE TECHNIQUES WE USE IN THE CLASSROOM TO THE ONLINE WORLD**

We decided to run a weekly live-coding programming video series. It's aimed at students who are in Years 8 to 10 (ages 12–15), as well as teachers and parents who are interested. The idea is to try to solve a new problem or explore a new concept each week and limit the videos to about ten minutes in length. Live coding means letting people into the thought processes and mistakes behind a program, so that they can build up their own experience creating their own programs. That means trying hard to strike a balance between not waffling for too long about each line of code, but also trying to give a running commentary that explains how each part works.

> "IN WORKING THROUGH ACTIVITIES, WE HOPE STUDENTS BALANCE INSTRUCTION AND APPLICATION

At the end of each video, students can choose from four interactive remote learning activities. The hope is that they can watch the video and work through the activities at their own pace, so that they can get a healthy balance of instruction and independent application of what they've learnt.

As a computing department, we've tried to use live coding as a pedagogical technique in our normal teaching, so this is a natural extension of that. The big revelation for us teachers was that it's OK to let students see our programming mistakes. I think students learn more from seeing how to fix something than being shown how to do it correctly in the first place. That's aside from the benefit of actively seeking out opportunities to praise students' attitude when they respond with resilience and creativity to fix their own mistakes.

Repl.it and Trinket also both offer great online Python tools. We wanted students to be able to write, run, debug, and share their code online without us having to worry about creating accounts or resetting passwords.

Pete Dring

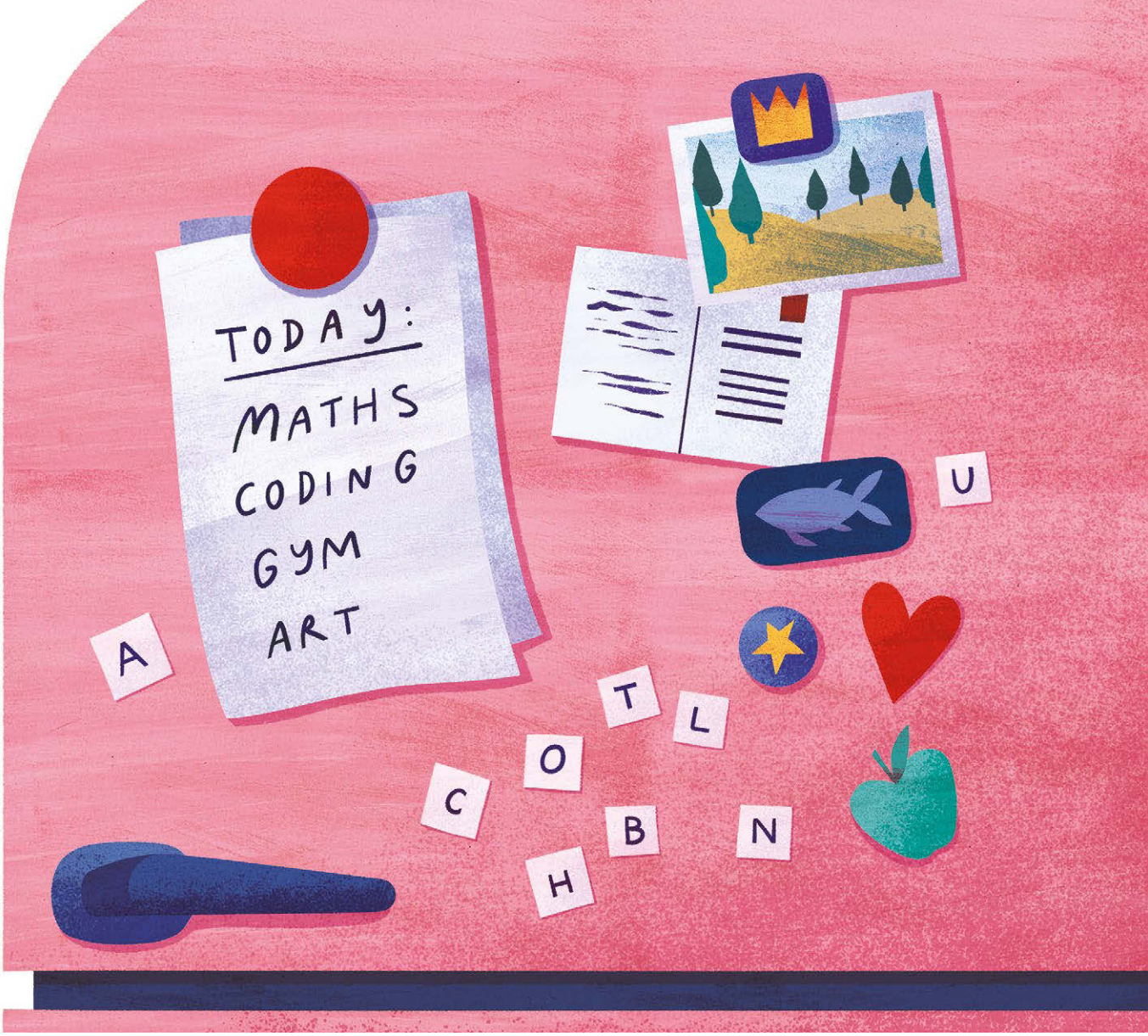
Now we have kind of got all over the emergency-ness of it, it's down to the nitty-gritty of teaching and learning. We're preparing for the GCSE non-exam assessment (NEA), so we're doing all of the preteaching for that. The students will have had lots of programming experience. But what we're doing is designing short programming tasks that build on each other, to enable the students to practise the skills that they'll need. The exam boards are currently saying that students cannot complete their NEA while not in the school building, which we're hoping will change quite quickly, because the NEA is not worth anything with regards to the GCSE weightings, and I cannot imagine anyone would want to spend 20 hours of the contact time we may have in the future completing it. So we're hoping that they'll change that rule. But in any case, it's a good way to practise programming.

Katie Vanderpere-Brown

THE FUTURE

Teachers have been reflecting on the impact of the coronavirus outbreak on their work and the future of education.

I really miss the kids. Because I've kind of been back and forth, I've been thinking about whether I'd leave the classroom or



© Amy Grimes

I'd like to be in an admin type of role. I've done a lot of that during this time, providing a lot of support for faculty members and curriculum writing. But at the end of the day, I really miss the kids. So it's taught me that I still really love teaching.
Alexis Cobo

Life has changed dramatically over the last two months and who knows what the future will look like, but we need to work together and stay positive. Our students are changing and adapting like nothing we have ever seen before.
Sam Hankin

I think there are definitely things like the way that I am teaching particularly that could change. If a student's not in school for whatever reason, if they're at home or they can't get into school, why can't they just join the class online? I've got a disabled student in my Year 13 class (age 16–17), and she's not missed an online lesson once, regardless of what's going on at home. So if she does have to be in hospital or she has to be doing something else, why aren't I using these tools all the time?
Katy Teague Head of Computer Science at Grey Court School, an academy in Richmond

I've learnt not to underestimate how resilient students actually are. The students have shown that actually they can learn at home quite well. I think giving them the resources and potentially more structured lessons to do at home is really, really beneficial. And come exam time they will know how to revise at home.
Jim Green

I hope that this crisis wakes the educational establishment up to the potential of remote learning and breaks the obsession with terminal exams, shifting the focus back on to the joy and wonder of learning something new.
Pete Dring

There is a sense of community that being at school brings. The buzz you get from a room full of young people ready to learn. Humans are innately social animals, wanting to come together in the same space to learn. That is something that simply cannot be replaced by video links and virtual classroom spaces. But the situation forced on us has given us a taste of an exciting new way of working. We will need to find a new middle ground. I hope for a change from the traditional Victorian model of school that has endured for so many years, to a new model fit for a new era that will come out of this time.
Matthew Wimpenny-Smith (HW)

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AND WHAT NEXT?

The implications of emergency remote teaching on the future of education are far-reaching

The need to switch to home teaching and learning has been a true emergency, and it's incredible that so much learning has been made possible within such a short time. Teachers have worked immeasurably hard to support pupils at home, and organisations and programmes have quickly pivoted to respond with engaging content and resources.

School closures can impact the most disadvantaged children in our communities. Research emerging at the time of writing illustrates that we can actually quantify the number of hours and weeks of education lost by those without full access to home learning, and the effect of class differences on access to education is incredibly sad. But what can we do about it?

Firstly, before rushing to reinvent the wheel, we need to learn from the research we already have. There have been decades of research on how to maximise the impact of online and blended learning. For example, the format of flipped blended instruction, where content is shared through the use of technology and the application of learning supported through an educator, has been found to demonstrate improved learning outcomes. It can be difficult for teachers to access such research findings, so the NCCE is providing accessible summaries at **teachcomputing.org/pedagogy**.

Secondly, we urgently need more research on how best to support our students and limit disadvantage as much as we can, in particular around the online participation of groups that are typically under-represented in computing education and those with special educational needs and disabilities (SEND). Catherine Elliott's column in this issue (pages 16–17) is a useful read to find out more about working with SEND children online. I hope that we can learn from all the experience we've gained in the period of school closures by reporting on what works and what doesn't.

Finally, we need to think carefully about the future of education. Are there new opportunities or ways of seeing things? A World Economic Forum report suggests that there are some ways in which education may change forever as a result of the coronavirus pandemic. Technology has stepped in to help us, the article suggests, but how does that change the role of the educator going forward—will they become more facilitator than deliverer? As we move into a world where we may have less opportunity for face-to-face interaction, in-person educational opportunities should be designed to maximise the impact of that precious time to support students, reduce isolation, and build resilience.

We can also learn from the impact of other emergencies on education. An article from the Brookings Institution uses the way school structures changed drastically in New Orleans after Hurricane Katrina to illustrate the long-term changes to education that can result from sudden crises. We've been introduced to online tools that may become a key part of the future of education, we may spend more time learning at home, and our educational opportunities may be more governed by the skills and knowledge we can evidence rather than 'age and stage'. In sum, as we move forward, we need to be prepared to think laterally about the way education works, bearing in mind the needs of all children and all families, as we put the learning from these difficult times into practice in the future. (HW)

There are many free resources students can access at home

FREE RESOURCES TO HELP TEACH COMPUTING REMOTELY

Amy O'Meara shares some of the best resources to inspire your students at home

At the time of writing, some lockdown restrictions are beginning to be eased in countries around the world. However, it is likely that remote teaching and blended learning approaches will continue to be a significant part of how we educate going forward.

When it comes to support for learning and teaching computing, there are a lot of resources out there. While this list is not exhaustive, we have compiled a snapshot of free resources that we hope will support educators in teaching their students remotely.

Khan Academy

Computing is one of the many subjects on offer from the non-profit organisation Khan Academy. Students from all over the world can avail themselves of their library of free videos, articles, practice questions, and lessons. During school closures, the organisation is offering free PDF schedules for children aged between two and eight. There are loads of resources to support teachers, including a step-by-step guide to remote learning, videos for engaging students remotely, professional development webinars, and more.

khanacademy.org

Crash Course: Computer Science

Crash Course is a popular educational YouTube channel where learners can access courses in a wide variety of fields for free. The computer science course is led by Carrie Anne Philbin, Director of Education Support at the Raspberry Pi Foundation and regular Hello World contributor. With over 40 instalments, the course covers the history of computing, the basic elements of programming and software, the evolution of how computers are used, and much more. It is ideal for anyone who wants to understand more about how computing has shaped our world.

helloworld.cc/crash

AMAZON FUTURE ENGINEER

Amazon Future Engineer is a programme that provides young people with access to computer science education, particularly those from underserved communities. To support learners during the pandemic, the company is offering free online computer science courses to teachers and students in the USA. There is a range of resources available for educators from Amazon Future Engineer and their partners, including online professional development, lesson plans, exam support, and more.

amazonfutureengineer.com

BAREFOOT COMPUTING

Barefoot is a UK-based initiative that aims to support teachers with delivering the primary computing curriculum. The group provides a range of free resources, such as cross-curricular lesson plans and online guides. In addition, their Learning Together activities are fun and engaging exercises for parents to do at home with their children.

barefootcomputing.org

Scratch in Practice

Scratch in Practice (SiP) is a platform where the Scratch team and educators from around the world can share ideas and materials. Each month, there is a new theme for educators to discuss and explore, such as Getting Started with Scratch, Curriculum Connections, and Many Paths Many Styles. Within each theme is a key activity or resource, a video from Scratch co-founder Mitchel Resnick, and a blog post by Lifelong Kindergarten group research scientist Natalie Rusk. Each theme also features tips from real educators. SiP is an opportunity to connect with other educators from around the world, and many of the resources on offer can be applied to remote teaching.

sip.scratch.mit.edu

Home Teaching

Home Teaching is a free programme from the National Centre for Computing Education (NCCE) that is designed to help students continue their computing studies while at home. Teachers and parents can schedule the activities as part of the school day. Using their network of computing hubs and a vast range of computing resources, the NCCE provides a timetable of sequential, topic-led activities and live online support sessions. The programme covers all priority curriculum topics, across all Key Stages.

ncce.io/hometeach

Online courses from the Raspberry Pi Foundation

The Raspberry Pi Foundation offers a range of free online courses based on various aspects of computing and digital making. There are lots of courses that are aimed at educators specifically, such as 'Impact of Technology: How to Lead Classroom Discussions', 'Programming 101: An Introduction to Python for Educators', 'Introduction to Cybersecurity for Teachers', and many more.

Much of the content from these courses can be applied to remote, as well as in-person, teaching. Teachers in England can also use a subset of the courses as credit towards their National Centre for Computing Education CS Accelerator Programme certificate.

helloworld.cc/rpicourses

Apps for Good

Apps for Good is a UK-based charity delivering workshops and courses to thousands of students. During the coronavirus pandemic, the team has built new versions of their courses that can be completed from home, and both classroom and home projects from around the world are eligible for an Apps for Good award. Some of the courses available that can be completed at home include: 'App Development using App Lab', 'Design an App—Paper Based', and 'Machine Learning—Home Study.'

appsforgood.org

> "TEACHERS AND PARENTS CAN SCHEDULE ACTIVITIES FOR THE SCHOOL DAY USING THESE COMPUTING HUBS AND RESOURCES

Isaac Computer Science

Isaac Computer Science is a free online platform for both teachers and students, which is part of the NCCE. For teachers, the platform offers a range of online professional development courses, high-quality materials written by experienced teachers, homework support, and much more. All the materials aim to correspond to A-level specifications. In April, the Isaac Computer Science team launched a set of new topics as well as a new series of free online workshops that teachers and students can partake in from home.

isaaccomputerscience.org

Tynker

Tynker is an educational platform on which young people can learn how to make apps, games, websites, and more. The platform has a range of block- and text-based courses tailored towards different age groups. While schools are closed, Tynker is offering free access to premium coding courses. Teachers can create a free account that will provide them with three free coding courses, over 35 Hour of Code

DIGITAL MAKING AT HOME

Digital Making at Home is a content series from the Raspberry Pi Foundation. The initiative, which began in late March, aims to support young people to get involved in coding activities from home. Each week, the team shares a weekly blog introducing a new theme, accompanied by code-along videos led by experienced teachers. There are activities for both new and experienced young coders, and many of the featured projects have been translated into multiple languages. This series is a free and accessible resource that educators can share with their students.

rpf.io/home

> REMOTE TEACHING AND BLENDED LEARNING ARE LIKELY TO REMAIN A SIGNIFICANT PART OF HOW WE TEACH

activities, professional development, and more. The platform is also offering distance learning resources for schools affected by coronavirus closures.
tynker.com

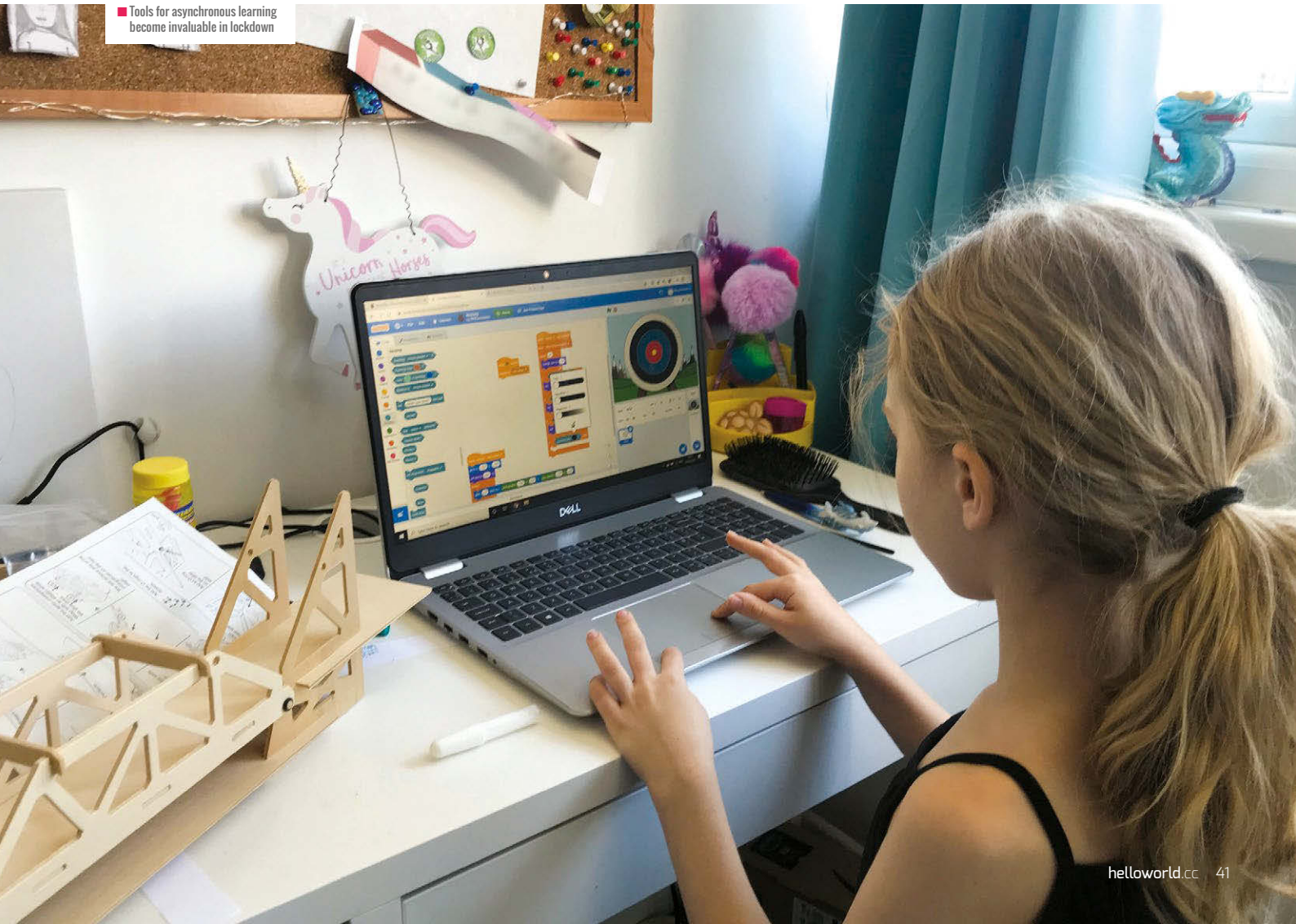
Edpuzzle

Edpuzzle is a free platform where teachers can engage their students through interactive video lessons. Using simple editing tools, teachers can personalise pre-existing videos from websites such as YouTube, Vimeo, TED, and National Geographic by adding questions, audio notes, or comments. Once the video lessons have been assigned, teachers can then track their students' progress. As learning becomes more asynchronous, with lessons conducted through video, tools such as Edpuzzle will become increasingly valuable.
edpuzzle.com

Code.org

Code.org is a US-based non-profit that aims to expand access to computer science in schools, with an emphasis on increasing participation by women and under-represented groups. Teachers around the world can create a **Code.org** account and access the organisation's curriculum, lesson plans, tools, and support for free.
Code.org (HW)

AMY O'MEARA
Amy is the Communications and Engagement Coordinator at the CoderDojo Foundation.



Tools for asynchronous learning become invaluable in lockdown

A device revolution? Image: Special Projects

HOW TO KEEP WELL WHEN TEACHING FROM HOME

The need to manage our relationship with technology is more important than ever. **Neil Rickus** offers some practical advice around digital well-being when teaching remotely

The sudden shift to teaching remotely has led to the blurring of boundaries between our home and work lives. In particular, the constant distraction of messages, notifications, and always-on access to our digital devices means it can be difficult to take a break from work, which can have damaging effects on our physical and mental well-being.

There is a range of approaches to help us use technology effectively and at an appropriate time, as well as ways to successfully manage a working environment from home.

Notifications and access

It can take around 25 minutes for us to refocus on a task following a distraction. An email arriving, or a message notification on a phone, can lead to a task taking significantly longer, even if we are undertaking work that requires little focus. Most digital devices, particularly phones and tablets, offer a do not disturb feature. While many people use this at night-time, it can also be helpful when you wish to limit disturbances. This is especially useful if you are taking part in a live learning activity, such as a video call with a class. You can also control permissions for notifications from certain apps, meaning you don't have to receive a message on your phone every time someone makes a comment in Google Classroom, for example.

On certain occasions, other solutions may be required to limit access to digital devices. While we may not wish to turn our devices off, as this may mean we miss an urgent phone call, apps such as Hold reward the user with virtual currency for not touching their phone for 20-minute periods, which can then be exchanged for other items, such as discounts on physical products.

Last year, Special Projects took part in Google's Digital Wellbeing Experiments, a collection of open-source projects to help users be more aware of how they use their devices and reduce their screen time. These include Paper Phone, a printout that contains important information for the day, and Envelope, where a user places their phone in paper packaging that limits use to phone calls or photography. While these whimsical projects may seem far-fetched, they serve as a reminder that there are ways to step away from our devices.

Social media usage has increased significantly during the coronavirus pandemic, and notifications from these platforms can be distracting. Most platforms allow the user to specify the type of

An envelope that restricts phone functionality from Special Projects

> THERE IS A RANGE OF APPROACHES AVAILABLE TO HELP US USE TECHNOLOGY EFFECTIVELY AND APPROPRIATELY

notifications displayed, such as only direct messages, which can be an alternative to turning off notifications completely. Interacting with family and friends is more important than ever. However, social media can put pressure on individuals to learn or try new things during this period. This can be a particular challenge for those with unexpected extra responsibilities; the potential negative effects of this hustle culture, such as the impact on our spare time, should be carefully considered.

Where feasible, it is also important to try and manage the digital well-being of others. Receiving emails at unsociable hours is often cited as a cause of anxiety, and at the moment, this can be difficult to avoid, particularly if you're having to manage changes in working hours and caring responsibilities. Many email platforms let you delay the sending of emails until a future time. For example, if you compose an email at 10pm, it is possible to ensure that it won't be sent to the recipient until the following morning.

Physical environment and exercise

When teaching in a traditional classroom, we often spend a significant amount of time on our feet, moving around the room and supporting students. The shift to spending large amounts of time sitting at a computer can also have an impact on physical well-being. The Health and Safety Executive outlines the importance of taking regular breaks from using a machine and provides a useful guide for setting up display screen equipment. A correctly positioned external monitor can contribute to improving posture.

As for many of us our home has now become our workplace, the distinction between the two can be difficult to manage. Packing away any technology, books, or resources you have been using, or closing the door to any dedicated working space that you may have, can help you transition away from work at the end of the day.

The need for exercise is regularly highlighted as important for improving well-being, and the opportunity to leave the home is a vital part of the day for many of us. A number of apps allow us to track our exercise and share it with others, although whether you wish to use a digital device in this manner will depend on your personal preferences. Strava enables you to measure your performance against other people that have also visited a similar area and to share your workouts, which has the added benefit of receiving kudos from others. Sweatcoin allows you to earn virtual currency through exercise, which can then be exchanged for other products, including physical items, in the real world. Finally, Geocaching allows you to find physical items in the real world, which can be logged and tracked online.

How are you managing your digital well-being while teaching remotely? Do you use other strategies? Perhaps some of the suggestions in the article have been beneficial. Do get in touch on social media and let the Hello World team know. (HW)

NEIL RICKUS

Neil is a Senior Lecturer in Computing Education at the University of Hertfordshire, a primary education consultant for the BCS, and the founder of Computing Champions. He is a CAS community leader, a CEOP Ambassador, and a Raspberry Pi, Google, and Microsoft Certified Educator (**@computingchamps**).

WHERE TO FIND SUPPORT

Professional support to manage your well-being can be accessed through your employer, your union, a medical practitioner, or from these organisations:

Mind, the mental health charity, has produced a guide examining coronavirus and well-being: **helloworld.cc/mindcovid**.

The Education Support Partnership (**educationsupport.org.uk**) has a free, confidential counselling service for teachers, on 08000 562 561. Their support is not limited to work-related issues.

Further practical advice is available from a range of teaching-related organisations, including NASUWT: **helloworld.cc/nasuwtcovid**.

The Samaritans (**www.samaritans.org**) offer free and confidential support 24 hours a day, and you can call their UK helpline on 116 123.

SAFEGUARDING IN ONLINE LESSONS

How do you organise live learning sessions that are both safe and help young people to learn? **Carrie Anne Philbin** investigates

Transitioning learning from a face-to-face interaction to online can sound straightforward, especially as we now live in a society where it's common to have access to devices and the internet. In a school environment, it is easier to promote the welfare of young people and vulnerable adults and to keep them safe, thanks to well-established routines built on decades of learning. So in this new world we find ourselves in, how do we promote the well-being of young people while they learn with you online? Here are some tips that might help, based on feedback and ideas from brilliant educators, and leading children's charities such as the NSPCC (nspcc.org.uk), who have tested different approaches to hosting online sessions.

There are four areas to think about if you want to host online teaching sessions:

- Choosing the right technology
- Communicating with young people and parents
- Designing your session
- Child protection

Choosing the right technology

There are lots of different tools that you could use to host live sessions, and they vary in their functionality, cost, and usability. When choosing a technology, think about how you intend to use it and how your intended audience will use it. Consider whether it allows private communication between you and young people, or between young people, as this could be a safeguarding risk. Use your school account and not a personal account when using online tools, and check the privacy settings. It's also a good idea to test the functionality of the technology with colleagues, perhaps by having a practice run of your session. They can stress-test any interactive features, and provide you with useful feedback to incorporate before you run it with students.

Another consideration is access. Does the technology you want to use require young people to have an online account? This may be an issue for learners below the age of 13. Do check your school e-safety policy, as it is likely that there is already guidance available on this issue.

SAFEGUARDING ONLINE GUIDES FOR TEACHERS

- NSPCC Undertaking remote teaching safely (**helloworld.cc/NSPCC**)
- GOV.UK Education for a Connected World Framework (**helloworld.cc/govuk**)
- UK Government Coronavirus safeguarding guidance (due to be updated in June) (**helloworld.cc/safeguarding**)
- Childnet-Teachers and Professionals Section (**helloworld.cc/childnet**)
- UK Safer Internet Centre-Social Media Guides (**helloworld.cc/guides**)

Communicating with young people and parents

Every organisation that provides activities for children and young people needs to get consent from parents or carers for their child to participate. A well-written consent form will support your efforts to ensure parents, carers, and children understand the benefits and risks of online lessons, as well as providing written consent for children to take part. The NSPCC have an example consent form to help get you started (**helloworld.cc/consent**).

It's also a good idea to share a link to your online session in advance with parents, carers, and young people, as well as any instructions they will need for joining. You could also share what you are planning for your learners to work on, including links to any online projects or PDF files they may need. This will help your students to prepare for the session, and keep their adults informed about the learning you want them to experience.

Designing your session

Like any lesson, you should design the session structure and prepare your materials before you announce that you're going live online. If it is the first time using the online technology, I'd recommend having an introduction or starter activity that gives students the opportunity to play with the features. If there is a live comment stream, you might ask them to all say who they are and what they're hoping to learn in the session. I find that allowing this type of structured play reduces the opportunity for misusing the technology later.

You can share instructions in advance

> WHETHER TEACHING ONLINE OR IN CLASS, YOU HAVE THE SAME SAFEGUARDING RESPONSIBILITIES AS A TEACHER

You should consider where you are going to present your session from. The NSPCC suggests you should be in 'a neutral area where nothing personal or inappropriate can be seen or heard in the background'.

I'd also advocate having another teacher or responsible adult acting as a teaching assistant during the lesson. They can moderate any feature misuse and keep an eye out for any safeguarding issues.

Child protection

Whether you are teaching online or in class, you have the same responsibilities as a teacher, and that means if you see or hear anything that worries you during the session, or a child discloses anything to you via email, then you must disclose this to your child protection lead immediately. Make sure you have their contact details to hand and check your school's safeguarding and child protection policy and procedures. (HW)

CARRIE ANNE PHILBIN

Carrie Anne is Director of Educator Support, Raspberry Pi Foundation, and host of Crash Course Computer Science and GeekGurlDiaries, leading educational resources for the NCCE.

HOW TO CURATE MEANINGFUL ONLINE LEARNING EXPERIENCES

Learning online is rarely simple. **Mac Bowley** shares his experiences of what works when teaching remotely

As the coronavirus pandemic continues to unfold, educators the world over are turning to online learning as a way of bridging the gap for their students. That being said, how can teachers and educators support their students to learn effectively from home?

My colleagues and I have been creating online learning experiences for four years, including professional development courses for teachers and introductory courses on digital making for anyone who wants to upskill. As a result, we understand the challenges of online learning and the pitfalls that course facilitators can face. Our work also requires us to understand how our audiences learn online and the best ways to make that learning stick. While our audience is largely composed of adult students, much of the experience we are about to share will also be transferable to younger learners. We would like to share our experience to help you and your students manage successful online learning.

Setting personal goals

I would assert that when a student sets personal goals, their learning becomes more meaningful. In our online courses, we always ask students in the beginning what key things they'd like to learn, and this has helped them guide their own learning. Likewise, teachers can encourage their students to take ownership of their learning by setting personal goals, and this will help the student to become more engaged. These goals can be long or short, and they do not have to be constrained to a single lesson.

For example, a student of mine who had just started a GCSE was struggling to practise programming at home, finding it difficult to overcome syntax errors. I asked him what he wanted to achieve and he decided he wanted to "finish a project". I then encouraged him to do one of the projects from the Raspberry Pi website, with guides to help him overcome errors. This was a smaller goal than the learning objectives we had in class, but after he completed it, I could tell it had been huge for him. He was excitedly telling other members of the class about his completed project with a smile on his face.

Encouraging ownership

Once students have outlined what it is they'd like to learn, it is important that they review and revisit their goals as often as possible. It is important that this process is more than a box-ticking exercise, and that students are regularly consolidating what they've learnt by putting it into practice. Teachers can work together with their students to assess how well they achieved their goals last time, and assist them in adjusting their current goals in response.

Mixing things up

Although the internet provides many learning resources, it also provides a plethora of distractions. When my colleagues and I are creating online courses, we have to acknowledge the fact that at any given moment, there are plenty of other things that learners could be doing! Many teachers will be faced with similar concerns when delivering online learning.

A good way to minimise distractions and to keep learners interested is by having variety within the learning material. In our online courses, we employ a mix of media and tasks to keep learners engaged in the subject matter. I'd recommend having a good mixture

Educators are using online learning to help students bridge the gap during the pandemic

■ Learning Manager Mac Bowley shares his experience of creating online learning experiences

of articles, videos, games, puzzles, quizzes, and audio in any home-learning assignment.

Applying learnings effectively

Learning online can be a fleeting process—it can be easy to whizz through a course or resource in no time, only to put it down and not think about it again. For teachers, there is presently the added challenge of not being able to reinforce students' learning in the classroom environment.

However, there is almost always some sort of practical task or project students can do to apply the theory they have been learning, and that goes for online learning too. For example, if students are learning about the World Wide Web, they could apply their learning by creating a DNS server in Scratch. Or, if they are covering binary conversions, using Python to make a converter will enable them to check their own answers.

Constructive assessment

Tests have a bad reputation. They are often associated with anxiety, fear of failure, and comparison to others—feelings that can arguably stem from our own past school experiences. However, online learning provides the opportunity to present tests in a new light, whereby the only comparisons learners should make is to their own previous skills and experience.

In our online courses we make use of frequent, short quizzes. This helps students to identify whether they have succeeded in their goals or if they need more work. A good approach is to frame the tests as being beneficial to the student, rather than the teacher, which in turn will hopefully reinforce the student's feeling of ownership over their learning.

Socialising is learning

As humans, we all benefit from social interaction across all types of learning—particularly in online learning, which can sometimes feel a bit lonely and isolated. It is well known that there are enormous benefits to be gained by sharing your knowledge with others, such as improved confidence, communication skills, and greater understanding of the material in question. We see this all the time in our online courses, whereby learners share their progress in the comments and their peers respond with encouragement, tips, and advice.

Teachers can foster this approach by encouraging students to share their learning and teach others—whether that be siblings, parents, or classmates. This could be implemented by providing a space for students to show off what they have done and receive constructive feedback, either through tools like Padlet, or through virtual learning environments where students can post and comment on each other's work.

Go forth and learn

I hope that teachers reading this will find these tips useful, and can use some of them in online learning assignments or lessons. Home learning can be a challenge, but it can also be a hugely productive way to teach. (HW)

■ Mixed media and a variety of tasks are important for ensuring students remain focused

E-LEARNING TOP TEN TIPS

1. Establish a routine: start and end learning at the same time each day
2. Encourage breaks: rest is important too
3. Make it interactive: give students opportunities to interact with each other
4. Students set their own learning objectives
5. Remote conversations don't always have to be about learning
6. Offer help and support just as you would in person
7. Background noise can help ease the sense of isolation
8. Create a space to work in that you don't use any other time
9. Don't stay indoors all day: get outdoors!
10. Socialising is not a distraction: use it for learning

MAC BOWLEY

Mac is a Learning Manager in the Raspberry Pi Foundation online learning team, and spends his days writing courses for computing educators. He also enjoys baking bread and tinkering with electronics. (**@Mac_Bowley**).

HOW TO MANAGE SCREEN TIME

Sway Grantham shares guidance for a balanced approach to children's use of devices, at a time when we all depend on them more than ever

The amount of time children should spend using devices is a hotly debated topic in schools. From trying to support parents and their children at home to ensuring learners grow up with the digital skills required to succeed, we are often trying to juggle the educational impact of digital devices but also their health and social implications. Digital devices are currently the way in which we connect to the outside world, attend meetings and lessons, and complete schoolwork. They are providing a vital escape during a difficult time. It becomes harder each year to avoid using screens ourselves or to ask that of children and young people, and right now, limiting screen time could mean limiting the time someone has to talk to a family member or to practise their times tables.

Not all screen time is the same

Children and young people are surrounded by digital devices and will have opportunities to use them throughout their lives. They need to learn from an early age how to do this safely and how to make informed decisions about their own device usage. Ofcom's 'Children and Parents: Media Use and Attitudes' report demonstrates just how prevalent devices were to young people in 2019:

- 24% of 3–4-year-olds have their own tablet
- 37% of 5–7-year-olds have their own tablet and 5% have their own smartphone
- 49% of 8–11-year-olds have their own tablet and 37% have their own smartphone
- 59% of 12–15-year-olds have their own tablet and 83% have their own smartphone

And, of course, there are many more children who, while they don't have their own device, do have access either to devices shared amongst siblings or an adult-owned device.

According to The Royal College of Paediatrics and Child's Health's 2019 advice, initial guidelines on the number of hours children of different ages should spend on a screen have largely been discredited as too simplistic and unachievable in modern society, as well as lacking in robust evidence. Research in this area was historically around watching TV, a more passive activity than many phone, tablet, or games console activities, and took

no account of differences in households where there may not be stimulating alternatives to learning through a screen.

This, paired with the latest conclusions from the LSE Media Policy Project, which is reviewing current advice and upcoming research on the topic of screen time, suggests that the name itself is the problem. It's not the time someone spends on a screen that is a concern, it's about:

- Screen context (where, when, and how digital media are accessed)
- Content (what is being watched or used)
- Connections (whether and how relationships are facilitated or impeded)

Other guidance from organisations such as the World Health Organisation expresses concerns about the sedentary behaviours that are associated with using digital devices, and many organisations are worried about device use displacing other activities, such as spending time socialising, doing physical activity, or getting enough sleep. A final concern is around adult behaviour when a child is using a device, as research shows a reduction in adults talking to children if the television is on, or if the child is using a device. If this happens regularly, children will be exposed to less vocabulary than those who are spoken to more frequently.

PRACTISE WHAT YOU PREACH

It's always worth taking the time as an adult to consider your own screen usage. After all, digital devices are as much a part of our lives as they are for the children we teach. Sometimes even more so when we use screens for work before, after and during school hours. Remember to share these health and safety tips with both children and adults:

- Sit properly, ideally at a desk, when using a device for a prolonged time
- Ensure you regularly give your eyes breaks from focusing on the screen by looking at something in the distance
- Try not to use a screen (TV, phone, laptop) for an hour before bed, as the blue light can interrupt the quality of your sleep
- Think now and then about what you would be doing if you were not using a device

> "INITIAL GUIDELINES ON HOW MANY HOURS CHILDREN SHOULD SPEND ON A SCREEN WERE TOO SIMPLISTIC

Implications for school

The nature of a school day means that it is unlikely that there will ever be prolonged digital device usage that could lead to concerns over excessive sedentary behaviours, not getting enough sleep, or reduced time socialising. Learners of all ages regularly change lessons, have scheduled breaks, and have to negotiate turn taking, all of which prohibit prolonged use. You may want to consider the value of learners sharing devices in lessons, not just for logistical or financial reasons, but also to ensure a positive social dialogue takes place as they are interacting with the device.

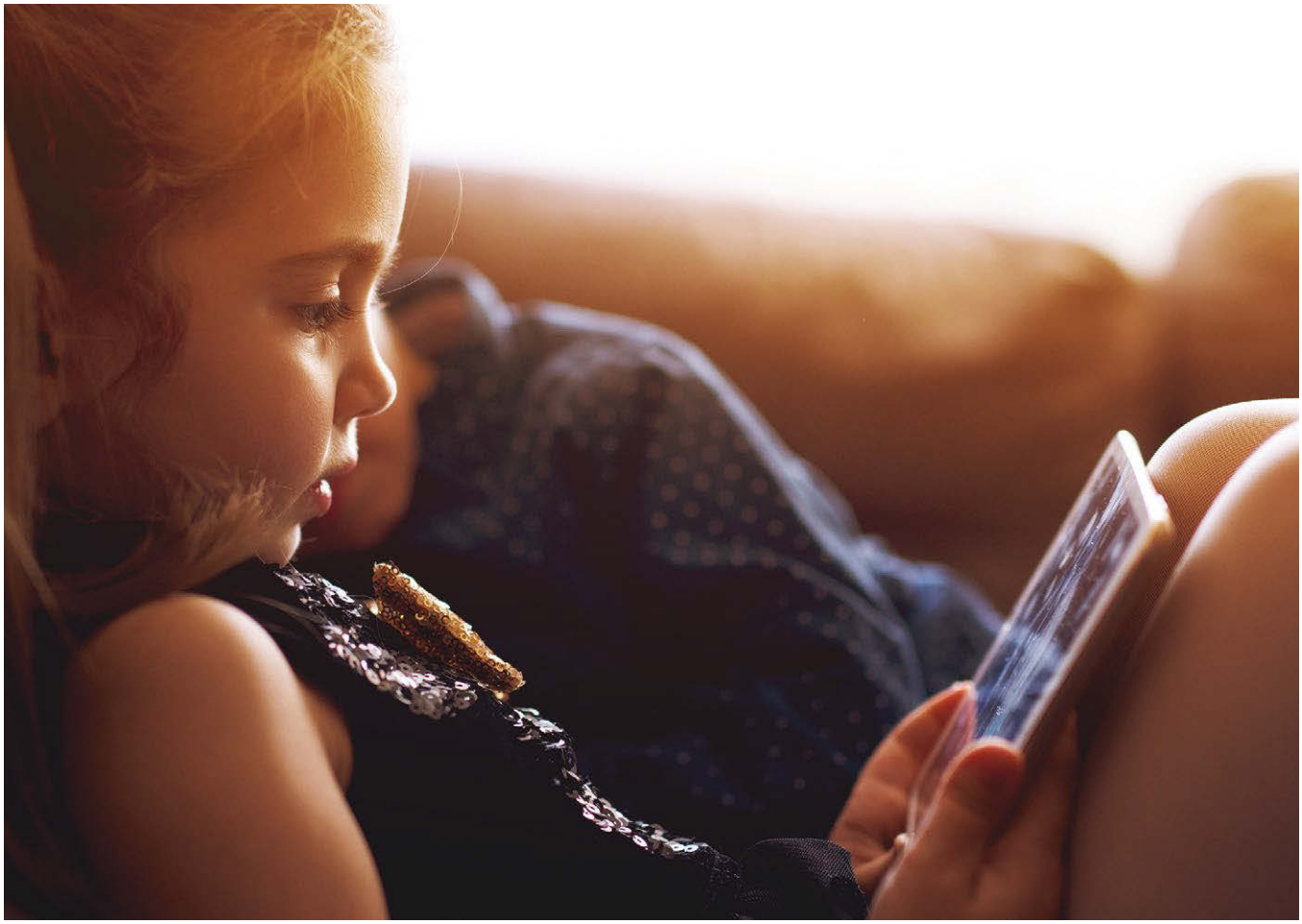
Another place school can support is in educating children around the importance of experiencing a range of activities and the development of self-regulatory behaviours. The Children's Commissioner's Digital 5 A Day resource is a great way to start talking about our habits, both online and offline.

The Children's Commissioner's Digital 5 A Day resource

After all, some people might argue that regularly spending all day reading a book and not socialising, exercising, or engaging with the world is just as detrimental to development—variety is key! This resource contains a wheel of activities that we should try to do each day such as connect, be active, and get creative.

It is important to recognise that children may want to connect and get creative using a digital device, and this is fine as long as they are also being active during another part of the day. All of us have preferences for how we spend our time, and some prefer more digital activities than others. Again, this is where the wheel is useful at encouraging us to spend a bit of time on the things we are less interested in. Alongside this, it's important that children begin to learn the difference between using a device to passively watch content and actively engaging through a video call or building a website. These are different activities on the wheel, and none are bad in their own right, as long as they are part of the variety of activities you take part in.

Finally, as children start to get older, they can use the tools built into their devices, such as Digital Wellbeing on Android devices and Screen Time on Apple devices, to recognise their habits and consider the diversity of activities that they are undertaking. Teaching young people how to use this information to help develop self-regulation skills can ensure they continue to use technology and enjoy its benefits in a healthy way.



Practicalities to support parents

There is no easy recipe for managing the use of devices, and so supporting the parents we work with can be a challenge. Any rules will need to grow and adapt as children and the world change, but it's important to make time to agree them together. Here are some questions we should all consider:

- **Screen context**: Are there some consistent times when I don't use devices, such as during dinner or for an hour before bed?
- **Screen content**: Am I taking part in a variety of activities on my device, some social, some creative?
- **Screen connections:** Am I still communicating with other people around me (virtually or in person) while using my device? Am I using a device when I could be talking to someone sitting next to me?
- **No screen**: Am I spending at least some time every day doing activities that do not involve a device?

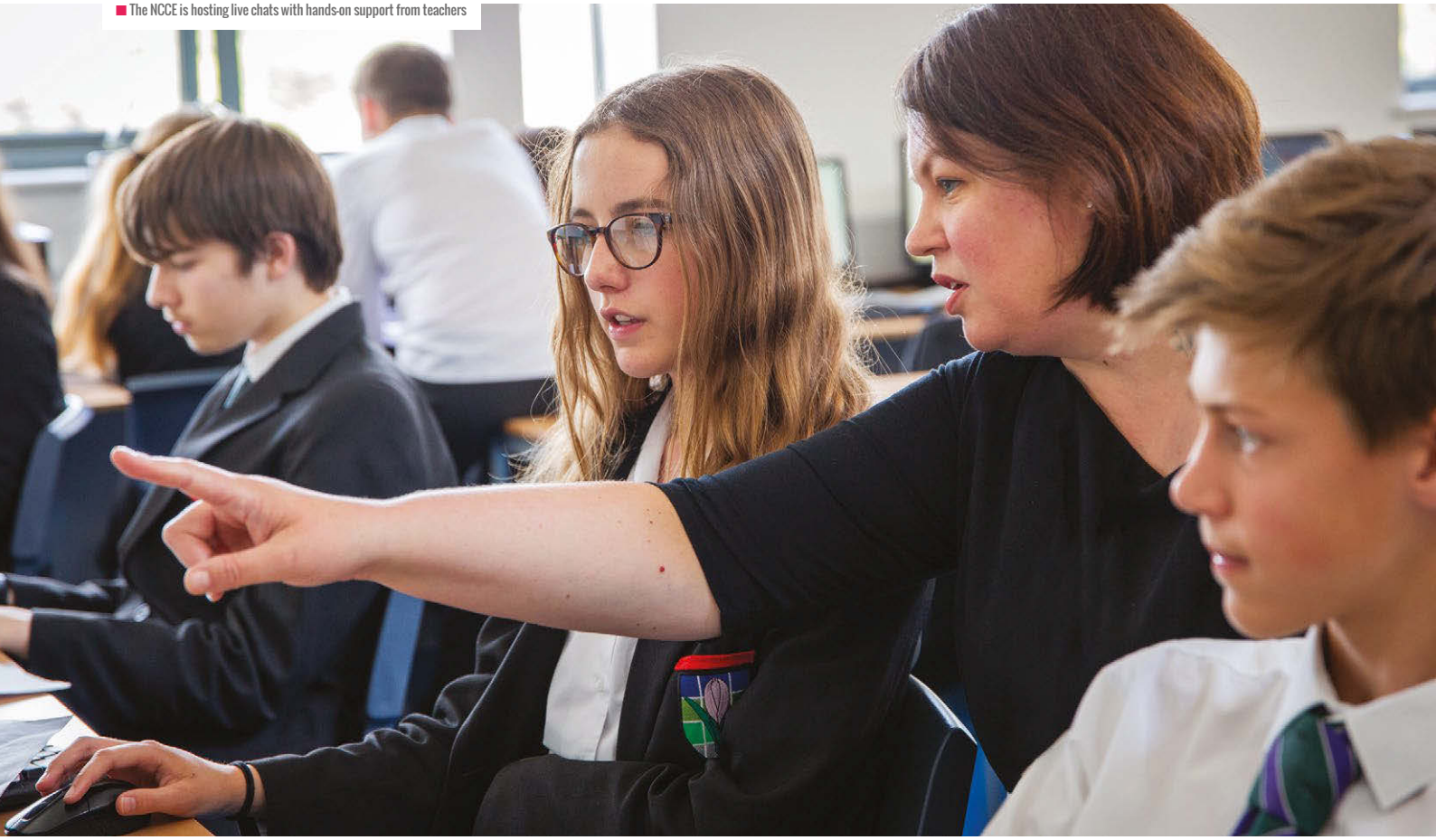
> IT'S IMPORTANT TO MAKE TIME TO AGREE ON SCREEN TIME RULES TOGETHER

Internet Matters has some tips for how to manage digital devices for each age group, which may help parents ensure they're setting appropriate expectations at **helloworld.cc/screentime**.

Using a digital device in itself is not a bad thing for any school-aged children. Whether it is for fun or for educational purposes, there's a time and a place for both. It is important to involve children in decisions about how they balance their time, both on and off devices, and the types of activities that they undertake each day. We should all try not to be too hard on anyone who occasionally has a device-centric day; after all, we have all had good intentions that haven't quite come to fruition once or twice! (HW)

SWAY GRANTHAM

Sway is a Senior Learning Manager at the Raspberry Pi Foundation, where she leads a team developing computing resources for primary teachers (**@SwayGrantham**).



The NCCE is hosting live chats with hands-on support from teachers

THE NCCE GOES ONLINE

Sue Sentance explains how the National Centre for Computing Education is continuing to support teachers

As regular readers of Hello World will be aware, the National Centre for Computing Education (NCCE), found online at **teachcomputing.org**, is an ambitious government-funded programme of training and support for computing education in England. The programme includes professional development for teachers, resources for classroom delivery, community support, and guidance on content and pedagogy, all delivered through a network of school-based computing hubs. The provision is aimed at students aged 5–18, including those taking the GCSE and A-level Computer Science qualifications in England, and includes a research programme focusing on gender balance in computing. **Although the NCCE is a virtual centre, with no central building, our hub-based delivery and community focus means that much of our activity involves teachers coming together to meet and learn about computing.**

With school closures and a new focus on learning at home, we at the NCCE have been busy ensuring that we can meet teachers', parents', and students' needs in computing.

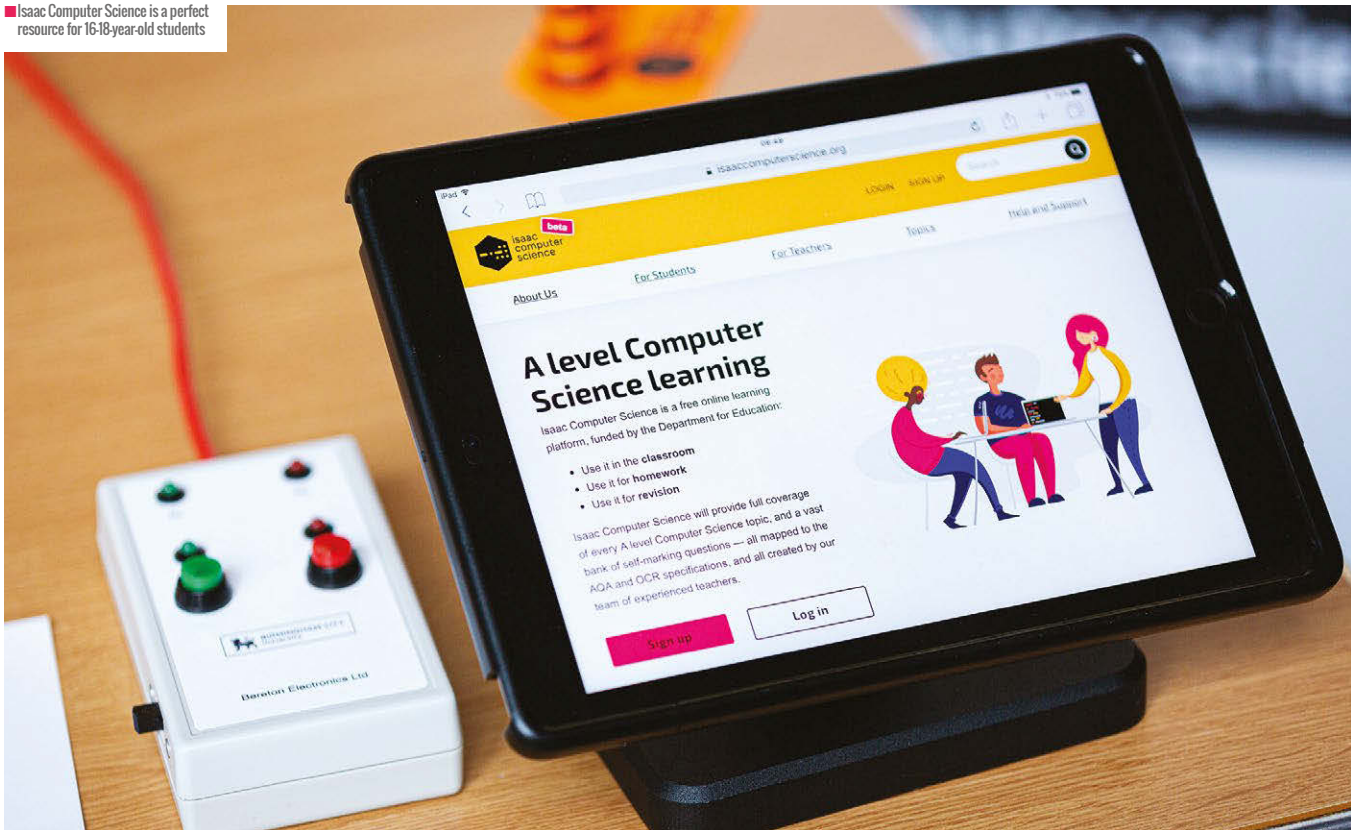
Home teaching from the NCCE

Home teaching is a completely new programme designed to help students to continue their computing studies while at home. Teachers and parents can schedule the activities as part of the school day.

Using our network of computing hubs and our consortium resources, the NCCE provides a timetable of sequential, topic-led activities and live online support during the summer term. The programme will cover a range of curriculum topics across all Key Stages.

The units of work feature high-quality and fun computing activities that are grouped by Key Stage.

If a student needs further help with an activity, they can attend one of our live drop-in sessions held online by the expert computing teachers at our school hubs. These Q&A sessions will be available every



Isaac Computer Science is a perfect resource for 16-18-year-old students

day to help explain the key principles of the weekly featured topics, and identify any misconceptions.

Our home teaching resources include the following:

- Lessons for pupils aged 5–7 that can be accessed by pupils, parents, and teachers. These are adapted from the unplugged Barefoot at Home resources (**helloworld.cc/barefoot**).
- Lessons for pupils aged 7–11 that can also be accessed by pupils, parents, and teachers. These are drawn from Code Club projects, which are perfect for developing programming and making skills, and providing both step-by-step and open-ended activities.
- For lower secondary-aged students (aged 11–14) the resources include lessons delivered by video involving walk-throughs of lessons taken from the resource repository, on topics such as mobile app development, and also Code Club projects suitable for this age group.
- For students aged 14–16, particularly those studying for qualifications such as GCSE Computer Science, there is a range of online courses that students can work through, facilitated by experts who can offer support at each stage. There are also units of work available from the Isaac Computer Science platform, which provide both explanations of topics and questions to work on.
- To complement all these resources, there are daily live chat sessions at pre-advertised times where pupils, parents, and teachers can talk to computing teachers about the work they've been doing that day.

The resources are freely available for all teachers and students anywhere in the world, with the live chat sessions available

> TO COMPLEMENT THE RESOURCES, DAILY LIVE CHAT SESSIONS ARE AVAILABLE

ONLINE PROFESSIONAL DEVELOPMENT
HOW IT WORKS, FROM TIG WILLIAMS, STEM LEARNING

We are breaking what would normally be a full day of teaching down into chunks. I feel that most people don't comfortably sit in front of a computer screen for seven and a half hours. We now take a full day of face-to-face professional development and deliver it as three sessions of an hour and a half each, spread over several days.

We're sending out joining instructions and asking participants to sign up to this at least 24 hours in advance to download any material they might need, get the relevant access codes, and get used to the systems. The main tip is then to check that everything works in advance, because if there is a problem, it's going to take a while to sort out.

KEEP IN TOUCH

We will be updating our website on an ongoing basis and sending out regular updates. Register for our newsletter (**helloworld.cc/nccenews**) or follow us on Twitter (**twitter.com/WeAreComputing**), Facebook (**www.facebook.com/WeAreComputing**), or LinkedIn (**helloworld.cc/nccelinked**).

You can also keep up-to-date with the computing world by listening to our podcast (**helloworld.cc/nccepod**), where experts, teachers, and educators come together to discuss computing education. Over the coming months, our podcast will explore the range of tools and pedagogies that support remote learning.

> THE RESOURCES ARE FREELY AVAILABLE FOR ALL TEACHERS AND STUDENTS ANYWHERE IN THE WORLD

for those in England only. Find out more about the home teaching offer here: **teachcomputing.org/home-teaching**.

Remote delivery of training courses

A wide range of training courses is available to support computing teachers developing both their subject knowledge and classroom practice. These have transitioned from a local face-to-face format to remote delivery, although they will still be run by our computing hubs. Find out more at **teachcomputing.org/courses**. A range of topics is on offer, from an introduction to primary computing to computer networks at GCSE and everything in between that you might need! They are available at a host of different dates to suit your particular needs and requirements. All remotely delivered courses are free and are delivered by certified facilitators who are all experienced computing teachers. These are aimed particularly at potential or practising teachers of computing in England, so if that's you, sign up now!

CAS Communities of practice

Computing At School (CAS) is a key element of the overall NCCE offer, providing an opportunity for teachers to meet each other, share ideas, and empower each other as computing professionals. CAS members have been meeting in communities since 2009 and are a source of great support for many teachers. CAS is a UK-wide network but is well known all over the world as a model of peer-to-peer support for educators. Traditionally CAS meetings have always been face to face, but have now transitioned to online formats. Guidance for Community Leaders has been developed to help leaders, all volunteers, run these effectively in the new format. Several regional CAS conferences planned for the summer term have similarly been transitioned to online delivery. Find out more at **computingatschool.org.uk**.

Isaac Computer Science

Isaac Computer Science is a student- and teacher-facing platform with complete curriculum content for A-level Computer Science. With a broad range of questions and hints, it's a perfect resource for 16–18-year-old students needing to work from home, and those preparing to start advanced Computer Science courses such as A-level Computer Science in September. There is a dedicated section on transition from GCSE (aged 14–16) to A-level (aged 16–18), which we know teachers and students alike find extremely useful.

Isaac events include student masterclasses and boosters, and teacher professional development. These have been transitioned from face to face to online, and continue to be delivered by higher education partners and computing hubs.

Finally, the Isaac Computer Science provision also includes a programme of online mentoring for teachers and students, where we provide small group support. Find out more at **isaaccomputerscience.org**.

Become certified

While schools are closed, there is no better time to work towards a computing education certificate to improve your understanding of computing and increase your confidence in teaching computing. Currently there are two different certificates you can work towards: Teach Primary Computing and Teach GCSE Computer Science, with a Teach Secondary Computing certificate coming soon. Find out more at **teachcomputing.org**. (HW)

SUE SENTANCE

Sue is Chief Learning Officer at the Raspberry Pi Foundation. An ex-teacher, a teacher-trainer, and an academic, she is passionate about research in computing education.

BLACKPOOL MICRO:BIT ILLUMINATIONS: A CROSS-CURRICULAR COLLABORATION

Two primary educators explain their cross-curricular collaboration encompassing design technology (DT), science, and computing using a Python-coded micro:bit

As anyone working in education knows, it can be a challenge to teach multiple subjects with varying objectives in the limited time we have for each class. However, one project last year gave us the opportunity to combine subjects and gave students a unique outlet for their creativity. This was a very exciting project and could easily be adapted for any year group in a primary setting. Watching pupils develop the social skills necessary to work as members of a team, as well as the ability to work independently when the situation demands, was very rewarding.

With a DT project looming and our science lessons focusing on electricity, we decided to create our own version of Blackpool Illuminations—a festival held each year since the nineteenth century. As we are based in Blackpool, our Year 6 children (10–11 years) had lots of inspiration to draw on.

Our first step was to evaluate the illuminations that previously featured as part of the festival, including installations such as the Four Seasons, the Enchanted Forest, and Alice in Wonderland. From this, we identified that these illuminations typically include a number of components, prompting the children to suggest that they would need to include electrical circuits to make their own designs stand out. However, something was still missing. We realised that many of our famous illuminations, such as the iconic *Swan Lake* installation, featured moving images. With this in mind, our computing teacher, Claire, suggested the missing piece we were looking for—the micro:bit!

Bringing together design technology, science, and computing

As a result of our new-found inspiration, our project was now covering three separate subjects: DT, science, and computing.

A display of finished illumination casings

The students would also need to get to grips with a range of new materials and technologies, including Python coding, micro:bits, and LED circuits. The goal was to design a series of illuminations together that would incorporate:

- Key aspects of DT, including the development and implementation of computer-based designs for practical use
- A demonstration of the pupils' ability to create a variety of electrical circuits containing multiple components
- A showcasing of the pupils' computing skills, and in particular their Python skills

The idea was simple enough to plan out, but between us, we soon realised it would be a while before we saw the final product. During weeks of DT and science lessons focusing on our goal, Claire was also working hard to keep the class up to speed with the coding of the micro:bit, to ensure everything was ready to piece together in the final week. As the pupils only had a one-hour session with Claire, two hours of DT, and two hours of science a week, it was important that every session was used wisely. Overall, the projects were expected to take six weeks, but more time was needed for Claire to introduce Python to the children, so it was important that she started before the project was introduced. Once the illuminations were finished, we planned to create a display in the school corridor for everyone to see, as well as sharing the creations with families at home on our school blog.

Creating the casing

After evaluating in detail existing illuminations in the town centre and the design criteria, the children were well

prepared to begin work on the casing of their illuminations. We had many ideas within the class, such as the Zoo Project, the Peppa Pig Project, and the Spinning Unicorn. With their audience and purpose in mind, they used general junk to create the shell of their product. They worked together in small groups of five to eight pupils to create the shape, size, and overall look of their casing, and we saw many creative ideas come to life. The children began to generate their designs in more detail and were encouraged to modify them as they found and overcame problems.

It was important that they considered their final product while creating the casing, as they had to think about the placement of the lights, and if they were including moving objects, they had to think about where they would attach them.

Electronics

The study and practical application of electronics was essential to our project. In science lessons, the pupils had three objectives to achieve, which linked well with the DT aspects of the project. The pupils were able to achieve these goals when designing, creating, and evaluating their product. The objectives they focused on were:

- Associating the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit
- Comparing and giving reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers, and the on/off position of switches
- Using recognised symbols when representing simple circuits in a diagram

Once children could demonstrate that they could create a basic circuit using a range of components, they could then incorporate it into their design. Many children decided to keep it simple with a few lights to attract their audience, while others included buzzers, motors, or pressure switches. When reflecting on and evaluating their design, it was the electronics aspect that they found most difficult. With the casing designed, painted, and ready, and the plans for the electrical circuits prepared, we were ready for the tricky bit—the micro:bit! Claire's portion of the article, below, will give us some insight into the process.

Claire: The project's computing side

Many non-specialist educators are reluctant to teach coding—imagine the scenario: your student tells you their code doesn't work and you have no idea why! However, there are lots of ways for teachers to incorporate computing into their lessons with only beginner-level knowledge. The purpose of this section of the article is to give an overview of how to run the computing side of the project.

There is also a separate section where we share some tips on how you and the students can learn through debugging (see Debugging Code box). It is inevitable that, once pupils start building up their code to contain more than a couple of messages or images, it will have errors, but these failures also allow pupils to practise their debugging skills and become more confident coders.

I would like to reassure educators not to be put off attempting this project if they feel that their students are not ready to write Python script—the same result can be achieved using the block-based Microsoft Make Code editor: **helloworld.cc/makemicro**. The Python editor can be found here: **helloworld.cc/pythonmicro**.

Pair programming is the norm for our pupils, but in this project they needed to adapt to working in groups of five to eight pupils. Working effectively around one laptop with this number of students had the potential to be quite challenging, so as long as they stayed on the same theme, they were allowed to split into subteams, write two scripts, and then combine them.

This could be achieved either by combining the code sequentially, or by using button press events so that one piece of code ran on button press A and another on button press B (see Button Presses box). Most students chose to work together at one workstation. We used laptops running Windows and a USB-connected micro:bit. To enable us to incorporate the micro:bits into the illumination casing, we also used battery packs.

At the beginning of the project, the pupils were given a handout with a list of the library images. Although this could be found in the online documentation, it was useful for them to have a hard copy to use when away from

BUTTON PRESSES

How to use button press events to make a selection between multiple sequences:

```
while True:
    if butt_a.is_pressed():
        display.scroll('Hi!')
        display.show(Image.H)
        sleep(2000)
    elif butt_b.is_pressed():
        display.scroll('Hi!')
        display.show(Image.R)
        sleep(2000)
    else:
        display.show(Image.C)
```

CLAIRE RAWLINSON

Claire teaches computing at Anchorsholme Academy, hosts a weekly Code Club, and is participating in Raspberry Pi gender balance research. She is a computer science graduate with past experience as a software engineer.

AIMEE HAINSWORTH

Aimee is a Year 6 Teacher at Anchorsholme Academy. She is the school's Modern Foreign Languages Subject Leader, as well as the director of their very successful drama club. This is the first computer science project she has been involved in.

the computer and planning the theme of their illumination. The list can be found here: **helloworld.cc/images**.

To be successful, it was expected that each group would display on the LEDs at least one scrolling message, and some library images on the theme of their illumination design.

They also had the option of some extension activities, including:

- Creating their own image and making it move
- Trying button press events to control which sequence was displayed

Downloading

In our Illuminations project, we used a USB cable to download the pupils' code onto micro:bits. We used Microsoft Edge as our preferred browser, because the children found it easier to specify where to download the file to. When Download is clicked, you can choose Save As from the pop-up box and find the micro:bit in the Save As box.

Once all code is completed and downloaded onto individual micro:bits, the pupils can attach a battery pack and they are ready to go.

Collaboration and unexpected learnings

The final stage of the project was for the children to combine the three areas (DT, science, and computing) in their illuminations. This allowed them to work collaboratively, with a strong emphasis on effective communication and skill delegation.

As a result, the pupils produced great final illuminations. They then spent some time reflecting upon the process. Interestingly, as an accidental benefit, pupils identified the value of collaboration as they saw two teachers using their knowledge and combining their skills.

At Anchorsholme Academy, we are proud to ensure that all pupils develop the creative, technical, and practical expertise needed to perform everyday tasks confidently, and to participate successfully in an increasingly technical world.

We found that this accessible, low-cost project proved a valuable learning experience for our pupils to develop these skills. We hope that our collaborative project will inspire other teachers to consider the use of coding in the wider curriculum. (HW)

Children worked in teams to write Python code to display images and words on a micro:bit

DEBUGGING CODE WITH YOUR PUPILS

When children first start learning to code, if their program doesn't do what they want it to, many will sit back and put their hand up for help. Debugging is a skill that they need to practise and develop. This involves going through their code meticulously line by line, checking the logic and syntax as they go. Giving them a debugging checklist, like the one I've shared below, helps them to track down some of their bugs independently. While working on this project, the pupils were only allowed to ask me for help once they had checked everything on the debugging checklist!

Debugging checklist

- Are all the words spelt correctly? Python is strict-every word must be spelt exactly right. Do not underestimate the number of students who will copy incorrectly!
- Are all words entered using the correct upper or lower case?
- Do all the brackets come in pairs?
- Do all the apostrophes come in pairs? Be mindful of pupils who may have included an apostrophe in their scrolling message. For instance, the line below would result in an error:

```
display.scroll('It's Great')
```

- Are your indents correct? Repetition is dependent on the indents. In the code below, pupils may wonder why the image of the square never displays. Only the indented lines of code are included in the 'while True' loop, so when it runs, it will continually loop through the scrolling string and the heart image, never reaching the square.

```
while True:
    display.scroll('Hello!')
    display.show(Image.HEART)
    sleep(2000)
display.show(Image.SQUARE)
```

- Are you using the sleep function when needed? Another reason pupils may think their code isn't doing what they expect is because they are not doing this. In the scenario below, the pupils are likely to wonder why the square is not showing. It actually is, but it is moving so fast that the eye cannot see it. They must include a 'sleep()' after each image, so that the micro:bit will pause before moving onto the next line of code.

```
while True:
    display.scroll('Hello!')
    display.show(Image.HEART)
    sleep(2000)
    display.show(Image.SQUARE)
```

- For the extension, when defining your custom image, have you set all 25 LED values, and have you included the colons?

```
boat = Image("05050:"
             "05050:"
             "05050:"
             "99999:"
             "09990")
```

For the children who had trouble visualising their custom images, I suggested they drew a grid on paper to represent the LED display, and created their image on that before writing the code. Custom images can be simplified by only using 0 and 9 for on and off, rather than varying brightness values.

Displaying scripts similar to the ones above on the large screen and predicting as a class what would happen gives opportunities for teachers to demonstrate debugging techniques and certainly aids understanding.

The final tip I give the pupils is that if their micro:bit is displaying a message that there is an error on line x of their code, the error will probably be found on line x-1.

AN INTRODUCTION TO UNPLUGGED CODING FOR PRESCHOOL CHILDREN

Hannah Hagon and colleagues share how young children were able to grasp complex programming concepts through guided play activities

Technology plays an integral role in modern society and it is widely accepted that children need to learn the relevant skills to be able to use it. We know that being introduced to a concept at a young age often gives children an advantage when learning a new skill. With this in mind, can young children learn and enjoy activities that relate to coding?

As a group of education and computing professionals, we conceived and planned a research study into the teaching of computational thinking skills to preschool children. As part of the study, we devised an exploratory investigation in the form of a coding club with three children aged two years, and another aged four years. The club took place over six weeks, with each session lasting about an hour. In this feature, we share insights and learnings from the initial session of this coding club.

Research into programming

Researchers into programming and coding with young children have suggested that young children (3–6-year-olds) can use software to program robots when taught on a one-to-one basis. However, they can find it difficult to understand the principles behind programming and coding unless the teaching methods are adapted to their needs. In addition, teaching materials need to be appropriate for the children's age, given that much of the available software, such as Scratch and Alice, requires a level of literacy that many young children do not have. Related research into the teaching of coding to 5–7-year olds, either through the medium of simple programming software (such as the Bee-Bot iPad app), or through the use of paper and pencil programming activities, found that both methods were equally successful at teaching the children to program.

Planning and organising the study

Utilising and adapting the methods employed by previous researchers convinced us that we first needed to teach children the principles behind programming and coding in simple everyday play sessions. We used an action research approach in which we planned activities, worked with the children, and then

Guided play activites helped to support the teaching of coding fundamentals

FURTHER READING

Gomes, T. C. S., Falcão, T. P., & Tedesco, P. C. D. A. R. (2018). Exploring an approach based on digital games for teaching programming concepts to young children. *International Journal of Child-Computer Interaction*, 16, 77-84.

Messer, D., Thomas, L., Holliman, A., & Kucirkova, N. (2018). Evaluating the effectiveness of an educational programming intervention on children's mathematics skills, spatial awareness and working memory. *Education and Information Technologies*, 23 2879-2888.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33-35.

evaluated the sessions. Each of the children had an adult helper—usually a family member—to support and facilitate them during the activities and to help us evaluate the children's responses.

For the first session, we focused on using guided play activities to support the children's learning of coding fundamentals. These activities incorporated music, play, and movement. The fundamental concepts we wanted the children to learn centred around:

- Algorithms: making and following rules
- Logic: the order in which rules were given
- Recording: producing a code that others could follow

We also wanted to find out if the children would be able to communicate and collaborate on tasks, particularly as they did not all know each other at the start of the study. We planned three activities lasting about 5–10 minutes, interspersed with free play and refreshments. These activities included an introduction using dolls, music, and movement, a guided activity, and a tabletop activity involving communication and collaboration.

> "THE STUDY IDENTIFIED WHETHER THE CHILDREN COULD COMMUNICATE AND COLLABORATE DURING THE TASKS SET

Dancing algorithms

After initial hellos, the beginning of the first session focused on using rules as a basic algorithmic principle. This started with a show-and-tell based on a set of moves that our dolls could make. The adults first demonstrated the dance moves of their dolls, such as sit the doll, lift the doll, or twirl the doll. We also introduced the term 'algorithm' at the beginning of the session, for example, 'My algorithm is standing the doll and cuddling the doll.'

Next, each child made up a set of rules for their doll and demonstrated these. All the dolls then danced the hokey-cokey—a popular child's song and dance that involves a sequence of repetitive actions—and, depending on location, we were all able to dance it too! We found that this song was a great way to demonstrate an algorithm in a fun and accessible manner.

The children loved the introduction with the dolls, and we decided to use these activities at the beginning of all the following sessions. Although the children did not use the word 'algorithm' (they could not even say it at the beginning!) they did understand it within the context of the introduction and the activities that followed. Our impression is that the children could learn and understand that a sequence of moves provided a set of instructions for the dolls.

Recipes for successful instructions

We wanted the children to use logic to work out a sequence or procedure, and decided to use a recipe for icing biscuits. The biscuit icing was a huge success, and the children collaborated well when working out the equipment we needed and the order of the recipe. For example, the children answered that we needed icing sugar, water, and biscuits, but had not realised that we would also need bowls and spoons to mix the ingredients. This experience was an introduction to identifying and correcting an error (debugging) and we were careful to emphasise the changing of the order of the recipe rather than apportioning blame if someone gave a wrong answer.

The children enjoyed ordering the icing biscuits activity stages

We also wanted to introduce the concept of recording their code. We felt that this was important in terms of helping the children to focus on the progression of a sequence of actions—something that could easily be lost in the excitement of taking part in an activity such as icing biscuits. We found that the children understood the concept of ordering pictures of the activities and discussed together the correct sequence. However, when the pictures were initially stuck onto the grid, the order of the pictures got confused. The children all helped each other to put them in the correct order (see picture).

Evaluating the session

Was the initial session of the coding club successful? Did the children enjoy the activities? What did the children learn?

The initial session of the coding club was successful in a number of different ways. The structure of alternating guided activities with playtimes worked well, as the children may have become fidgety or distracted if the guided activities were too long. We found that the children quickly began to work as a group, after some initial shyness. They loved making the dolls dance and making the icing, and this enjoyment helped their engagement with potentially difficult activities. At the end of the session, all the adults discussed the activities and it was thought that one of the two-year-olds needed a lot of support, while the other two only needed a little. The four-year-old mostly worked independently. Our impression is that although the youngest children sometimes needed support, this was because of distraction or some initial shyness with others, rather than a misunderstanding of the activities themselves.

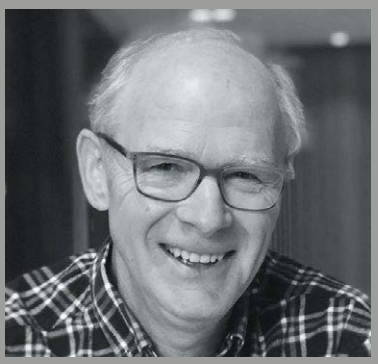
Overall, our conclusions are that many two-year-olds should be able to carry out these types of unplugged activities, which are closely related to programming and coding processes. Not only could these activities take place within any coding club for young children, but they could easily take place within a preschool or nursery setting. (HW)

HANNAH HAGON

Hannah Hagon works in the legal technology sector and also has a passion for promoting diversity in tech. As a mother to daughters, she feels it's important to show them how important technology can be for the future.

VALERIE CRITTEN

Valerie Critten was an IT teacher and coordinator at a special school for children with physical disabilities. Since graduating with an EdD from the Open University, she has published research into children with disabilities,.



DAVID MESSER

David Messer is Emeritus Professor of Education at the Open University. He has a long-standing interest in technology and education. .

COLLABORATION IN PROGRAMMING PROJECTS

Stefan Seegerer, **Tilman Michaeli,** and **Jane Waite** introduce Smerge, a free version-control system for the block-based programming language Snap!

Getting pupils to collaborate effectively on programming projects is tricky. Often we can't see how much work each pupil has done and it's hard to interrupt the flow of work to provide constructive feedback. It's also difficult to bring the reality of the world of work, and how programmers work in industry, into the classroom. Smerge is a free Snap! add-on developed by a research team in Germany that helps tackle these issues.

What is a version-control system?

Version control is crucial in real-world software development. Whether you are working in a small or large team, collaborating face to face or remotely, knowing where you are up to in the creation and modification of your code is essential. Learning about version control and the underpinning concepts as a core computational practice is important, as is learning how to use version control. However, professional tools are extremely complex, and even professional software developers can have problems with them.

Version control for Snap!

Smerge is an easy-to-use, beginner-friendly online version-control system for the block-based language Snap! Smerge enables students to work together collaboratively to develop programs. Teachers and peers can provide feedback on specific versions of a project, giving hints, tips, and suggestions for improvement, and they can do this in class or at home.

The design of Smerge was based on a review of professional version-control systems and how they were used in computer science classrooms. While being tailored to novice programmers, Smerge still includes all core concepts of professional version-control systems, which are:

- Project history: in Smerge, the project and its history are visualised in a project history diagram (a graph).
- Committing: changes are added to the project by committing them to the version control system; this is done within Snap! as changes are committed back to Smerge by simply clicking on an add-on Snap! block ('Post to smerge').
- Branching: branching opens an alternative path so that changes can be made in parallel. A branch might be used for developing new features or fixing bugs, without impacting the current state of the project. This is where Smerge differs from many existing systems. Each person editing the shared program is provided with their branch automatically.
- Merging: a version control system simplifies combining changes and the resolution of conflicts. For merging, users select which nodes they want to merge in the project history diagram (graph) and confirm their selection. When possible, conflicts are resolved automatically by Smerge. If they cannot be automatically resolved, the conflicting code fragments are shown in a merge view in Snap! for the person editing the program to sort out.
- Data backup: having all files backed up to version control allows for returning to every (older) version easily, thus, enabling risk-free trial and exploration of different ideas. In Smerge, old versions can be accessed using the graph.

How to Smerge

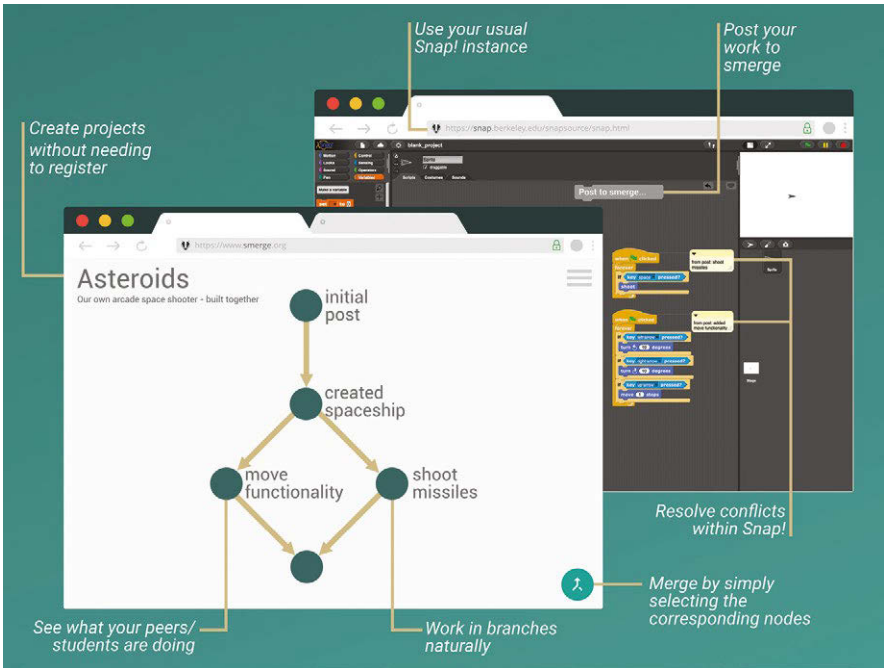
To get started with Smerge, the teacher or students create a project on **smerge.org**. At no point do they need to register on the Smerge system. Students might start from a given template or a plain Snap! project. Imagine that a team wants to create a game such as Asteroids, the classic arcade shooter game. One student can develop the functionality to move the spaceship, and another to program the feature to shoot missiles.

To start implementing this in Snap!, each of the students just double-clicks on the node they would like to edit. Each student is automatically provided with their own branch to work on. Then, they just use their usual Snap! window for programming. When finishing adding their feature, they post their program back to Smerge by using the custom 'Post to smerge' block in Snap! This block is found on the variables palette.

USEFUL SMERGE FEATURES

Smerge was created for classrooms and offers teaching and learning features:

- Enables collaboration on project-based learning with Snap!
- Teachers can supply custom sample code
- Teachers and students can provide feedback or marking and suggest alternative ways forward
- Helps teach industry version control skills
- Helps students think about the development process by making it more transparent
- Students can see the version history, revert changes, and go back to old versions
- Teachers and students can easily share projects with no need to register and no personal information stored



■ Smerge makes version control simple

One of the students then activates the merge mode in Smerge. This is done by clicking the merge button. The student selects the two nodes to be merged and confirms the selection. The code will be automatically merged, resulting in a new version. If more than one student changed the code for the same script in the same sprite, both versions of that changed script are retained by Smerge and both are shown in the new merged code. This enables the students to discuss the conflict, test the two options, and choose which version to keep.

Project ideas

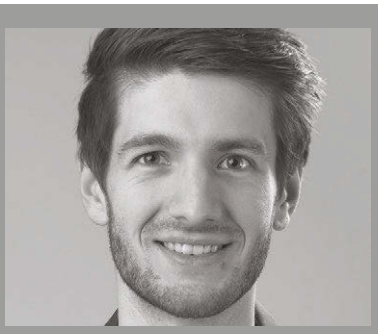
You can use Smerge for any Snap! project. Here are some ideas to foster collaboration:

- Animal dance party: the teacher creates a starter program, with one dancer and music. Every student then adds their own dancer to the party.
- Celebration card: in this project, students collaboratively create a celebration card, such as a birthday card. Every student creates one letter, and the letters are shown one after the other. This involves students working out how to coordinate the appearance of each sprite.
- Quizzes: the teacher provides a starter quiz and students add extra questions. Lots of testing might be needed here to check that shared variables, such as a score, and lives are used in the same way by all contributors.
- Animated story: students storyboard the animation of a story, figure out what work needs to be done, and share the work between group members.
- Games: last but not least, students can collaboratively create games, as each student focuses on its different parts.

Pedagogy ideas

As well as modelling how Smerge works, try a 'use, modify, create' approach. Create an example Smerge project and ask students to explore the project history. Then ask them to take one branch to make their own version. Ask the students to work in pairs to compare their versions and discuss a potential combined version. Encourage using the merge mode, and compare the results with their expectations. You could start more simply, introducing collaboration later on.

Using Smerge in the classroom provides valuable opportunities to address important aspects of collaboration and program design. When using version-control systems, students learn to sensibly decompose functionality, create reusable functions, think about interfaces or test data, and meaningfully name sprites, assets, or descriptions of what has been changed. Smerge is free to access at **smerge.org**. (HW)



STEFAN SEEGERER

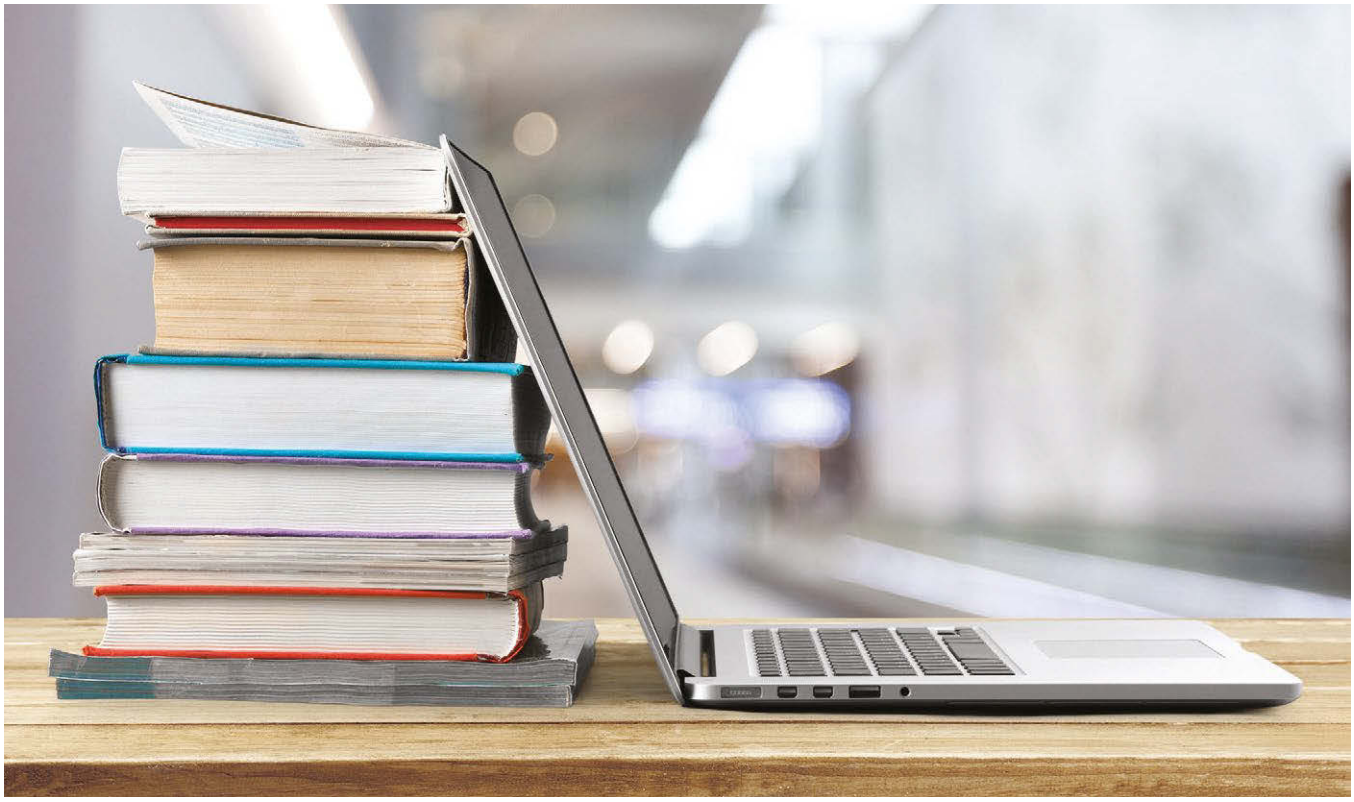
Stefan is a researcher at the Computing Education Research Group within the FAU in Germany, exploring ways to make computing accessible to everyone (**@StefanSeegerer**).

TILMAN MICHAELI

Tilman is a researcher at the Computing Education Research Group within the FAU in Germany. He is working on projects such as developing concepts for the classroom supporting debugging skills, demystifying AI, and fostering collaboration for programming projects.

JANE WAITE

Jane is a researcher and teacher trainer at Queen Mary, University of London. Current interests include using design in primary programming, semantic waves, PRIMM, and migrating to online teaching using ABC.



BACK TO SCHOOL

Computer science teachers come to the subject with a wide range of backgrounds. **Victoria Temple** shares the story of Karen Morris, who is taking A-level Computer Science while teaching the subject at GCSE

Computer science teacher Karen Morris may be head of department at Stroud High School, but she's also a student—at her own school. Karen teaches computer science at the girls' grammar school in Gloucestershire, and also sits alongside the sixth form students to study for Computer Science A level. Karen says she "absolutely loves" her dual role and her enthusiasm for computer science is genuine and inspiring.

It's also a relatively new journey for Karen, who trained as a geography teacher with ICT as a second subject. She taught geography for four years before joining Stroud High School as an ICT teacher eleven years ago. In 2014, when the government introduced computer science as a subject to replace ICT, Karen had just returned to work after her maternity leave. She switched to full-time teaching of computer science and knew that she needed to upgrade her skills. "I had really had my head in the sand prior to that regarding computer science, but I knew I was going to have to try to learn programming and get to grips with it," she said. In the last two years, Karen has stepped up a gear, driving forward exciting change at the school.

Teacher and A-level student

"We've been working at full pelt, and I've really enjoyed shaping the department and the development of computer science at the school," said Karen, who completed the NCCE Computer Science Accelerator programme last summer, which aims to upskill non-specialist computer science teachers.

"Our current Year 12 [16–17 years] were the first year to do GCSE Computer Science and they've shared my journey. I realised that we would also need to have a really strong foundation in Key Stage 3 [11–14 years]. We've developed our programming and put in a really good foundation ahead of the GCSE years," she said.

"One thing which has had a massive impact has been being a part of the local Cyber First Schools programme created by the National Cyber Security Centre (NCSE) at GCHQ. We've been taking part in many CyberFirst events and competitions, which have really inspired our students. Being part of that has had a huge impact on us."

KAREN'S TOP TIPS

- Be a role model-if students see you being inspired by tech, they will be too
- Offer as many opportunities as you can to engage with the subject outside of lessons, as lesson time is limited
- Don't be afraid to say you don't know something-you can find out together
- Speak to other specialist CS teachers, who will probably be more than willing to help and support you
- Be enthusiastic!

Karen has now also joined her pioneering group of Year 12 students to study for Computer Science A level at the school. "I really love it. It's been a massive opportunity and has given me the understanding and confidence to be a better teacher, as well as a fuller understanding of how and why computers work. Everyone here at Stroud High has been so supportive. My teaching timetable has been fitted around the A-level class."

Karen's YouTube star teacher

Karen's A-level class is being taught by her colleague, Craig Sargent, YouTube star of the Craig 'n' Dave videos.

"He's been an amazing support, and he's a real celebrity in the world of computer science education, particularly with students who have used the videos for their learning," said Karen.

"We've been using their flipped classroom method, which students watch videos before they come in and then build on that in class—it really helps to consolidate their learning."

Of course, Karen, like her fellow A-level students, is now getting used to working from home following the closure of schools as a result of the coronavirus crisis.

"For us working in computer science, it's been a fairly straightforward adjustment, as there are so many good resources available online that we can provide our students links to, but there have been the usual technology and login issues at the students' end which needed ironing out. With Craig 'n' Dave lessons in place for GCSE and A level, business can just carry on as normal on the whole—just remotely!"

Computer science teacher Karen Morris is also an A-level student

She's also been grateful to CAS for valuable resources, but particularly the CAS Community. "I attend local CAS Hub meetings and the opportunity to talk to others is one of the most valuable things I take from CAS. We're currently in the process of rearranging things for next September and have been looking at using CAS resources to enhance our Key Stage 3 curriculum, particularly Python-related resources."

Interest in computing science is growing throughout the school and Karen is aware that she's a role model for the girls. "They have seen it's not just about programming. There are all sorts of different things you can do with these skills," she said. "We've been really pleased to see our computer science department growing—and that many girls are now keen to do the subject. We've got increasing numbers in each year group now, and it looks like we'll have a good uptake for next year's GCSE group. It's a really exciting time, and I'm so proud of how computer science is a key part of the curriculum at Stroud High, with many girls being inspired by the power of tech!" (HW)

VICTORIA TEMPLE

Victoria Temple is press officer at BCS, the Chartered Institute for IT.

HOW MORAL IS YOUR MACHINE?

Diane Dowling explores the moral and ethical dimension in computer science education

The A-level computer science specification of all English exam boards requires students to have the ability to 'articulate the individual (moral), social (ethical), legal, and cultural opportunities and risks of digital technology'.

Ethics and morals are terms that are sometimes used interchangeably, as both refer to behaviour that can be labelled 'right' or 'wrong'. Ethics may be guided or directed by codes of conduct in the school or workplace, or by faith leaders for those who practise a religion. Ethical guidance is provided to computing professionals by external bodies such as the British Computer Society (BCS) which sets the professional standards of competence, conduct, and ethical practice for computing in the United Kingdom.

On the other hand, morals are guided by our own principles and a sense of permitted behaviour. Charles Darwin maintained that "of all the differences between man and the lower animals the moral sense or conscience is by far the most important". It is a generally accepted view that as humans we all have:

- The ability to anticipate the consequences of our own actions
- The ability to make value judgements
- The ability to choose between alternative courses of action

Although we all have the capacity for moral behaviour, our individual moral code is not biologically determined, but arises as a result of human experience. Our morals will be influenced by the society in which we live. For young people, it will be formed by the views of parents, teachers, and the opinions of others whom they interact with. Increasingly for most of us, and especially for young people, this will include content consumed through the internet. The internet does not respect national borders; thoughts and ideas can be readily shared on social media, in chat rooms, and on forums. Such a wide sphere of influence can and will result in diverse views of what is right and wrong, even between members of the same household.

Some moral values are widely held by most societies, but there can be shades of grey in even the most widely held beliefs. 'Thou shalt not kill' is a tenet of many religions and most people, when asked, will agree that killing another human being is wrong. However, across the globe, 56 countries retain the death penalty and research shows that in these countries, the majority of the population agrees that the penalty is an appropriate punishment for those in society who commit the most serious crimes.

An interesting dilemma arises when we have to choose between two alternative courses of action, where both are morally reprehensible. An example of such a dilemma is the much-studied trolley problem. In this thought experiment, there is a runaway trolley. Ahead, on the tracks, there

are five people tied up and unable to move; the trolley is headed straight for them. You are standing, some distance away, next to a lever. If you pull this lever, the trolley will switch to a different set of tracks. However, you notice that there is one person on the side track. You have two options:

- Do nothing and allow the trolley to kill the five people on the main track
- Pull the lever, diverting the trolley onto the side track, where it will kill one person

The dilemma can be made more challenging by adapting the alternatives to include children or animals, or by varying age, gender, intelligence, or socio-economic factors. Examples of how the trolley problem can be used in the classroom were given by Marc Scott in issue 12, page 86 (**helloworld.raspberrypi.org/issues/12/pdf**).

> DELEGATING MORAL DECISION-MAKING TO MACHINES CAN BE FASCINATING OR FRIGHTENING, DEPENDING ON OUTLOOK

Make the link

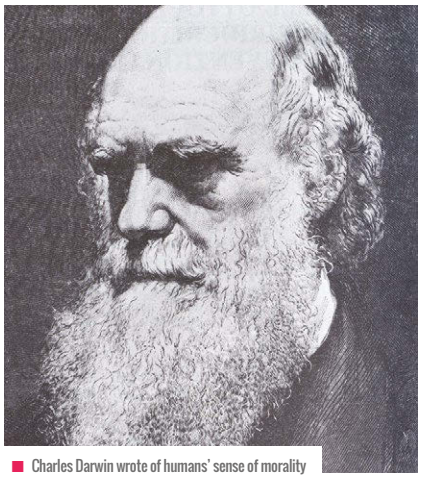
The moral conundrum is interesting, but how does any of this relate to computer science? The fact is that many of today's computer science students will become the software engineers of the future and a large number will be faced with the task of designing and writing code for applications of artificial intelligence such as self-driving cars. These programs will have to make complex—often life or death—autonomous decisions.

The prospect of delegating moral decision-making to machines can be fascinating or frightening, depending on your outlook. The trolley problem is one that can be abstracted to encompass many moral dilemmas. Sometimes, unprecedented situations such as the current coronavirus pandemic will throw up new moral dilemmas. In hospitals around the world, medics are being forced to prioritise their patients. Who gets a ventilator when there is insufficient supply for all who need one? Would it be better if a machine were given the responsibility of making this impossible choice?

An algorithm may ensure that consistently reliable decisions are made, but whose morals will determine the way that autonomous machines are programmed? Would you rather a human could override a machine-made decision, or would you rather rules were absolute and consistently applied? Machine learning muddies the debate still further. Neural networks used for this purpose are difficult to analyse and determine why a decision was produced, so there is a serious issue of accountability.

The Massachusetts Institute of Technology has created a website—the Moral Machine—that is collecting data that will help researchers by providing a platform for 'building a crowd-sourced picture of human opinion on how machines should make decisions when faced with moral dilemmas, and crowd-sourcing assembly and discussion of potential scenarios of moral consequence'. Projects like this will allow researchers to gain a better understanding of the choices that humans make.

In guiding young people through the moral maze, there are many topics that can be discussed in the classroom that will promote lively discussion. Facilitating a debate in which students propose arguments for both sides will allow a wide range of views to be shared and discussed. However, there are issues that will need careful consideration. For example, when discussing autonomous vehicles, a young person with a friend or family member who has been involved in a traffic accident might find this a very hard topic to engage with.



Charles Darwin wrote of humans' sense of morality

Life-and-death choices are at the extreme end of the decision dilemma. There are many less contentious areas that could be discussed. In her excellent book, *Hello World: Being Human in the Age of Algorithms*, mathematician Hannah Fry introduces a range of topics, from medicine to law, where algorithms are already being used to automate decision-making. For example, in some US states, an algorithm that uses data about a defendant to estimate their likelihood of committing a future crime is deployed to recommend whether someone awaiting trial should be granted

Surveillance and privacy are hotly debated topics in ethics

bail. If you search for more information on this, you will quickly find some fascinating examples of bias in the data.

Artificial intelligence and automated decision-making are not the only topics in which morals play an important role. The use of big data and the ability of organisations and government to analyse personal information is worth discussing.

The power of the state to monitor behaviour is always contentious. Advances in facial recognition technology are enabling some regimes to monitor and track their citizens, putting in doubt the principle of informed consent. Since early December, all mobile phone users in China registering new SIM cards must submit to facial recognition scans, giving rise to suspicion of mass state surveillance.

Such an initiative would have been widely vilified by more democratic societies but, since coronavirus has swept the globe, many governments are now deploying tracking apps. In the UK, the government is currently piloting an NHS app to automatically collect details of those we have been in close contact with, to help control the spread of the virus. Many will applaud such initiatives, but defenders of civil liberties and the right to privacy will be dismayed by such developments; their moral code would not condone such a measure, even for the greater good.

The use of social media and other online platforms is another area that can facilitate lively debate. How much freedom should people have to express a viewpoint? Where is the line between what is allowed and what should be banned? In the recent general election campaign, many female candidates said that they felt unsafe. In research funded by Joseph Rowntree Reform Trust, analysis of 139,564 tweets sent on a single day in November 2019, which either replied to or otherwise mentioned any of the 2,503 election candidates (who used Twitter) found that 23,039 (16.5%) of the total were abusive.

> “ INTEGRATING THE STUDY OF MORALS AND ETHICS WILL RELATE REAL-WORLD ISSUES TO MORE THEORETICAL TOPICS

Of greater relevance to teenagers might be the death of Molly Russell, a 14-year-old girl who took her own life in 2017. Her Instagram account contained distressing material about self-harm and suicide. Molly's father claimed the algorithms used by some online platforms push similar content towards you, based on what you have been previously looking at.

However, there are also stories of social media being used for collective change. In 2017, actor Alyssa Milano encouraged women to say 'me too' if they had experienced sexual harassment or assault, and the hashtag #MeToo quickly swept the globe and encouraged empowered victims to speak out. Social media also gives a voice to many who live in less liberal societies. In Hong Kong, activists have been able to use social media to communicate and organise large-scale demonstrations against what they see as an attempt by the Chinese government to undermine the region's autonomy and civil liberties.

Plan for morals and ethics

Integrating the study of morals and ethics into your scheme of work for computer science will provide the opportunity to relate real-world issues to more theoretical topics and to make them relevant to the world in which we live. Many of the topics introduced in this article are emotionally challenging and teachers may feel uncomfortable introducing them into the classroom. However, for A-level learners who are nearing adulthood, many of these issues are relevant and important. Teachers have a unique place in the lives of young people and an important role in steering and guiding their moral development. (HW)

Sometimes, social media can inspire positive changes

DIANE DOWLING
Diane is a Learning Manager at the Raspberry Pi Foundation, where she works on the Isaac Computer Science platform. In her spare time, she is a trustee of a national charity that runs robotics events for sixth-formers.

MAKING THE TRANSITION FROM SCRATCH TO PYTHON EASIER WITH EDUBLOCKS

EduBlocks is a free online tool helping young people across the world progress beyond Scratch with a block-based implementation of Python

I was first introduced to programming in 2013 by Alan O'Donohoe, who runs Preston Raspberry Jam. When I sat down to do my first bit of programming in Scratch, I was instantly hooked. I loved how easy it was to get something working with just a few simple blocks. From that point on, I knew that I wanted a career in software development. Through attending many other events, I quickly realised that I needed to move on from Scratch and learn text-based programming in Python. The thought of leaving the visual environment behind and moving into a text environment, which would involve learning a specific syntax, was daunting. However, after a few months of trial and error, I was able to code in Python confidently to make some projects.

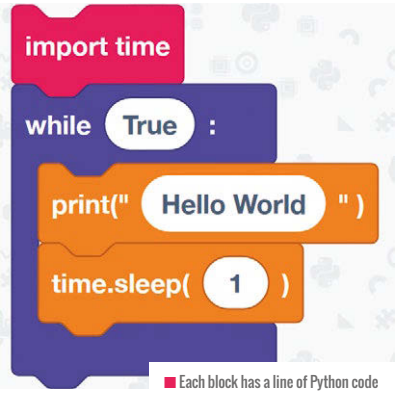
JOSHUA LOWE
Josh is a 16-year-old student who has spent the last four years developing EduBlocks and working on ways to make the transition from Scratch to Python easier for young people around the world. Last year he was named Arm and Uptree's Young Coder of the Year.

A few years on from this, I learnt some JavaScript and HTML and decided that I wanted to make something to help teachers and students like me to make the move from Scratch to Python. I was inspired to create the project from my own personal experience. This is where EduBlocks was born. It started off as a basic application for Raspberry Pi, which enabled the user to control LEDs, buzzers, and Minecraft from a block-based program built around the Python programming language. Now, having dedicated my spare time to developing the program for the past four and a half years, EduBlocks is being used by over 300,000 people every year, in countries all around the world.

What is EduBlocks?

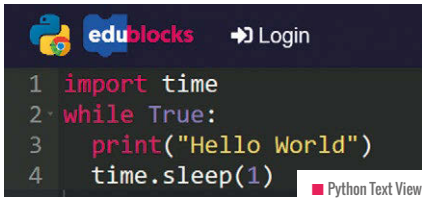
EduBlocks is a free online drag-and-drop version of Python 3 that allows students to learn Python syntax with minimal errors, making Python accessible to younger learners. A lot of students find learning this language a difficult task, due to things like being afraid of making errors and uncertainty around typing—a skill that is key to learning a text-based programming language. The aim of EduBlocks is to make the transition from blocks to text-based programs easier for students and teachers, as presently there is no drop-in solution that bridges this gap. There are three main ways that EduBlocks achieves this:

- **Python code on the blocks**
  One of the unique features of EduBlocks is that each block has a line of Python code, rather than a single word or verbal command. This allows students to learn Python code quickly and easily in the same drag-and-drop environment.



Each block has a line of Python code

Teachers find EduBlocks useful for filling in the missing link for students going from Scratch to Python, as it makes it a simple matter to teach core programming concepts such as sequencing, selection, and iteration that are important for learning text-based programming. It's designed to be really easy for students to compare their Scratch code to Python code by using the same block shapes and visual environment.



- **Python text view**
  With a click of a button, students can enter Python text view, where they have access to a Python text editor. In this view, students can look at their block code in Python text format, again making the link between the block code they just created and what they'd have to type into a text editor if they were coding in Python. Students can edit their code in the text view once they are more confident with using Python.

- **Fun and engaging Python libraries**
  Some students can find going from a visual environment like Scratch to a text environment like Python quite boring. I've tried to add as many fun and engaging Python libraries, such as Turtle and Processing, as possible so students can create fun projects similar to Scratch, but with a text-based language.

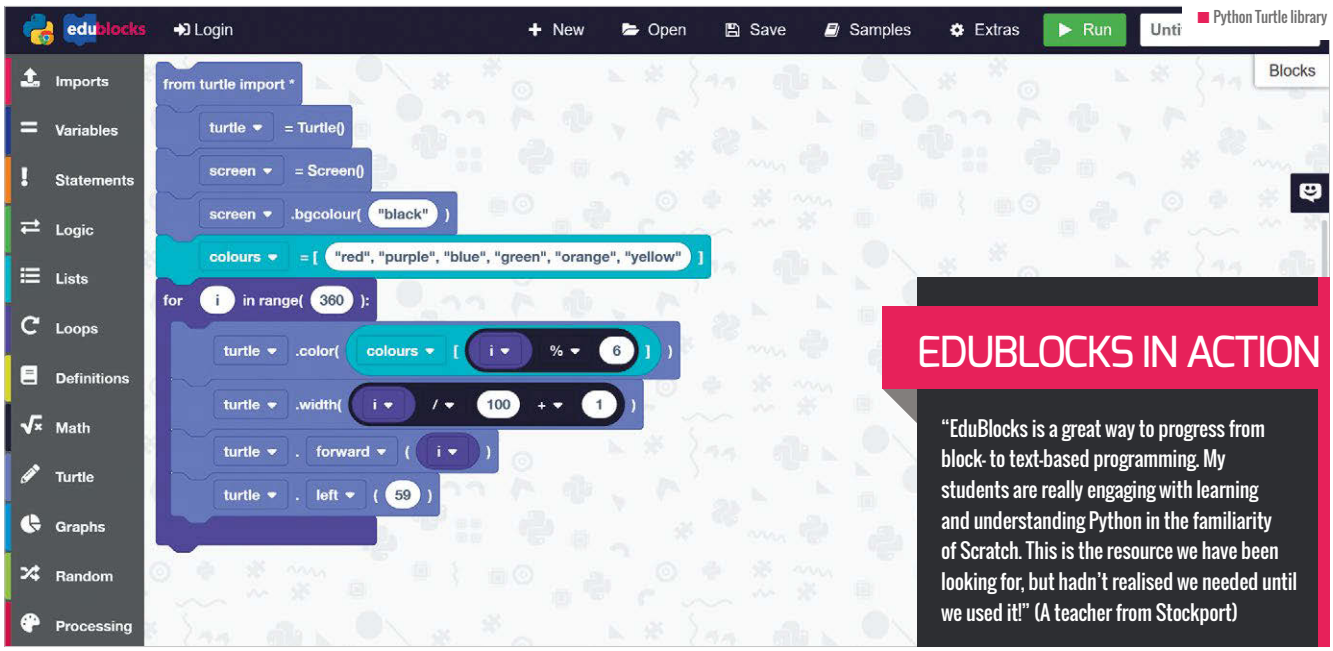
> "EDUBLOCKS IS A FREE ONLINE DRAG-AND-DROP VERSION OF PYTHON 3 FOR STUDENTS LEARNING PYTHON SYNTAX

What can EduBlocks do?

I've tried my best to make the program as accessible as possible. EduBlocks has four modes, each with its own set of blocks. The most popular mode is Python 3, which is a web-based mode that anyone can use on any device with a modern web browser. It runs on Trinket, a popular browser-based implementation of Python, so there is no need to install anything. In this mode, students can learn the basics of Python, like how to use iteration, selection, functions, lists, and variables, as well as create projects with fun libraries such as Turtle, Pygal, and Processing.

EduBlocks also works with popular hardware-based, Python-powered boards, such as the BBC micro:bit, which allows teachers and students to create physical computing projects in the classroom with MicroPython. There's full support for all of the on-board micro:bit features and the layout is very similar to Microsoft's MakeCode, providing a familiar experience for students. Alongside this is support for Raspberry Pi and Adafruit's CircuitPython, which covers all the major physical computing platforms. Examples of some projects young people have made in the past are a neopixel clock and an automated plant-watering system. EduBlocks is great for making these sorts of projects; without it students would need to learn Python to program. As a result, the tool also enables more students to access concepts like physical computing.

Inside the EduBlocks editor, there is a range of handy features for teachers. A bank of example programs within each EduBlocks mode can be loaded up with a few clicks, providing quick examples that teachers and their students can tinker with. Alongside this, there's a login system that allows students to save code to their Google, Microsoft, Apple, and email accounts so that transferring



EDUBLOCKS IN ACTION

"EduBlocks is a great way to progress from block- to text-based programming. My students are really engaging with learning and understanding Python in the familiarity of Scratch. This is the resource we have been looking for, but hadn't realised we needed until we used it!" (A teacher from Stockport)

code from different machines is easy. Through this system, students can also share their code via a shareable URL that makes collecting code files at the end of a lesson simple.

Another handy feature is split view, which allows teachers to have blocks on one side and a text-based Python editor on the other, so that they can see the Python code in real time.

Resources for teachers

EduBlocks has a number of tutorials that are built for use in the classroom. The EduBlocks Learning Portal (**learn.edublocks.org**) has a growing bank of resources that teachers can use in class and covers all sorts of different projects using Python, BBC micro:bit, Raspberry Pi, and CircuitPython. Each project has explanations for each block, so students know exactly what each part of the code is doing. In addition, there are a number of unofficial resources on the internet that are written by teachers who have already started to use EduBlocks in their classroom.

One of the best resources for teachers to use is the six-week EduBlocks Python Curriculum. This curriculum is designed to cover core Python programming concepts to help students make the move from Scratch to Python. It uses Turtle to provide a fun and engaging set of lessons, with each lesson building on previous lessons to the point where ultimately, each student creates their own individual Python project. It's completely free (**curriculum.edublocks.org**) and each lesson has a lesson plan with an accompanying slideshow and code examples.

For those teachers wanting to get some EduBlocks lessons started via remote learning, the EduBlocks Home Learning page (**learn.edublocks.org/tutorial/home-learning**) is the place to go. It's full of resources created by teachers, such as home learning resource sheets and video lessons. They've all been designed for remote learning, making them ideal for students new to EduBlocks.

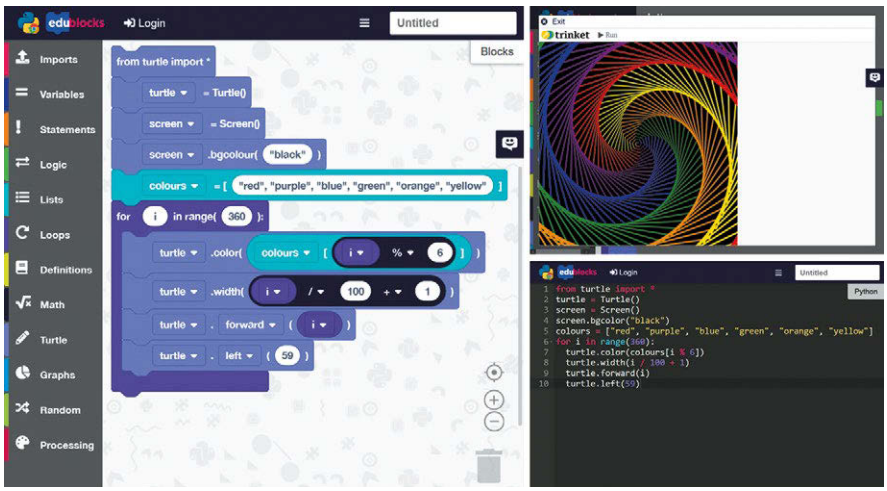
SIX-WEEK EDUBLOCKS CURRICULUM

- Completely free curriculum for teachers around the world to use
- Covers key programming concepts like iteration, selection, sequencing, variables, and functions to aid the move from blocks to text
- Extensive lesson plans cover all key aspects to enable teachers to deliver six lessons using EduBlocks
- Slide shows for each lesson match the lesson plans, making the curriculum easy to deliver
- Available to download for free at **curriculum.edublocks.org**

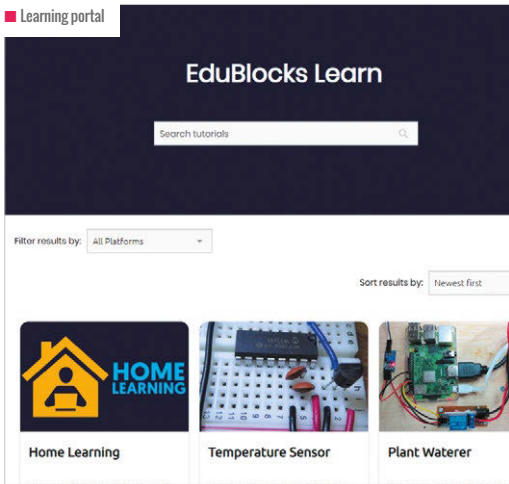
> EDUBLOCKS IS AN IDEAL TOOL FOR SELF-GUIDED HOME LEARNING

How can teachers get involved with the project?

EduBlocks is a free open-source project which is built on top of community contributions for both software and resources. It's only possible due to a number of people who have helped me get it to where it is today. The best way for educators to get involved in the project is by sharing any teaching material you make with EduBlocks, so that teachers all around the world can make use of the project in their own classrooms. I hope that you can find a use for EduBlocks in your own classroom and that it helps your students move from blocks to text. You can find out more about the project at **edublocks.org** and access the editor via **app.edublocks.org**. (HW)



Learning portal



- **Small top left image:** The 'select your mode' function enables users to work in one of four modes, each with its own set of blocks
- **Large left image:** This EduBlocks editor has code to create a rainbow spiral in Turtle, one of the many lessons available

DEBUGGING IN SCRATCH

Sean McManus explains how you can help students to find and fix some of the most common errors in Scratch projects

It's a great feeling when code works the first time, but sometimes it's even more satisfying when it doesn't. One of the best learning opportunities comes when there's a bug, or error, in a program, and we take the time to truly understand the code. Debugging may sometimes be frustrating, but it is an inevitable part of programming.

Educators can focus on guiding students, rather than getting bogged down in code, if they can identify the cause of problems quickly. In this article, I'm going to share some tips on debugging Scratch, based on my experience volunteering at a Code Club. You can use these techniques yourself, and perhaps share some of them with your students.

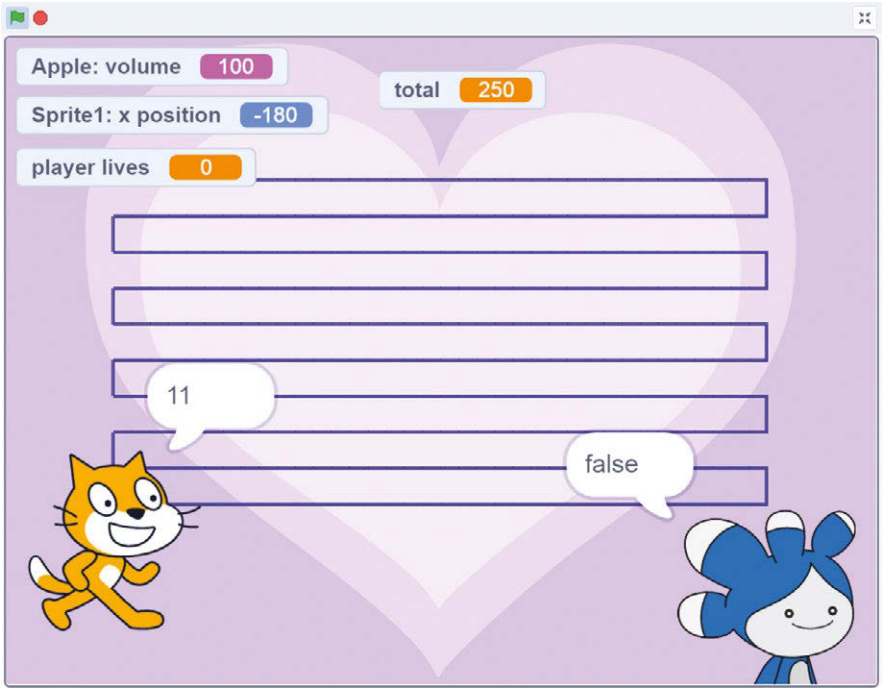
Reproducing the bug

When you're helping a student who has found a bug, the first step is to observe the problem yourself so you're not relying on a second-hand report to understand it. In the classroom, I would usually pull up a chair beside the student and then invite them to show me what they did last time, using the same inputs. I would ask them to talk me through it, including what was surprising about the program's behaviour, so that I could understand what they thought the problem was.

When working remotely, you could ask students to send you a copy of the project, together with instructions on how to reproduce the error, or a video capture showing the bug in action. You should also ask them to explain what they think the code should be doing, and how that's different from what it is doing.

Sometimes there might not be anything wrong with the code. Students might be expecting the script to do something that it's not designed to do, or the code might have missing bits that still need adding from the worksheet. When building their own projects, students might need to rethink the right instructions to use to get the result they want. These reported errors aren't what I would really consider to be bugs, and they can be clarified without any testing or tinkering.

If there is an error, seeing it in action now means you can see the difference when it's fixed later. It's hard to be sure a bug has been fixed if you don't run the code before and after.

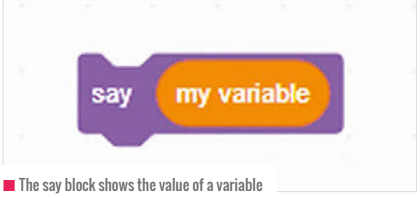


Scratch gives you several ways to see what's going on inside your program, such as using the pen to show where a sprite goes and using say blocks to display the program status

Diagnosing the bug

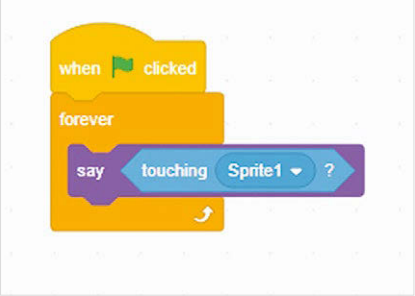
The next step is to diagnose the problem. Scratch is a highly visual language, so you can often see what's happening just by looking at the stage. Sometimes, you might need to get an insight into what's going on inside the project's scripts, or might need to understand what happens at a particular point in the program flow. There are lots of different ways you can do this.

For example, you can click a variable's block in the block palette to see its current value. This doesn't just work for variables: you can use it for x position, y position, direction, costume number or name, backdrop number



The say block shows the value of a variable

A block that makes it say whether a sprite is touching another sprite



or name, size, volume, loudness, and the pointed sensing blocks (such as touching color). The sprite list also shows a sprite's position, direction, size, and visibility.

Variables and some of the blocks have tick-boxes beside them in the block palette that show their values on the stage. These readouts update as the project runs.

You can also use the say block to show the value of a variable at a particular point in the program's execution. This will not update, and will stay visible until you next run the say block on that sprite, or click the green flag.

You can create a simple script to report when a sprite is touching another sprite, or any other condition you want to check for. The script above makes a sprite say whether it's touching another sprite. When it is, the speech bubble text changes from 'false' to 'true'.

The pen can be used to leave a trail of a sprite's movements, and sound effects can be added to indicate when a script starts or reaches a particular point.

To make it easier to find where the bug is, you can break projects down into smaller parts for testing. Instead of clicking the green flag to start a project running, you can click one script in the code area to start it by itself. If you have loops inside loops, you can drag the inner loop out and click it to test it. To see what the script does up to a particular point, you can add a stop this script block, or use a wait one seconds block to pause it. You can also add a wait block inside a loop, such as a movement loop, to slow it down so that you can more easily see what it's doing.

With these techniques, there could be side effects. The timings in the project might be thrown out, for example. If you test individual parts of the script, they might not work without other parts. Nonetheless, breaking the program down like this often helps to isolate where the error is by quickly confirming which bits are working fine.

Image: Scratch Foundation

> "SOME OF THE BEST LEARNING OPPORTUNITIES ARISE WHEN THERE'S A BUG IN A PROGRAM

LEARN FROM DEBUGGING

Students can sometimes fix the bug without learning anything. They might spot the difference between what they've got on-screen and what's in the worksheet, or just tinker until it works. Discussing bugs with the affected students, or with the whole group, helps to ensure that the cause of the error is understood.

Students can also be encouraged to code mindfully, thinking about what the script does as they build it, rather than just copying it from the sheet. That helps to reduce errors, and helps them to prepare for making their own projects.

Fixing the most common bugs

Over time, I found that the same bugs were coming up repeatedly in my Code Club, and it became easier for me to identify what was wrong. I was able to steer students away from some of the pitfalls by leading a group discussion about the potential problem before they built the scripts. In the rest of this article, I'm going to share the most common bugs I saw.

Variable creation

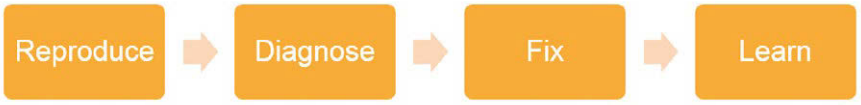
The first concerns variables. A Scratch variable can be created for all sprites (so they can all use its value) or created just for one sprite (so only one sprite can use its value). It's a really useful feature when you're cloning sprites, because if you create a variable for one sprite only, each clone of that sprite has its own separate version of the variable. For example, you can create an alien that stores how many lives it has left in a variable created for that sprite only. Each clone of the alien will behave in the same way, with its own record of its own lives left.

You can see whether a variable is for one sprite or all sprites by ticking the box beside it in the block palette to show it on the stage. If it's for one sprite, it'll have the sprite name beside it.

When a project requires students to create a variable for one sprite only, this often results in errors. This is quite tricky to fix, because you can't just change whether a variable is for one or all sprites. There's an additional complication, too: if you delete a variable you created in error, Scratch also deletes all the blocks that use it, leaving no trace of it in your scripts. If you're using the variable in lots of blocks across lots of scripts, it can be difficult to put those blocks back in again.

Here's a process for changing whether a variable is for one sprite or all sprites:

- Create the variable correctly with a different name to the one originally used. Scratch won't let you use the same name for a variable for all sprites and a variable for this sprite only.
- Update the scripts to use the new variable. The program should now work.
- Delete the variable that was originally created incorrectly, to avoid using it by mistake.
- Now you can rename the new variable to the correct name, if you want it to match a worksheet.



Debugging can be thought of as a four-stage process, from reproducing the fault through to learning from it

Lookalike blocks

The second most common error I encountered was lookalike blocks, responsible for about a fifth of the errors in my group. This was a common error when copying code from worksheets. In particular, students mixed up set and change blocks; x and y blocks, broadcast, and broadcast and wait blocks; and say, and say for two seconds blocks. This can be hard to spot, because at a glance the script looks good, with the right coloured blocks in the right place and most of the text on the block correct, too.

Wrong blocks in wrong brackets

Problems often arise when students put the wrong blocks inside or outside the brackets of the blocks for repeating (repeat, repeat until, forever) or making decisions (if, if... then... else). Wherever there are brackets, it's worth doing a quick check at the top and bottom of them to make sure the right blocks are inside them.

Blocks in the wrong order

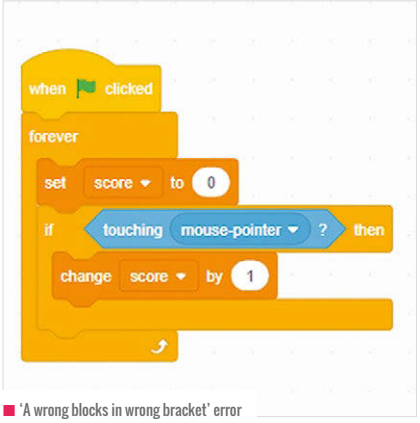
Getting blocks in the wrong order can sometimes stop the program from working as expected. In particular, it's a problem when variables or lists are being initialised after scripts have started changing their values. In the script at the bottom of this page, the score never goes above 1, because it's being reset inside the forever loop, instead of outside of it at the start of the program. This is also a 'wrong blocks in wrong bracket' error. It's easy to see the problem in this tiny script, but it can be harder to spot in longer scripts, or in projects that have multiple scripts.

Rogue spaces

When you're comparing pieces of text, rogue spaces can cause unexpected results. In the script opposite, it looks like these two pieces of text ('hello') are the same. They're not, because the one on the left has an extra space, so the sprite says 'No match!' In a real project, you'd probably have an answer block or a variable in place of one of these hellos, which would make it even harder to spot the problem.

Scripts on the wrong sprite

When using worksheets, some students in my Code Club used to skip straight to the code without reading the instructions fully. That sometimes resulted in them putting scripts on the wrong sprite. Students can copy the script to the correct sprite by dragging it onto that sprite's icon in the sprite list. They will often forget to delete the script on the wrong sprite, though, so you need to watch out for this.



'A wrong blocks in wrong bracket' error

Image: Scratch Foundation

Duplicate scripts

Duplicate scripts arise when students forget to delete a script they originally put on the wrong sprite, or when they are following a worksheet and create a new script instead of adding blocks to an existing script.

If the project runs really fast, that might be because there are two movement scripts running at the same time.

Students might call your attention to the new script they've made, which is perfect, and you might not immediately notice thatthere's an old script that does nearly the same thing on the sprite. You can drag a duplicate script into the block palette to delete it.

Synchronisation and timing issues

Using multiple scripts in Scratch can help to keep code readable, but it can lead to synchronisation and timing issues when different scripts are running at the same time.

Simplification is the key, and reducing the number of green flag scripts often helps. The broadcast and wait block can be used to trigger scripts that should finish before the program proceeds. If the scripts sending and receiving the broadcast are on the same sprite, you can make your own blocks instead.

Some of these errors may seem fairly basic to experienced Scratch users, but they can be frustrating to newcomers, and consume a disproportionate amount of energy. Over time, it gets easier for students to avoid, find, and fix bugs like these, but they can still crop up. I hope that this article provides a handy checklist so educators can help students more effectively. (HW)

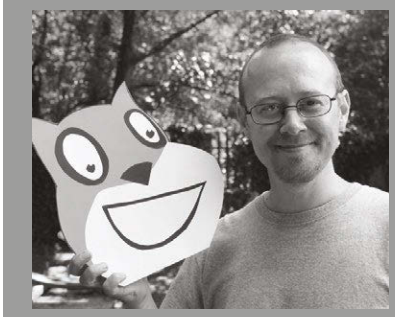
> "STUDENTS SHOULD BE ENCOURAGED TO CODE MINDFULLY, THINKING ABOUT WHAT THE SCRIPT DOES AS THEY BUILD IT

Not changing default numbers

It's easy to overlook that the number in a repeat 10 block needs to be changed to 100 when copying scripts from a worksheet. Similarly, students sometimes forget to change the default values in operator, motion, and other blocks.

'It worked a minute ago' errors

Sometimes a program runs fine the first time, but behaves strangely after that. These errors often result because the project doesn't reset to a known state when it runs. For example, a new game might begin with a main sprite



SEAN MCMANUS

Sean McManus is a copywriter and author specialising in technology. His books include the new 2nd edition of *Scratch Programming in Easy Steps*, *Cool Scratch Projects in Easy Steps*, and *Mission Python*. He posts his Scratch resources at sean.co.uk/scratch (**@musicandwords**).

A DEBUGGING WORKFLOW

This is the kind of workflow a professional programmer might use if they're alerted to an error in a program by a user:

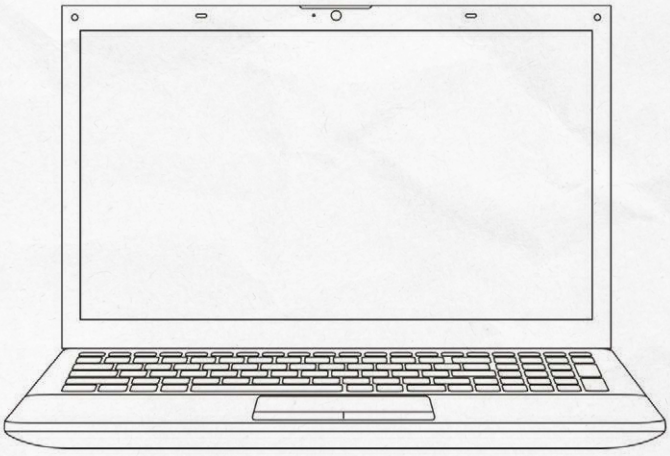
- Reproduce the error so they can see it for themselves
- Diagnose what's causing it, using a mixture of testing and logical thinking
- Fix the problem by updating the code
- Learn from it, to prevent it happening again

There might be loops in the process, because fixing one error might cause or reveal another.

Rogue spaces can cause unexpected results

Laptop Computer

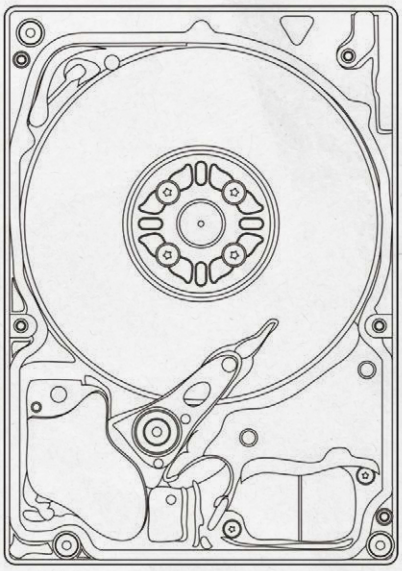
Computer systems come in many different forms. A popular portable version is a laptop. Whilst laptops can perform most of the tasks that a larger desktop can, they are generally less powerful than a desktop. Many come with built-in webcams, microphones and speakers.



To avoid damage, you should always close your laptop screen when you are carrying your laptop and avoid holding your laptop by the hinge.

Hard Disk Drive

Magnetic storage gets its name from the electromagnets which are used to magnetise and demagnetise sectors on a spinning disk or tape. A magnetised sector on the disk could represent a 1, whereas a demagnetised sector can represent a 0. Hard disk drives like the one below offer large storage capacity at a relatively low cost.



The electromagnet on a hard disk drive is attached to the end of a moving arm. The arm frequently has to move to different sectors and this takes time. By modern standards, hard disk drives are considered to have slow access speeds.

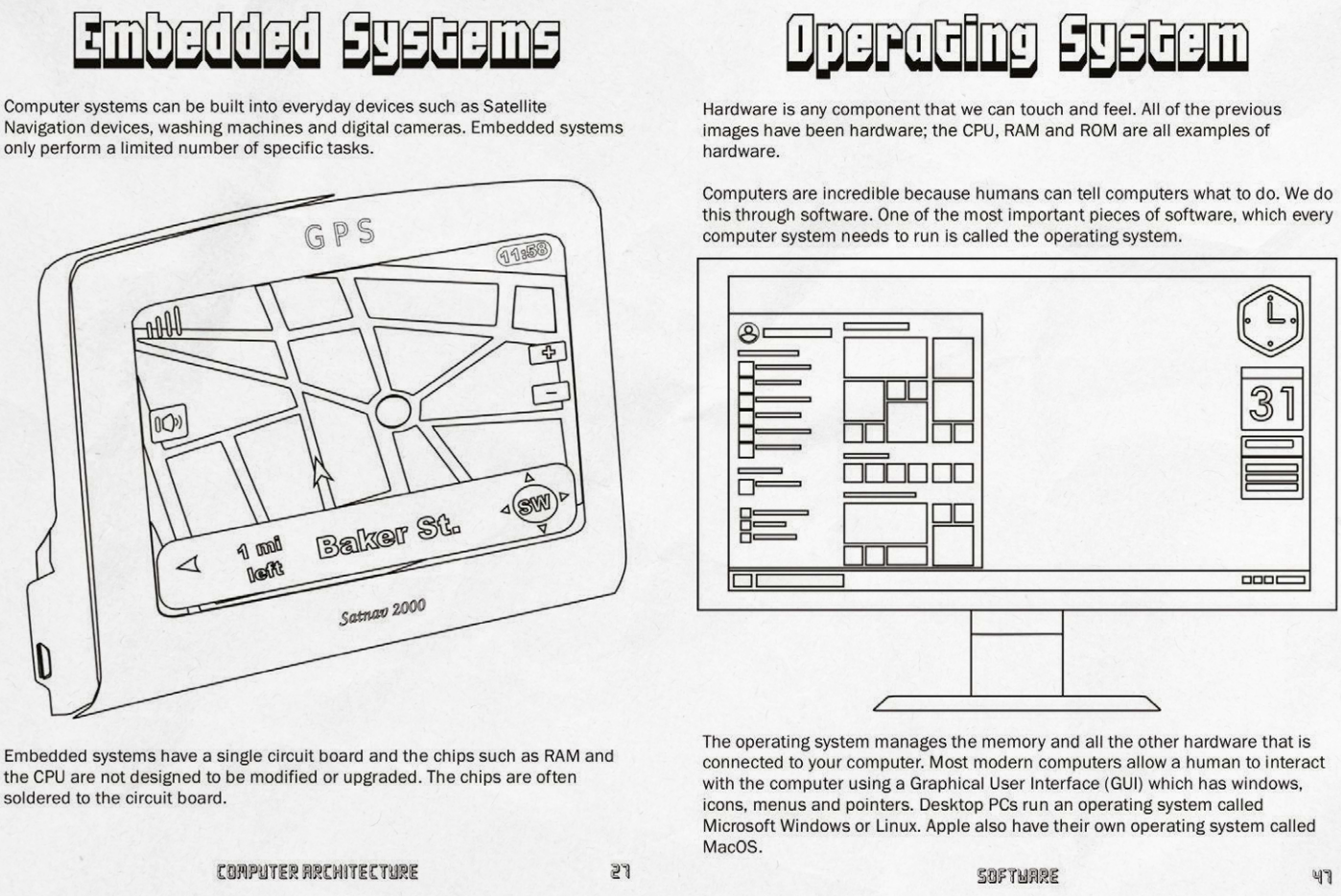
A FUN AND COLOURFUL GATEWAY TO COMPUTER SCIENCE

William Lau has created a colouring book to help make computer science accessible to all

For many people, their first educational experience of computer science will involve some challenge and some jargon. Some will encounter computer science at primary school, others at secondary school, and some may never receive any formal education in the subject. For teachers, it quickly becomes apparent which group a student falls into. Students will have varying prior knowledge and for those with no prior knowledge, this means the gap that they have to bridge in order to access the school curriculum may be much greater than their peers. These educational experiences vary even more for the adult population. What if there were a resource that could make computer science accessible to all, regardless of age or income? Creating the *Computer Science Colouring Book* has allowed me to reach this broader audience and introduce computer science concepts in a new and creative way.

Colouring outside the lines

My experience of teaching computing has given me time to reflect on the best medium for teaching certain topics. Computers have their purpose in computer science education, for example, when visualising simulations, learning programming, and teaching IT-related skills such as graphic design, animation, and video editing. But there is so much more to computing, and much of it can be achieved using unplugged and traditional



media. I am also wary of putting children off from an early age.

While sitting next to my own children, aged six and one, I thought about how colouring is accessible from a very early age. I also thought about how computer hardware in particular is usually either black, silver, or white. Yet children love colours, and in primary schools many computing devices are colourful. Putting all this together, the *Computer Science Colouring Book* was born.

"What does this say, Daddy?"

Colouring books themselves vary in quality; some have puzzles and some are educational. Before my son could read, he could colour in, and he would ask me, "What does this say, Daddy?" The colouring books became reading books. This led me to add some basic accompanying text to the colouring book so that it would be accessible to young children, students in secondary school, and adults. Aside from colouring, there are quizzes and, like all good activity books, the answers are in the back.

> "THE COMPUTER SCIENCE COLOURING BOOK AIMS TO INTRODUCE COMPUTER SCIENCE CONCEPTS IN A NEW AND CREATIVE WAY

The choice of images was generally inspired by GCSE Computer Science content. I was also motivated by wanting to demystify certain hardware and software and to provide the general public with an introduction to computer science. People often hear of the terms 'CPU' and 'RAM', but the layperson probably doesn't know what these look like, or what role they play. My colleague, Leila Lassami, later suggested including pages where students could colour by number. The computer science version of this is colouring pixels to make images, and this led on nicely to introducing colour depth. The book therefore covers some foundational GCSE topics and is suitable for all ages.

Another learning experience

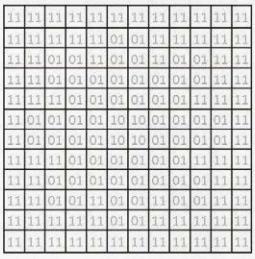
Throughout my teaching career I have had to learn new skills, and this is the beauty of being a computing teacher. Creativity will necessitate learning new software, tools, and skills. As a teacher, you will have an idea and then you will need to find a way to implement it. This book allowed me to learn how to edit vector graphics. There

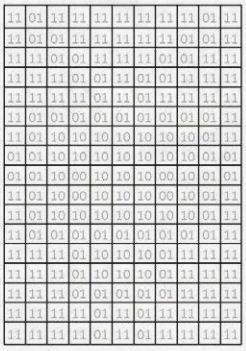
Images

When we could only have one number in each pixel, we could only have two possible colours throughout our entire image. If we want to increase the number of colours, we can increase the "colour depth" by using more digits. If we use two digits, this would give us four possible colours. You can pick two of your own colours for the codes below:

00	Black
01	
10	
11	White

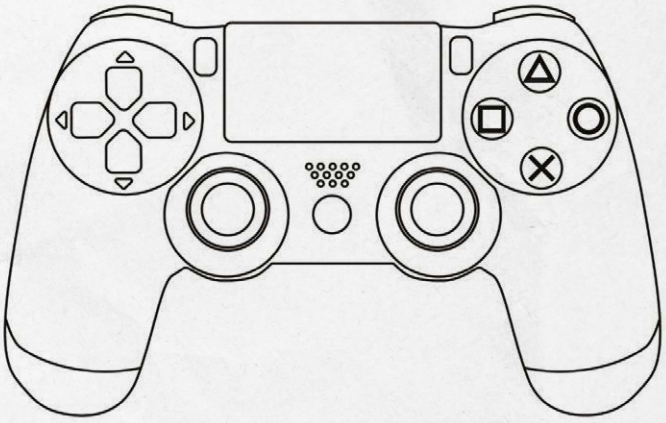
Now colour in the grids below using the colours from the table above.





Work and Play

It's hard to avoid the technology that computer scientists have brought into our homes for entertainment purposes. From voice assistants such as Amazon Alexa and Google Assistant to Smart Watches, Games Consoles and Smart TVs. There are so many ways to access information.



Some may argue that there are negatives to the amount of technology in our lives, we may become overly dependent on technology. Some people develop tech addiction, which is just as serious as any other addiction. We should use technology responsibly and remember that technology is there to help us when we need it, but at other times it is good to switch off and enjoy reality without any technology.

was a large bank of Creative Commons (CC0) and public domain images on websites such as Pixabay. I then needed to learn how to make these images black and white and to outline them so that they were suitable for colouring. Some images took seconds; others took hours!

I thought about approaching a publisher with this idea, as the colouring book market is quite big and this book could attract some adult readers too. Ultimately, I stuck to my previous publication model: to make digital copies of the book available for free as a PDF; if people want to support me by buying physical copies, they can do that too. The book has already been downloaded over 500 times and some teachers have already said that they have included the book in their home learning packs while schools are shut. The great thing about the PDF is that parents, grandparents, and teachers can print off individual pages that a child might be interested in and then the whole educational experience can take place offline, away from a screen. I hope that the book will broaden access and inspire future generations to pursue computer science.

> "PRINT OFF PAGES AND THE WHOLE EXPERIENCE CAN TAKE PLACE OFFLINE

- The free PDF is available from **helloworld.cc/colouring**
- Physical copies can be bought from **helloworld.cc/colouringbuy**

I would love to hear from readers who have printed out or bought the book and I encourage you all to be bold and reimagine hardware and software in whatever colours you choose. Share your creations on social media using the hashtag **#CSColouringBook**. (HW)

WILLIAM LAU

William Lau leads Key Stage 4 Computing (ages 14-16) 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*. (**@MrLauLearning**).

AGE RANGE
11-13 years

YEAR GROUP
UK Year 9,
US Grade 10

LESSON TYPE
Unplugged

REQUIREMENTS
- PC, Mac, or Chromebook
- A Google account to access worksheets and slides, or download and open them using MS Office

CYBERSECURITY

Teach your learners to be cyberaware with this unit of work suitable for both the classroom and home learning

This is a unit of work for the National Centre of Computing Education, which we have converted to be used directly by students, with videos and worksheets for learners to complete at their own pace. The full student-facing unit is available at teachcomputing.org/home-teaching.

The unit takes the learners on an eye-opening journey of discovery about techniques used by cybercriminals to steal data, disrupt systems, and infiltrate networks.

The learners will start by considering the value of their data to organisations and what they might use it for. They will then look at social engineering techniques used by cybercriminals to try to trick users into giving away their personal data. The unit looks at the more common cybercrimes such as hacking, DDoS attacks, and malware, as well as looking at methods of protecting ourselves and our networks against these attacks. (HW)

LESSON 1: YOU AND YOUR DATA

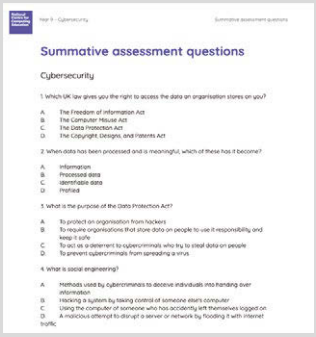
The aim of this lesson is to introduce learners to the unit and to help them understand the value of data to companies. The focus will be on what data companies collect from their users and how they use it. Learners will explore this topic through scenarios, as well as by looking at the privacy policies of some tech companies who they may already be providing data to. They will be introduced briefly to the law regarding data protection and will reflect on why cybercriminals might want to gain access to data.

OBJECTIVES

- Describe the value and importance of personal data
- Gain an understanding of the common methods of attack used by cybercriminals
- Explain the need for laws that protect their data and act as a deterrent to cybercriminals
- Identify strategies to protect data and reduce the chance of cyberattacks being successful

> LEARNERS NEED TO CONSIDER THE VALUE OF THEIR DATA

ASSESSMENT



Summative assessment questions

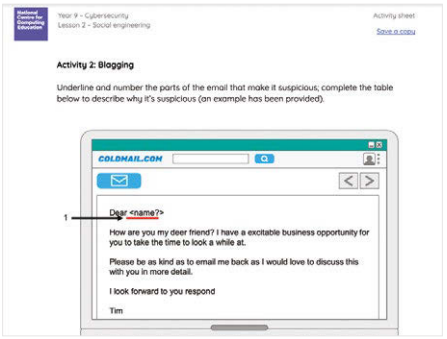
Cybersecurity

While this unit presents many opportunities for formative assessment in the lessons, we have provided summative assessment in the form of a set of multiple-choice questions. The questions aim to test the learners' understanding of the key terminology and concepts covered in the unit.

LESSON 2: SOCIAL ENGINEERING

Which rock star are you? We've all seen this type of quiz on the internet before. This lesson starts by luring the learner into taking a quiz in the form of a Scratch program (**ncce.io/rockstar**) that they think will tell them which rock star they are. In the process, they will unwittingly submit data that could be used by a cybercriminal to hack into their accounts. Don't worry; this is just to highlight a point, and no personal data is stored anywhere.

The aim of this lesson is for learners to become aware of how humans can be a weak point in the system, as well as looking at the social engineering tactics deployed by cybercriminals to dupe users into giving away data that could lead to further crime. Learners will then be taken through the common social engineering techniques, completing exercises in the lesson to encourage them to think more deeply about the consequences of the scams and how to avoid becoming a victim.



Activity 2: Blogging

Underline and number the parts of the email that make it suspicious; complete the table below to describe why it's suspicious (an example has been provided).

COLDMAIL.COM

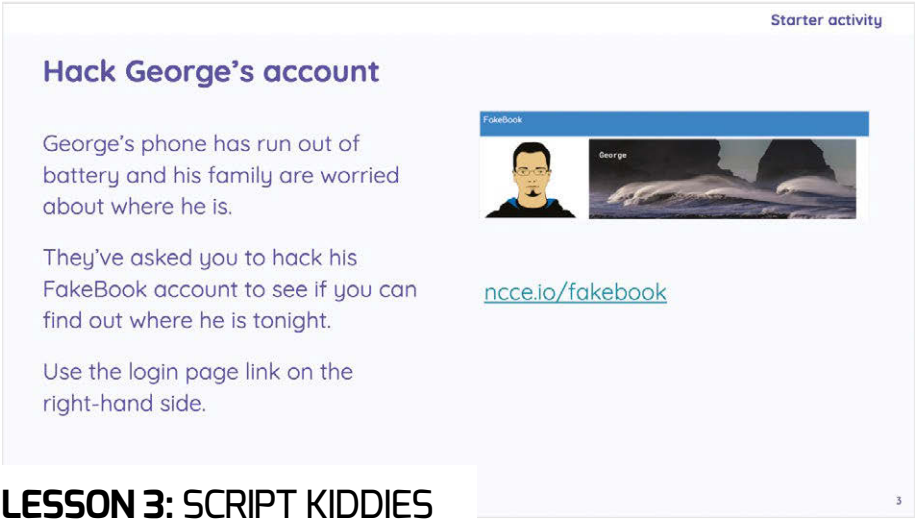
Dear <name?>

How are you my deer friend? I have a excitable business opportunity for you to take the time to look a while at.

Please be as kind as to email me back as I would love to discuss this with you in more detail.

I look forward to you respond

Tim



LESSON 3: SCRIPT KIDDIES

This lesson allows learners to explore the concept of hacking and how hackers exploit computer systems. Start with asking learners to look for clues to hack into a friend's account. They can use information posted by their friend to their social media account to help his parents find out where they are. Ask them to think about the ethics behind their actions. The rest of the lesson looks at terms such as brute force attacks, hacktivists, script kiddies, and DDoS attacks. The learners will use a simple Python program, written to match passwords, to explore how more secure passwords make it harder for brute force attacks to be successful. Some of the key terminology is introduced around the Dyn attack example that disabled DNS servers. The lesson will conclude with the learners exploring the Computer Misuse Act (1990) and the consequences of hacking.

LESSON 4: SOCIAL ENGINEERING

Imagine walking into a room where all the screens have the same concerning message on them. This could be the sign of a ransomware attack, and by casting the opening slide to the learners' screens while they enter the classroom, you can simulate this attack. Get the learners to decide what they should do. Should they pay the money, or alert the authorities? Time is running out. The purpose of this lesson is to make learners aware of malware and its different categories, as well as understanding how they work and the potential damage they can do. This lesson focuses more on the technical side than on prevention methods, which will be covered in Lesson 5 of this unit. After the starter activity, they will be introduced to the key terms before being instructed to do a research task to create a fact-based quick read on one type of malware they have learnt about. Towards the end of the lesson, the learners will be introduced to web bots and what task they perform on the internet. They will then be shown how bots are used in conjunction with malware and will be given a scenario that allows them to understand the hidden role of bots and what potential influence they could have on societal issues.

LESSON 5: THERE'S NO PLACE LIKE 127.0.0.1

If you have never visited **threatmap.checkpoint.com** before, the site is a great starting point to this lesson which allows learners to gain a sense of the global scale of cyberattacks. The learners will develop their understanding of the risks that cyberthreats pose to a network, followed by an exploration of some of the more common methods of defending a network against attacks, such as firewalls and anti-malware. The learners will look at the more common threats that exist globally before thinking of the threats at the level of a school network. Learners will discuss methods used by network managers to reduce risk. The homework for this lesson is to write a short report to the head teacher on how to manage the most significant risk to the school network.

RELEVANT LINKS

teachcomputing.org/resources

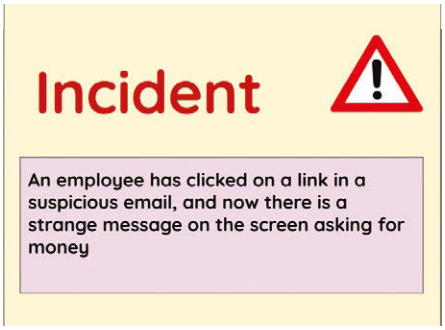
teachcomputing.org/home-teaching

Learning graph to show progression: **ncce.io/cybs-lg**

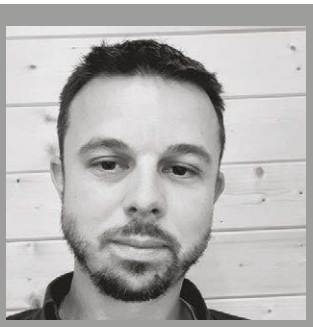
threatmap.checkpoint.com

LESSON 6: UNDER ATTACK

This lesson is called 'Under attack' because it starts with the learners being given the task of becoming network managers for an online retailer and they have to work in small groups* to think strategically to defend themselves against incoming attacks. Learners will work in groups to plan their defence strategy on a tight budget before cyberattacks start to happen. The use of their budget will be key in determining whether or not they were able to defend the organisation against the attack. The groups must work together to identify what form of cyberattack is taking place and to determine if their protection methods are sufficient. Two more rounds are played where the learners get additional budget to spend to thwart further attacks.



**This activity has been adapted for home learning where group work is not possible.*



BEN GARSIDE

Having been in the classroom for 14 years, Ben is now a Learning Manager for the Raspberry Pi Foundation. As well as being an RPi-certified educator, Ben is a CAS Community leader (**@BenberryPi**).

AGE RANGE
14-19 years

YEAR GROUP
Year 9-Year 13

LESSON TYPE
Web-based tutorial

REQUIREMENTS
- Any device capable of connecting to the web, for example, a desktop computer, laptop, tablet, mobile, or Raspberry Pi
- A web browser (Chrome, Safari, etc.)
- Access to cstechnobool.swan.ac.uk

THE ORS AND ANDS OF BOOLEAN ALGEBRA

The Technocamps Delivery Team introduces Boolean algebra through an easy-to-use web-based application

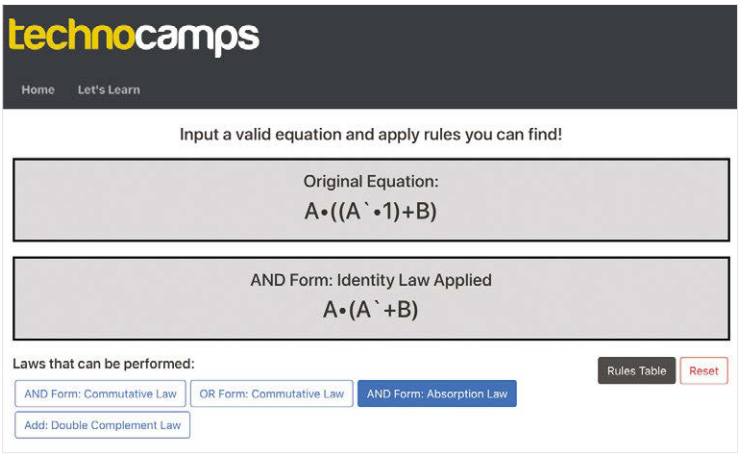
Boolean algebra is often seen as a topic within computer science that is difficult to teach and hard to grasp. To help change teachers' and students' perceptions of this topic, the Delivery Team at Technocamps—led by Christina Meggs, a third-year computer science student at Swansea University—has developed an interactive progressive web application to introduce and lead students through the topic. We have developed this app with the UK GCSE and A-level Computer Science qualifications in mind.

As a progressive web application, it can run on any web browser; on tablet and mobile devices it can look and feel like a native application. This allows students and teachers to experience the application on the devices they are most used to using. On mobile devices it can also be added to the Home Screen as an app, and once added it can be used offline.

The app is split into two sections: Tools and Let's Learn. Within the Tools section, there are four purpose-built tools to support your understanding of Boolean algebra, which we will discuss below. The Let's Learn section of the app contains a series of tutorials and quizzes, which introduce the topic of Boolean algebra and allow the user to test their knowledge.

Helpful tools

Many of the activities within the tutorials and quizzes have been created as simple-to-use tools to help you solve different questions when practising. There are four tools: Expression Builder, Test Truth Tables, Rules Simplifier, and Test Rules Simplifier.



An example of the Rule Simplifier tool

OBJECTIVES

- Understanding Boolean operators and how they can be used to model real-world scenarios
- Creating truth tables for Boolean expressions using 1, 2, and 3 variables
- Understanding the rules to simplify Boolean expressions and how to apply them in a range of different expressions

STEWART POWELL
Stewart is the Operations Manager for Technocamps, a university-based programme delivering inspiring and engaging STEM-based workshops to pupils across Wales.

ACTIVITY 1: GETTING STARTED—USING THE APP 5 MINUTES

The first thing you need to do is access the app, which can be done by navigating to **cstechnobool.swan.ac.uk** on your preferred device. We recommend using it on a touchscreen device where possible. The app is designed around drag-and-drop interactions.

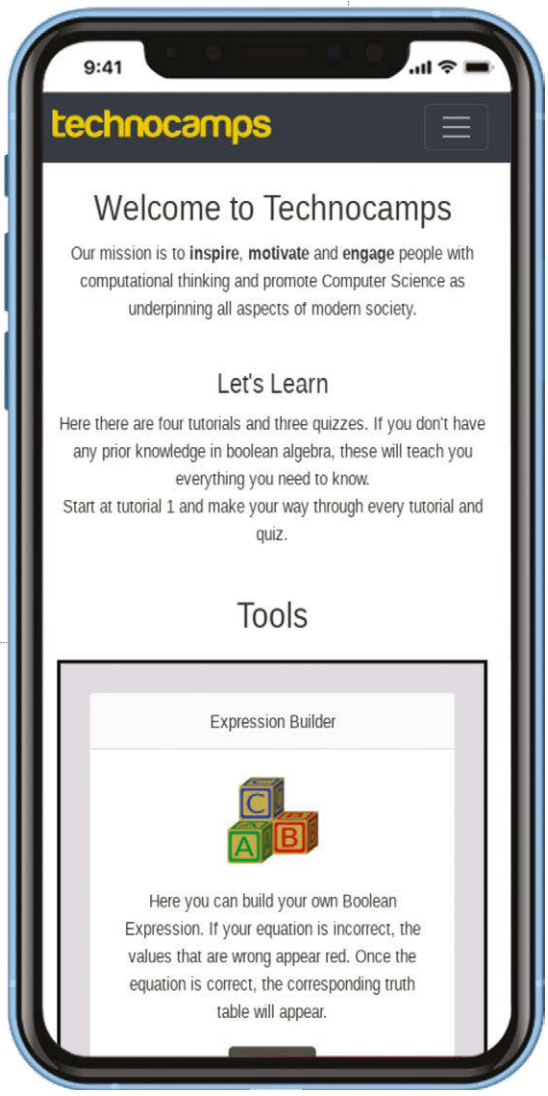
To familiarise yourself with the app, first click on Expression Builder. You can drag and drop any of the elements (A, B, +, etc..) into the display box to create your first expression.

As you drag and drop the elements, they will turn green if valid. If invalid, they will turn red and give an error. Once you have created a valid expression, it will display the truth table for the expression. Try and drag in A · B (don't worry if this does not make sense yet!)

You can start again by clicking the clear button, or remove individual elements by dragging them into the bin.

Next, let's navigate to the Let's Learn page. You can do this by clicking on Let's Learn at the top of the page (on a mobile device you may need to click the ☰ button).

This is the page where you will access all of the tutorials and quizzes. You can see your progress, as well as the tutorial/quiz to do next in the blue bar at the top of the page.



The home page of the applicationrunningon an iPhone

> BOOLEAN ALGEBRA HAS A REPUTATION FOR BEING DIFFICULT TO TEACH AND HARD TO GRASP

Expression Builder helps you to build a valid Boolean expression using a drag-and-drop interface. Once a valid expression is created, you will see the corresponding truth table appear underneath.

The Test Truth Table tool allows you to either build your own Boolean expression or generate a random one and then complete the missing values in the truth table, checking it once done by clicking the Done button. You can switch between the levels of difficulty, depending on how many columns of the table you want to be left blank.

The Rules Simplifier tool gives you a quick and easy way to discover the different rules you can apply to an expression, allowing you to select them and then generating the new expression once the rule has been applied. This is often one of the tasks students find most difficult.

Finally, the Test Rules Simplifier works similarly to the Rules Simplifier, but once you have selected the law you want to apply you must then create the simplified version of the equation yourself.

The app has been developed to provide the user with interfaces and tools that support their learning by addressing some of the key misconceptions that can arise when learning about the topic. It can be used both inside and outside the classroom, with a teacher leading the learning and using it to supplement their usual content on Boolean algebra or as a self-paced introduction or review of the topic.

We have used this app to teach a wide range of different groups Boolean algebra with significant positive feedback from students and teachers alike. It was particularly noted that the drag-and-drop interface helped to reduce students' reluctance to try problems, as it removed the need to remember the syntax.

ASSESSMENT

Assessment is included in the activities in the form of quizzes.

Once you have completed all the activities, you can further assess your knowledge of Boolean algebra by completing the Technocamps Boolean Algebra Activity Pack quiz, which includes a full range of questions covering all of the topics covered within the tool.

DIFFERENTIATION

This tool can be used inside or outside the classroom, so support should be provided by teachers where necessary-particularly for students who are learning the topic for the first time.

When students enter incorrect answers to the quizzes, they are provided with instant feedback and hints to encourage them to try again.

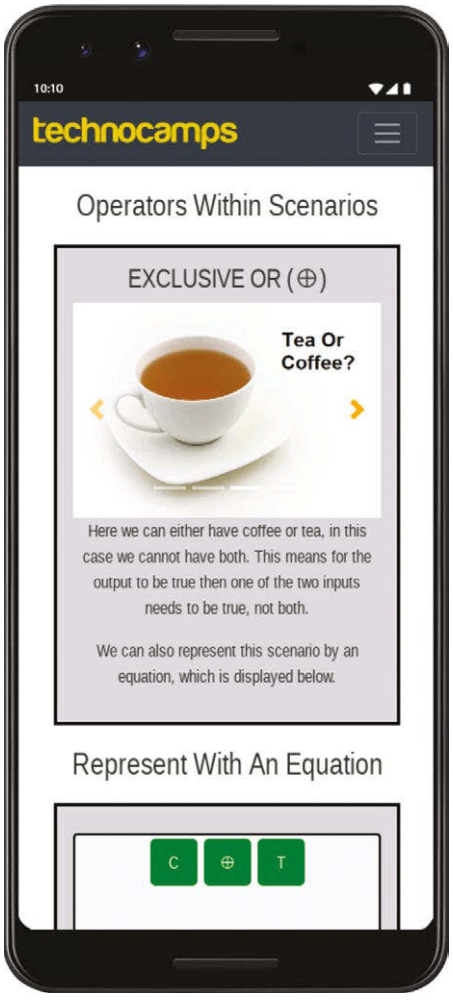
To help us understand Boolean Logic, we use four operators that each represent a logical statement.

These include:

OPERATOR	SYMBOL
AND	•
OR	+
EXCLUSIVE OR	⊕
NOT[1]	`

[1]NOT is sometimes represented as a bar on top of the variable(s), i.e. Ā

Boolean operators and their symbols



Exclusive OR is explained in Tutorial 1

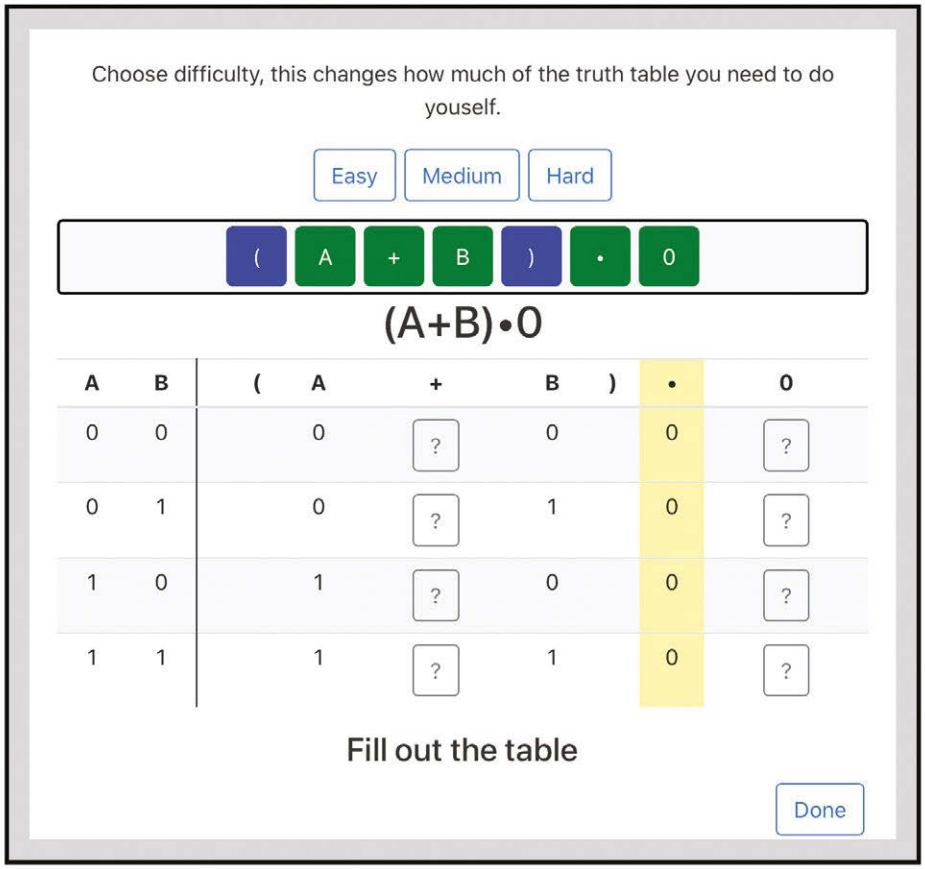
ACTIVITY 2: LET'S LEARN —TUTORIAL AND QUIZZES

1 HOUR

The Let's Learn page of the app guides you through a series of four tutorials and quizzes to learn and test your knowledge of Boolean algebra. As you complete the tutorials and quizzes it will open up new ones, with your progress saved on your device.

The first tutorial introduces the concept of Boolean variables, which are often represented by a capital letter relating to the action or object they are representing, and Boolean operators that connect variables together. The operators covered are AND, OR, Exclusive OR, and NOT. Each of the operators are introduced with different scenarios, which helps the user to understand when each should be used. After completing Tutorial 1, Quiz 1 opens up and tests your understanding of creating Boolean expressions that represent real-life scenarios.

Tutorial 2 covers truth tables and explains them using the scenarios from the first tutorial. It also looks at the number of different rows of a truth table, depending on the number of Boolean variables: when you have one variable, it can either be True or False, and therefore there are two rows. As you add more variables, each one doubles the number of



Quiz 2 asks learners to complete this Truth Table

> THERE ARE FOUR PURPOSE-BUILT TOOLS TO SUPPORT YOUR UNDERSTANDING OF BOOLEAN ALGEBRA, PLUS TUTORIALS AND QUIZZES

rows, so a truth table with two variables has four rows and one with three variables has eight. (Hint—there's a pattern: for n variables there are 2n rows.)

Once you have completed Tutorial 2, Quiz 2 opens, which tests your ability to complete truth tables. You need to complete easy, medium, and hard versions of each of the problems. You fill out the truth table by clicking on the '?' changing it to a '1', and then again to change it to a '0'.

Tutorial 3 explains how we can use different rules to simplify Boolean expressions by reducing the number of variables and/or operators. The tutorial explains intuitively using a truth table to show equivalence of each of the rules and how they are applied to expressions. Tutorial 4 then provides easy, medium, and hard expressions for you to try and simplify, using the rules you have learnt previously.

Once this tutorial is complete, the final quiz, Quiz 3, opens up. This quiz provides three different expressions, which you need to simplify by selecting the correct law and then creating the simplified equation by dragging and dropping the correct components and clicking Done.

RELEVANT LINKS

- **cstechnobool.swan.ac.uk**
- **technocamps.com**

ADDITIONAL RESOURCES

Technocamps has developed a range of additional resources for students to follow at their own pace as Activity Packs, which can be found at **technocamps.com/en/activity-packs**.

THANKS AND FEEDBACK

This tool has been developed and improved through detailed, helpful feedback from teachers. As such, we'd like to take this opportunity to give them a massive thank you. If you would like to provide any feedback, please email me at stewart.powell@technocmaps.com.

AGE RANGE
7-10 years

YEAR GROUP
Years 5 and 6

LESSON TYPE
Visual/block-based coding

REQUIREMENTS
- Scratch 3
- Computer, laptop, or tablet
- Imagination and creativity!

HACK YOUR WINDOW WITH SCRATCH

Nikki Cossey shares a fun Scratch project that enables children to reimagine what they see through their windows

Eduard Muntaner Perich, who teaches technology at the Faculty of Education of the University of Girona, proposed this creative activity using Scratch while children are in lockdown. They reimagine the view outside their windows, using their ideas to create stories, games, or animations—the possibilities are endless!

Children take a photo of their window, upload it as a sprite, erase the view outside, add a backdrop, and code creatively. I left this as open-ended as possible, provided them with a video tutorial and instructions via Google Classroom, and had weekly Zoom meetings to provide further clarity or guidance. Children loved the idea of recreating the world outside their windows and engaged with the task creatively and enthusiastically. I used this with Year 6 (aged 10–11) pupils who already had experience of creating games and animations in Scratch. Not only did this task make being stuck indoors more entertaining, it can also be used with Years 5 and 6 to teach programming concepts. (HW)

ACTIVITY 1: ENGAGING PUPILS WITH EXAMPLES 5 MINUTES

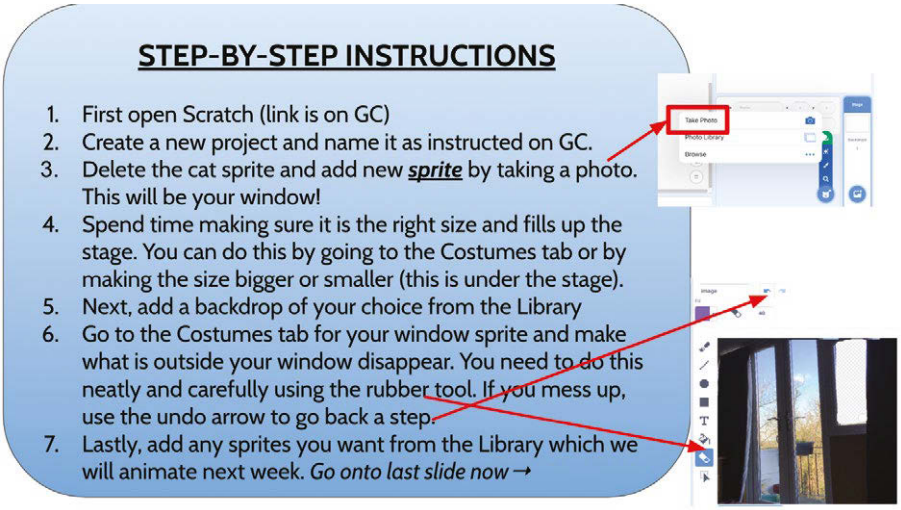
Since this lesson was delivered remotely, the starter activity was in a Google Slide attached to an assignment on Google Classroom. The slides show GIF images of projects that had already been created to inspire them and get the creative juices flowing.

OBJECTIVES

- To use layers in Scratch to code something imaginative using our window as a stimulus

> BEING STUCK INDOORS BECAME MORE ENTERTAINING

NIKKI COSSEY
Nikki is Computing Subject Leader at Thomas's Clapham, a prep school in southwest London (**@perpglo**).

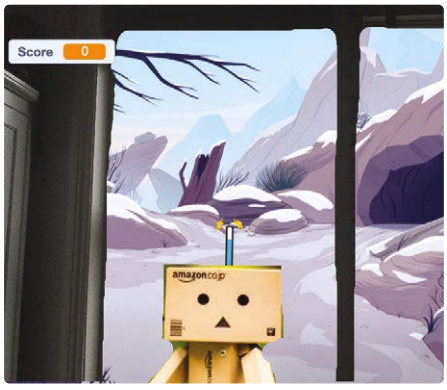


ACTIVITY 2: UPLOADING THEIR WINDOW, REMOVING THE BACKGROUND, AND CODING 40 MINUTES X 3 LESSONS

I thought it would be best to split this up over three weeks considering the slower work rate when learning from home. In the first week, I had step-by-step instructions on a Google Slide, as well as a screen recording of me demonstrating how to upload the window image as a sprite and removing the view on my iPad. I had to ensure that they were able to do this as independently as possible. Many found the video tutorial helpful with the option of a 15-minute Zoom call to resolve any potential issues.

In week two, the window sprite was already uploaded with a backdrop behind it. I encouraged them to follow the steps on the website blog of the creator, Eduard Muntaner Perich. It was then time for them to decide what they were going to create. I encouraged them to make animations by changing costumes of sprites, and using motion and sound blocks. The ideas they came up with were very original and entertaining!

In week three, they extended their animation by adding in other sprites and ensuring it reset appropriately. There was also an opportunity to attempt the extension tasks to make a fun game. The children really enjoyed this project with some saying how much fun it was. Some went the extra mile by creating their own sprites and costumes, or sourcing backdrops from Google Images.



ACTIVITY 3: PEER ASSESSMENT 10 MINUTES

I encouraged pupils to look at each other's projects on Scratch. I used the Scratch Educator account and had the entire Year 6 cohort in a class, so it was very easy for them to play each other's projects and heart react or provide constructive feedback as a comment to finish off this activity.

They enjoyed seeing what each other created and their comments were positive and affirming.

ASSESSMENT

SUCCESS CRITERIA:

- Have an image of your window in the front layer
- Have another backdrop behind your window sprite
- Have other sprites that appear in the scene and are animated in some way
- Add sounds
- Ensure project is original and creative

DIFFERENTIATION

Pupils with SEN and EAL really benefited from the video tutorial I created. When schools reopen for all, I will make more use of these videos in lessons. I usually have help sheets printed out or on Google Classroom, but the learners found it comforting to have a video to refer to, instead of needing to remember a demonstration.

Extension tasks:

- Make a game that keeps track of the score
- Have a different level (backdrop) show if you reach a certain score.
- Have a timer (you will need to Google this)

RELEVANT LINKS

- My instructions: **helloworld.cc/window**
- The blog post of the creator, Eduard Muntaner Perich: **helloworld.cc/windowblog**
- The Scratch studio by the creator where everyone can submit their projects: **helloworld.cc/windowstudio**
- My Scratch studio with the best responses from my Year 6 pupils: **helloworld.cc/windowy6**

ANIMAL ALGORITHMS

Link English to your Computing lessons with this practical unplugged activity in which children get to keep, wear, and show off what they create

AGE RANGE
7-10 years

YEAR GROUP
Year 3

LESSON TYPE
Unplugged (pen and paper)

REQUIREMENTS
- Pipe cleaners
- Bracelet letter beads
- Pen and paper

This hands-on, unplugged activity reinforces the concept of algorithms to children in Lower Key Stage 2 in a fun, practical, and engaging way. Children are given the resources to make their own bracelet featuring an animal name no more than three letters long. Before creating their bracelet, they must consider how many animals' names exist that are only three letters long, how these names are composed in terms of vowels and consonants, whether there are any patterns, and whether there are any anomalies. As the children create their bracelets, they must note down the steps they are taking, paying special attention to the precision of their instructions. When we practise this activity in schools, we encourage the children to consider all the options of animals available to them, how words are constructed using vowels and consonants, and to enjoy the freedom of designing their own bracelets with a range of colours and bead styles. Once they're on their wrists, the children are always keen to explain what they are and how they were created using an algorithm! (HW)

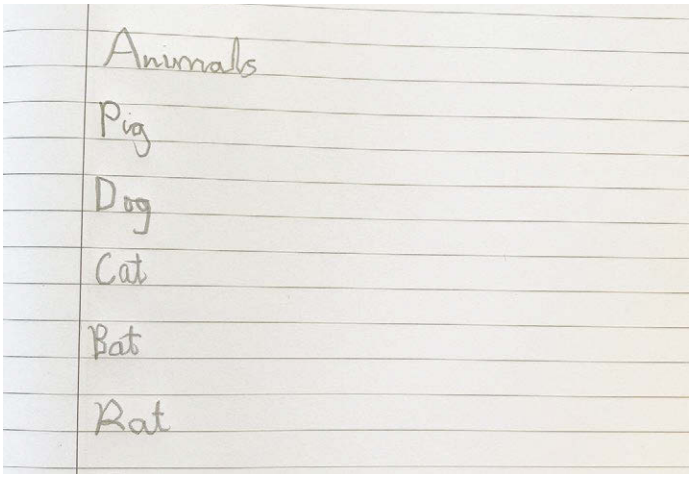
HEALTH AND SAFETY REQUIREMENTS

It is worth reminding children not to put the letter beads in their mouths. Other than that, just have fun!

PAUL GERRIE AND RICHARD SMITH
Primary computing consultants Paul and Richard work in schools across Shropshire and Telford for AmazingICT. Richard is also a CAS Community Leader and Paul is a Subject Matter Expert (SME) for the NCCE. Follow Richard at **@AmazingICT** and Paul at **@AmazingICT_Paul**.

OBJECTIVES

- Create a precise algorithm to make an animal bracelet
- Identify errors (bugs) in code
- Evaluate the work and improve its effectiveness



ACTIVITY 1: HOW MANY ANIMALS CAN YOU NAME WITH ONLY THREE LETTERS?

5 MINUTES

To start, the teacher will need to reinforce what is classified as an animal. It is OK if children stray slightly in their classifications—the goal is to list as many animals to work with for the main activity. Spend a few minutes encouraging the children to think of as many three-letter animals as possible, and then offer the use of iPads for the remainder of the time to find others they may have missed.

Once the time is up, ask children to feed back the animals they have, and list some on the board to work with as part of the main activity. The teacher may wish to have a prepared list of three-letter animals with pictures to show the children.

ACTIVITY 2: CREATING AN ALGORITHM TO MAKE A WEARABLE BRACELET 45 MINUTES

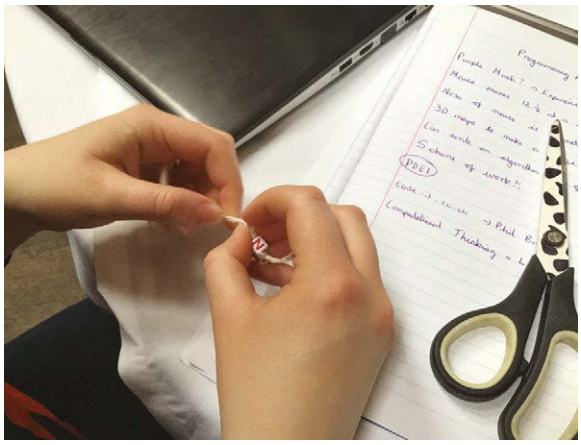
After the starter activity, children will have created an extensive list of animal names with only three letters from which to work. The teacher asks the pupils to look at their list of words and to think about how they are created using vowels and consonants (time may be needed to recap on these).

Children begin to recognise that a large number of words are created using a consonant-vowel-consonant (CVC) spelling pattern, which refers back to previous learning in English. The teacher asks the pupils—in pairs or groups—to look through their list and start to think about how we can separate our main list into a number of other lists based on the spelling patterns in the words. For example, they will likely end up with a CVC list, a VVC list, a VCC list, and so on. To extend the learning, we usually ask pupils what patterns won't exist and what won't happen in our algorithm, e.g. CCC.

Once the lists are confirmed, the children can begin to consider how these varied formations of words may affect the algorithm we produce. Can we always say in our algorithm to 'select a C, then a V, then a C'? Must the animal bracelets that we create come from a predesigned list that is formed by the spelling pattern used to form the word?

Once children realise that the creation of the words comes from a predesigned list of animal names based on a spelling pattern, e.g. CVC, they can start to gather resources to create the bracelets. Before creating, the teacher reinforces the importance of precise and detailed instructions. The teacher also asks the children how the algorithm will distinguish the different consonants or vowels, if there are more than one. How could they be identified as different? Allow children time to decide this and feed back to the class. One way may be to number the letters to create a word, for example, bee = C1 + V1 + V1 (same vowel), whereas bat = C1 + V1 + C2 (different consonants represented by C1 and C2).

Working in pairs, one pupil creates the bracelet while the partner notes down the instructions, ensuring accuracy. Once they have created one bracelet, the pair swap roles; however, this time the partner must follow the rules written down previously. As they do this, they reflect on the accuracy of the code. Are there any errors (bugs)? Can they modify their code in any way?



Beads are carefully threaded to create each bracelet

To extend the learning, children could look at how the algorithm checks for errors based on previous feedback of what cannot be formed, e.g. a CCC word. Further still, children could move onto looking at how a four-letter animal name may be created and how this could change the algorithm.

For older year groups, children could look at any loops that could be used to make more than one bracelet. They could also look at the use of selection when checking whether an animal has already been used, for example by selecting letters and checking the animal names against the word list. If the word is not found, they can thread the letters to their bracelet, or else discard and repeat.

Through this activity, the children will learn the important skills of critical thinking, problem solving, debugging, and evaluation.

> "CHILDREN TEST THE INSTRUCTIONS AND DEBUG THEIR CODE

ACTIVITY 3: DEBUG THE TEACHER! 10 MINUTES

On the board is an algorithm written by the teacher for making one of the bracelets, but it has errors (bugs). Can the children identify the bugs? Extend the learning by asking them to fix the bug.

ASSESSMENT

The children will be able to self-assess the validity of their algorithm when they come to make the second bracelet in their pairs, using the instructions they have already written.

The teacher will assess during the lesson, looking through their algorithm, and asking relevant questions to ensure the code works.

DIFFERENTIATION

Students with special educational needs can be supported by pairing up for this lesson, and with the help of a teaching assistant if this is within their usual support structure. Children can be placed in mixed pairings to collaborate on creating their bracelets, while teaching assistants can support those with limited fine motor skills in helping to thread the beads and fasten the bracelets.

A MUSEUM IN YOUR POCKET

Alan O'Donohoe explains how to recreate the magic of a school trip at home

In the year 1834, Ada Lovelace, widely recognised as the first computer programmer, visited factories and mills in the north of England under the guidance of her mother, Annabella Milbanke, as part of her education. If we close our eyes, we can try to imagine a young Ada gasping at the noise and clatter of a Jacquard loom mechanism as she witnessed the extraordinary force of steam powering the machinery used to manufacture textiles on an industrial scale. History books tell us that young Ada did not have a conventional school-based education; she was largely homeschooled. Ada's mother must have known the potential of an educational visit to expose Ada to learning experiences beyond traditional learning.

Nintendo's Game Boy was released in 1989

Educational trips that take place outside the normal learning environment offer enormous potential to inspire and engage young minds. However, the organisation involved in such trips has become overwhelming. Enhanced levels of preparation, risk management, and hazard controls can mean that as more energy is diverted into organising the trips, the actual content or experience may suffer, and as a result, become less stimulating.

It's also possible that in broadening the appeal of a trip to a wider audience, the unique opportunities of the visit may be diminished. If you're planning an educational trip in England, computing teachers can choose to visit museums in London, Cambridge, Manchester, Sheffield, Bradford, or Bletchley—but these locations are not easily accessible to all. The idea of having a museum literally close to home does have a certain appeal and many practical advantages. So, rather than making our homes castles, let's make them our local computing museums.

Learning during lockdown

At the time of writing, in common with my friends, family, and colleagues, I'm confined to working from home in a lockdown situation with no exit date in sight as yet. We're currently in the second month, and while we know that this enforced isolation at home is temporary and necessary to save lives and protect our health service, it's become increasingly challenging for teachers and parents to continue to provide rich experiences for learners confined to home. As school closures were announced, museums also closed their doors, thereby cancelling opportunities for future visits or trips. The unique nature of this lockdown period has prompted me to explore alternative methods to unlock the potential that museums, exhibitions, and objects still have to educate, engage, and inspire learners.

If you try out any of the resources suggested below, or have shared computing artefacts with your students, why not share your experiences by using the hashtag #MuseumFromHome on Twitter?

For home or school use

While writing this guide, I have considered how it might help children, parents, and families interested in hosting a museum from home during current or future enforced periods of home confinement. I have also included thoughts on how teachers and students might additionally curate a computing museum in their classrooms outside of a lockdown period.

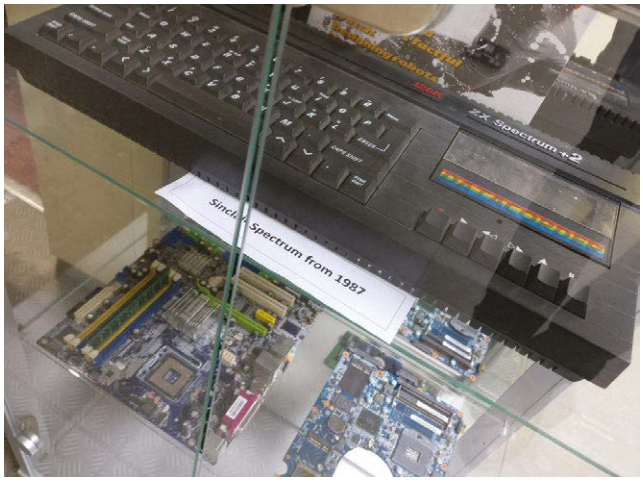
> HAVING A MUSEUM AT HOME DOES HAVE SOME PRACTICAL ADVANTAGES

In the rest of this guide, I will share with you some ideas that I have tried and tested, as well as some ideas still in development around the theme of a computing museum at home or in school. All of these ideas should work equally well in a classroom situation beyond the current period of isolation and social distancing.

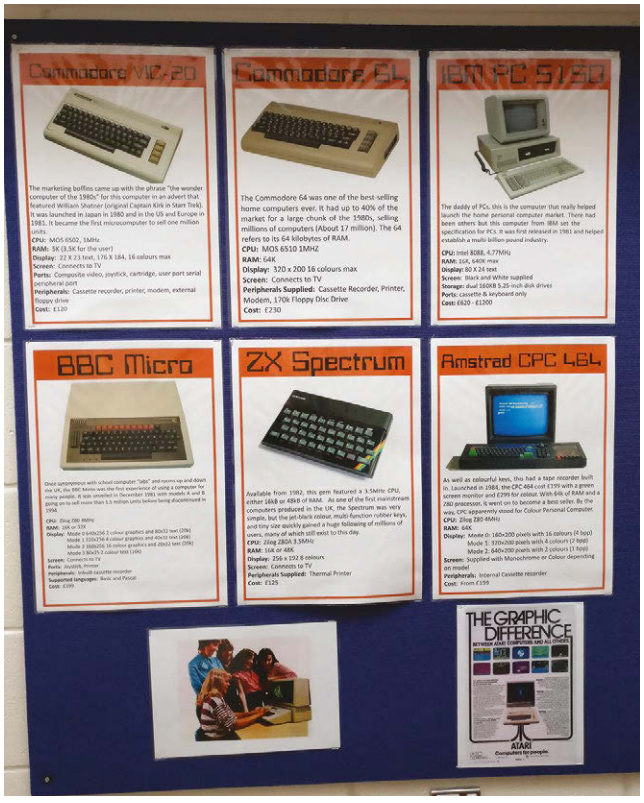
We're going to start with objects (individual items) and collections (groups of objects).

A pocket museum of computing

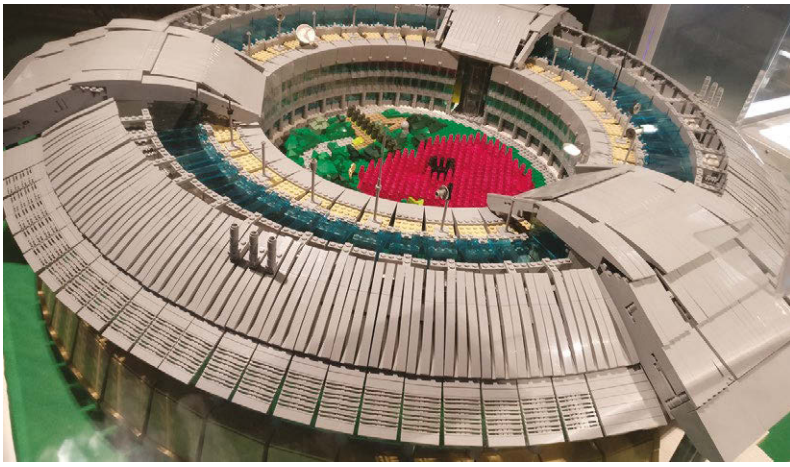
Quite simply, this is a museum small enough to fit in your pocket containing tiny objects to stimulate conversation. The museum opens the moment you retrieve it from your pocket, and only closes when you put it away again.



Museums have huge potential to educate, engage, and inspire



There's a huge range of objects that you could house in your museum



The compact size and portability mean that you can carry this museum around with you. When an opportunity presents itself, you simply open the museum and unleash the collection of objects and the stories that accompany them. Pockets vary in size, and so will these miniature museums. You might design a museum with a specific pocket in mind. An upcycled mint tin containing some surface mount components, for example, may be no larger than a few centimetres.

Another pocket museum might be an assortment of information cards or images. A pencil case museum could contain a glass valve, a floppy disk, a punched card, a CPU, RAM, a micro:bit, an Arduino, and a Raspberry Pi. Granted, not all of these objects are going to easy to acquire immediately, but it's fun trying to source objects for your collection. Many of the objects I've collected for my own pocket museums have cost me around £1 on online auction sites. You may be surprised to find you already have some objects lurking in the bottom of an old drawer, cupboard, or garage, or salvaged from devices that are beyond economical repair. Your pocket museum could have a theme; for example, 'The Memory Box' might contain only objects related to data storage and computer memory, e.g. RAM, ROM, and disks.

#exabition

This is a freely downloadable, printable resource I created to help you start your own pocket museum of computing. Once it's printed out, you simply cut along the dotted lines, and hey presto! If you're particularly skilful with a pair of scissors, you can cut out the profiles of the objects, and there you have the beginnings of your very own pocket museum. This museum is so small it will fit in an envelope, so you could design your own wallet from paper or card and expand the collection to include other items.

Computing cards

A set of cards is really just an alternative version of a pocket museum of computing. I have been struck by the beauty and simplicity of Giles Booth's cards, which he designed when he was just 13. Giles was inspired to make the cards because he loved window shopping for computers in magazines and dreamed of designing his own one day. He made these computer trump cards in the early 1980s; around that time he had a Commodore PET at home. He had access to a dot matrix printer, so it made sense to him to use it to generate the text descriptions. A former computing

WHY VISIT A MUSEUM?

I invited educators to share their reasons for visiting a museum.

- **Alan Harrison, teacher:** "The stories behind the artefacts are what I enjoy: tales of human endeavour, triumphs of hope, and ingenuity over setbacks and criticism. I also like the downright weirdness of the inventions and the absolute genius needed to come up with them, like CRT memory and mercury delay lines. I mean, not many among us could conjure those solutions! I love to arrange technological developments in a historical context, e.g. why did computing develop the way it did? What were the drivers? What will the next big leap be? For me, museums are a trip around the minds of historical figures, flawed geniuses who cause me to sk, how did they come up with that, and why?"
- **Jo Newell, teacher:** "I love learning about the history of things. Seeing objects and displays helps add context rather than someone just talking about history."
- **Dean Belfield, CoderDojo mentor:** "Curiosity, more than anything, and to see up close an object that was, in the past, just a tool, or a document, or an article of clothing, or whatever, that is valued now for its historical value. My favourites include space race artefacts and the John Harrison clocks at Greenwich. I find that the stories and people behind the inventions are usually more interesting than the artefacts themselves. If you can find a good curator, that's an added bonus!"
- **Paul Knighton, teacher:** "Museums offer wonderful glimpses into the past and reminders of the dotted line to now. They offer so many wonderful stories and happy accidents to share. I'm often humbled by past innovation and expertise, as we too often assume technology was only invented in our lifetimes."
- **Jo Badge, teacher:** "The advantage of visiting a museum is to see things I wouldn't normally be able to see and learn some fascinating facts about them. Retro items at home or school... where shall we start? Nokia 3310, PlayStation 2, 20th anniversary Mac, Palm Pilot visor PDA, white scroll wheel iPod, iPad2, iPod touch, Memotech 500 BASIC home PC, and others I've forgotten about and more cables than you can shake a stick at."
- **Matt Helliwell, teacher:** "The reason I visit is to see how they bring the history and story to life, be it in how they present it, being able to touch or interact with it, or just how they tell the story of something in an engaging and relatable way."
- **Nic Hughes, teacher:** "For me, learning something new and it being presented in a fun and interesting way. I'm always keen to go back to old favourites, though. I could always keep looking at the Apollo Command Module in the Science Museum. I still remember seeing the Apollo 11 Command Module in the Smithsonian as a child."
- **Eric Clottey, teacher:** "They remind me of how far we have come as the human race and how little we have learnt (sometimes in equal measures)."

A pocket museum provides a focus for discussion

RESOURCES TO GET YOUR POCKET MUSEUM STARTED

- **#exabition:** Print at home version **helloworld.cc/exa**
- **Home Computer Cards:** Dominic Pajak has shared for free his print-and-play version of the Home Computers retro collectible cards/trumps card game **helloworld.cc/trumps**
- **Computer Combat Cards:** Available to purchase to cover printing costs, or as a digital download under a Free Creative Commons BY-SA 4.0 licence; find a sample pack here **helloworld.cc/combat**
- **The Internet Archive:** A vast repository of PC/MS-DOS computer games that you can play in your web browser **helloworld.cc/classic**
- **RetroPie:** Software for the Raspberry Pi to enable you to install and run vintage computer games **retropie.org.uk**
- **Enigma machine:** From the Science Museum's collection **helloworld.cc/enigma**
- **Apollo 11 command module:** At the Smithsonian **helloworld.cc/smith**
- **From Lisa to Windows:** The Science Museum tells how the computer mouse, desktop, and graphics we're so familiar with are relatively recent inventions that have defined our experience of home computing **helloworld.cc/lisa**
- **The Little Museum:** Designed as a HyperDuino project that was shown at ISTE2015. Touching sensors on the panels activates additional information shown on a computer **thelittlemuseum.net**
- **Rocky Bergen:** Has created a print at home set of retro computers including a ZX Spectrum **helloworld.cc/rocky**

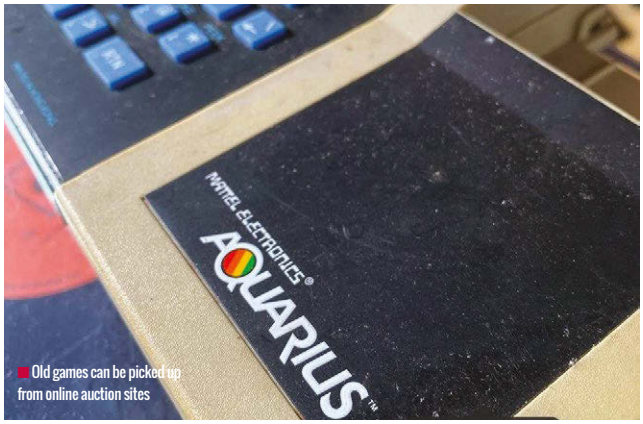
teacher, Giles now works for the Micro:bit Educational Foundation. Perhaps creating those cards set the young Giles on a path towards a career in computing?

William Lau, a computing teacher and author of *Teaching Computing in Secondary Schools*, was inspired to create Computer Combat Cards when his five-year-old son came home with some Top Trumps cards from a friend at school. Kirstie, a home educator, is a fan of the Computer Combat Cards, and has found that they have motivated her home-educated learners

> "THE DEEPEST ENGAGEMENT TAKES PLACE WHEN STUDENTS DEVELOP THEIR OWN CARDS AND RESOURCES

to research more about the technologies that appear on them. Enthusiast Dominic Pajak designed and created a Computing History Collection for printing at home. You can also order a high-quality printed version from the Cambridge Centre for Computing History.

Whether the activity takes place at home or in school, learners could start their collection using some of these packs as a basis. I'd suggest that the deepest engagement occurs when they begin to develop their own versions based around these examples. They can



Old games can be picked up from online auction sites

select the theme for their own card collections, for example, classic Nintendo games, mobile phones, handheld games consoles, or social media networks.

Vintage computers, games, and consoles

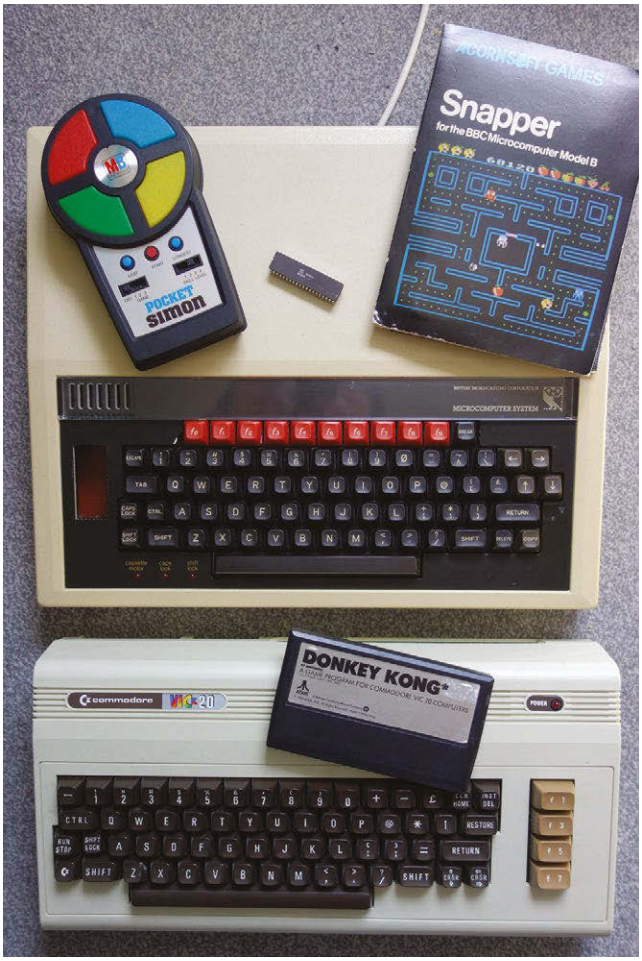
Some households still have vintage games consoles, personal computers from bygone ages, and accessories, books, and software titles in their possession. These items may be buried away in a box in the garage, the loft, or the spare room, just waiting to be relocated to their new museum home.

From time to time, you can pick up these things from online auction sites and charity shops. I recently bought an early 1980s game for £10 and there are others available at the time of writing. During a period of lockdown, when only essential travel is allowed, it's best to find other ways of reliving the experience of vintage computer games. Enthusiasts have shared footage from these games for watching on video sharing sites, as well as an archive of original TV programmes such as *BBC Micro Live* and *Tomorrow's World* that featured developments in technology.

The Internet Archive hosts thousands of vintage MS-DOS and PC games that can be played in a web browser from the comfort and safety of your home. Using a piece of free software called RetroPie that allows you to install 16-bit and 8-bit games on Raspberry Pi, some teachers have built versions of their own arcade games cabinet, including a tabletop game housed in a low-cost IKEA table.

Reproductions and representations

As a computing teacher, I've regularly set an extended holiday homework project for my students to build a 3D representation or reproduction of an object from computing history, using materials that are available to them. I've had students use a whole variety of skills to represent difficult concepts. Courtney, a Year 10 (14–15) GCSE Computer Science student, baked a cake with coloured layers to demonstrate the layers of the TCP/IP model! Students have used LEGO to build conceptual models of Turing machines or CPU system architecture. Plasticine, cardboard, and paper are easily pliable materials for creating reproductions of objects from history. Teacher Paul Jones has in his classroom plasticine models of storage devices, made by students. In my home, I've enjoyed making a Raspberry Pi, a Nintendo Game Boy, and Mario artwork from Perler or Hama beads with my children.



Many households can find some vintage games consoles hidden away

Virtual museums

There is a plethora of online resources that in one way or other allow you to explore museums and objects from your browser, or even better when combining a mobile phone with a VR headset. My personal favourites are the Enigma machine in the Science Museum's collection and the interior of the Apollo 11 command module at the Smithsonian. It's easy for these activities to become passive experiences, so I'd recommend you ask learners to act as curators and plan a virtual trip during which they lead the visitor on a trip with interesting insights, anecdotes, and factual details provided by the curator while the visitor wears the headset. (HW)

ALAN O'DONOHOE

Alan has over 20 years' experience teaching and leading technology, ICT, and computing in schools in England. He runs exa.foundation, delivering professional development to engage digital makers, supporting computing teaching, and promoting the appropriate use of technology (**@teknoteacher**).

THE BEBRAS PUZZLE PAGE

Each issue Chris Roffey shares a computational thinking challenge for your students

THE CHALLENGE: DIGIT RECOGNITION

Which segments are necessary to identify all ten digits?

A digit recognition system understands digits that look like these:

Each digit is made up of up to seven segments.

Not all segments are necessary to recognise a digit. It is possible to understand a digit if only some of the segments are visible.

The task:

Which segments are absolutely necessary to identify all of the ten digits (0...9) unambiguously?

Solution on page 97.

Further information

Pattern recognition algorithms generally aim to provide a reasonable answer for all possible inputs and to perform 'most likely' matching of the inputs while taking into account their statistical variation. Pattern recognition is a branch of machine learning that focuses on the recognition of patterns and regularities in data. One approach to recognition is to extract specific features that allow uniquely identifiable objects. Computer vision is an actively developing field of information technologies.

DOMAIN

Computer processes and hardware

SKILLS

Abstraction, decomposition, evaluation

AGE

12-18 years

DIFFICULTY RATING

Ages 12-14 hard;
ages 14-16 medium;
ages 16-18 medium

ABOUT BEBRAS

Bebras is organised in over 50 countries and aims to get students excited about computing and computational thinking. Over a quarter of a million UK students took part in last November's free annual challenge. Our archived questions let you create your own auto-marking quizzes at any time during the year. To find out more and register your school, head to **bebras.uk.**

COMPUTING KEYWORD SPOTLIGHT: ABSTRACTION

Defining an everyday technique used by problem-solvers

Abstraction is one of the fundamental computational thinking skills employed by engineers and computer scientists. It is also used more generally, by everyone, when solving everyday problems. The problem-solver abstracts when they look at a complex problem, to identify and extract information to define the main ideas. This then reduces the complexity of the main idea. This is slightly more than just decomposing a problem into smaller subproblems. Here, the focus is on getting clarity for the main idea.

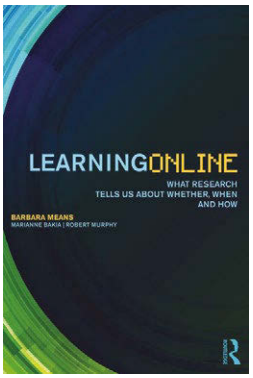
A programmer abstracts when they refactor their programs and pull out sections of code that can be put in a separate class or function, leaving a descriptive function call in its place, e.g. authenticate_user(username, password). Note that in this situation, the programmer has not removed detail, or hidden it. They have made it clear what is happening in the main program, and allowed anyone reading the program the ability to look up the authentication process, should they wish to.

How to spot a student using abstraction:

- They are hiding unnecessary details in some way (e.g. using footnotes)
- Spotting key elements in a problem presented to them (e.g. using a highlighter)
- Choosing a representation of a system (e.g. the Tube map)

LEARNING ONLINE: WHAT RESEARCH TELLS US ABOUT WHETHER, WHEN, AND HOW

INFO **BY** Barbara Means, Marianne Bakia, Robert Murphy | **PUBLISHER** Routledge | **PRICE** £29.59 (£34.99 RRP) | **ISBN** 978-0-415-63029-0 | **URL** routledge.com



During a time when we are all searching for help on how to deliver remote teaching, finding research on online learning seems to be a good place to start. To that end, I started to look for a summary of current research on online learning and came across this book, *Learning Online*. The authors are well-respected education psychologists and educational researchers with distinguished careers in this field. Last updated in 2014, this book is easy to read, honest, and balanced in its arguments. It provides very useful definitions of terms, models for reviewing and improving online learning, and a summary of how online learning is used in schools, universities, and informal settings.

The authors avoid making general sweeping statements about the effectiveness of online learning and instead look for detailed evidence of the different approaches to online learning and which are more or less likely to be effective in specific circumstances. This means that despite the text not being written with lockdown in mind, there are several pertinent sections that are useful right now. I found the conceptual framework (page 10) that summarises the dimensions of online learning very useful, as it provides vocabulary to compare and contrast remote teaching approaches. And there is general solace in reading just how difficult and time-consuming it is to design effective online learning programmes.

In chapter 7, 'Online learning for less-prepared students', a particular quote resonated: 'Online pedagogies assumed a level of independence, motivation, and self regulation on the part of learners, or the presence of parental guidance for younger students working at home' (page 140). The chapter goes on to describe research on how to adapt online learning for the less-prepared learner groups. But don't rush to this chapter; there are no magic bullets here. Instead there are warnings about online learning failing weaker students who have 'weak academic preparation, competing workplace and family priorities, a lack of technology skills, a lack of technology infrastructure and underdeveloped skills of learning independently'.

Figure 7.1 (page 151) gives a list of strategies for increasing success rates, but these strategies take time to implement and many require increased teacher and peer connections, which counter or challenge current safeguarding and GDPR issues, something that is not considered by the authors.

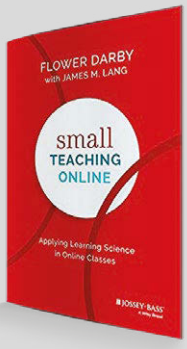
Emergency remote teaching is not the same as online learning, but this is a good read that can help us reflect on the differences between the two, realise what a great job has been done during lockdown, and reflect on the way forward as pupils start to move back into bricks-and-mortar schools. *Review by Jane Waite.* (HW)

ESSENTIAL READING

Three more books on effective online and hybrid education

SMALL TEACHING ONLINE: APPLYING LEARNING SCIENCE IN ONLINE CLASSES

BY Flower Darby, James M. Lang
PUBLISHER Wiley
PRICE £22.99
ISBN 978-1-119-61909-3
URL wiley.com



Small and strategic changes have the power to improve student learning. This book suggests minor changes for achieving significant learning gains, identifying areas of best practice.

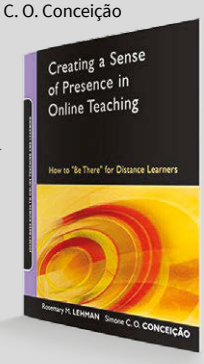
ESSENTIALS OF ONLINE TEACHING: A STANDARDS-BASED GUIDE

BY Margaret Foley McCabe, Patricia González-Flores
PUBLISHER Routledge
PRICE £23.99
ISBN 9781138920545
URL routledge.com

This guide to teaching online in higher education and corporate learning environments encourages the application of concepts with the help of real-world examples, technical insights, and professional advice.

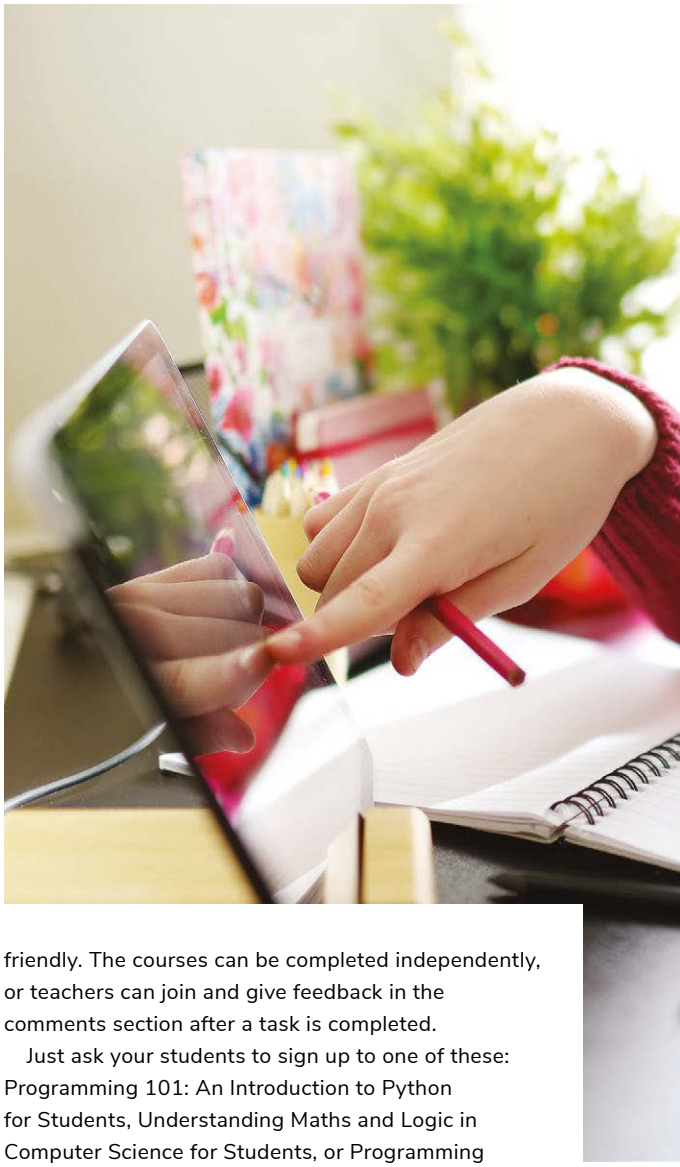
CREATING A SENSE OF PRESENCE IN ONLINE TEACHING: HOW TO "BE THERE" FOR DISTANCE LEARNERS

BY Rosemary M. Lehman, Simone C. O. Conceição
PUBLISHER Jossey-Bass
PRICE £23.99
ISBN 978-0-470-87311-3
URL wiley.com



A sense of online presence can contribute to greater student satisfaction. Here, the psychological and social aspects of online presence from both the teacher and student perspective are explored.

YOUR QUESTIONS



Q OUR EXAM YEAR STUDENTS ARE NOT LEAVING UNTIL JULY. WE'VE BEEN TOLD TO KEEP TEACHING THEM, BUT THIS DOESN'T COUNT TOWARDS THEIR FINAL QUALIFICATION. TO MAKE IT WORTH THEIR WHILE, DO YOU KNOW OF ANY ICT- OR CS-RELATED FOUR-WEEK COURSES THAT WOULD BE BENEFICIAL TO THEM?

A **LAURA SACH:** There is a special run of the NCCE object-oriented programming course reserved for Year 11–13 students (aged 15–18) which can be accessed via **helloworld.cc/ks5**. This course covers the basics of object-oriented programming in Python; it is free and is facilitated by educators from the Raspberry Pi Foundation. There are four weeks of material to cover.

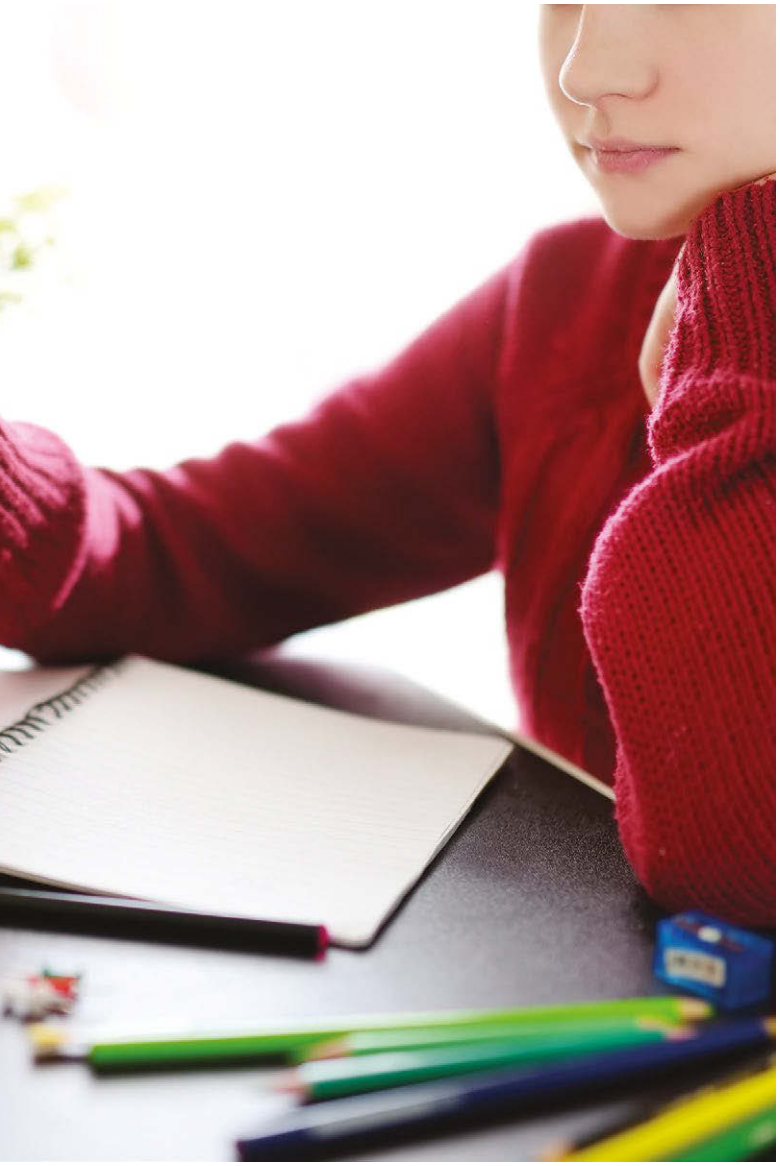
There are also the Raspberry Pi Foundation's online courses. These have been amended to be student-friendly. The courses can be completed independently, or teachers can join and give feedback in the comments section after a task is completed.

Just ask your students to sign up to one of these: Programming 101: An Introduction to Python for Students, Understanding Maths and Logic in Computer Science for Students, or Programming 102 for Students: Think Like a Computer Scientist, at **helloworld.cc/rpicourses**.

Q WE CURRENTLY HAVE BETWEEN FIVE AND TEN STUDENTS IN SCHOOL. WE CAN'T USE THE COMPUTERS FOR HYGIENE REASONS. DO YOU HAVE ANY GOOD IDEAS OF ACTIVITIES TO DO WITH A SMALL GROUP OF STUDENTS FROM ACROSS DIFFERENT SECONDARY YEAR GROUPS?

A **MATT HOGAN:** This step from Raspberry Pi's Creating an Inclusive Classroom online course explains a little more about the background to unplugged activities: **helloworld.cc/unplugged**. STEM Learning also has a good article with 20 unplugged activities: **helloworld.cc/stemunplugged**.

LAURA SACH: CS Unplugged has a series of free worksheets, which are all computing activities but don't require any hardware: **csunplugged.org**.

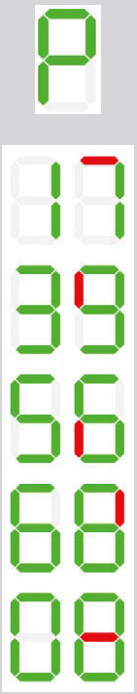


If you have a question you'd like the Learning Team at the Raspberry Pi Foundation to answer, contact us on Twitter via **@HelloWorld_Edu**. Alternatively, email us with 'Question' in the subject line at **contact@helloworld.cc**.

Q I'M LOOKING FOR PLACES TO GET HELP WITH YEAR 8 AND YEAR 9 STUDENTS WHO ARE MAKING APPS. MY STUDENTS HAD THE TASK TO 'DESIGN AN APP TO MAKE LOCKDOWN MORE INTERESTING' AND MOST OF THE STUDENTS WHO PICKED THE TASK WANTED ADVICE AND HELP TO ACTUALLY MAKE THEIR APP, RATHER THAN JUST DESIGN IT.

A **MATT HOGAN:** The Year 8 Programming: Mobile App Development resources from the NCCE can take learners through the entire process of creating their own mobile app, using code.org's App Lab**: teachcomputing.org/resources**.

BEBRAS PUZZLE SOLUTION (PAGE 94)



To understand whether five segments are enough, let us carry out the following reasoning. Since 0 and 8 differ only in one segment, this segment must be used in recognition, and we must select it.

All the digits may be split into two sets, depending on whether this segment is present in a digit: for {0;1;7} it is not present, and for {2;3;4;5;6;8;9} it is present. Next, note than 1 and 7 also differ in only one segment, thus we must also select it.

Now, all the digits are split into four sets, depending on whether they contain or not contain the two selected segments: {1}, {0;7}, {4}, {2;3;5;6;8;9}. So the two selected segments already allow us to recognise digits 1 and 4. Now let us find more digits that differ in exactly one element. These are 8 and 9. Let us also select this segment.

Digits are split in the following sets with identical elements: {1}, {0}, {7}, {4}, {2;6;8}, {3;5;9}. Similarly, 6 and 8 also differ in only one element, so let us select it.

After that, the four segments divide digits into the following subsets: {1}, {0}, {7}, {4}, {2;8}, {6}, {3;9}, {5}. Thus, four segments are not enough. 3 and 9 differ only in one segment. This segment also allows us to distinguish between 2 and 8, so we may select this element, and all the digits will be separated.

If we now overlay the segments that we have identified as being unique, we get our solution.

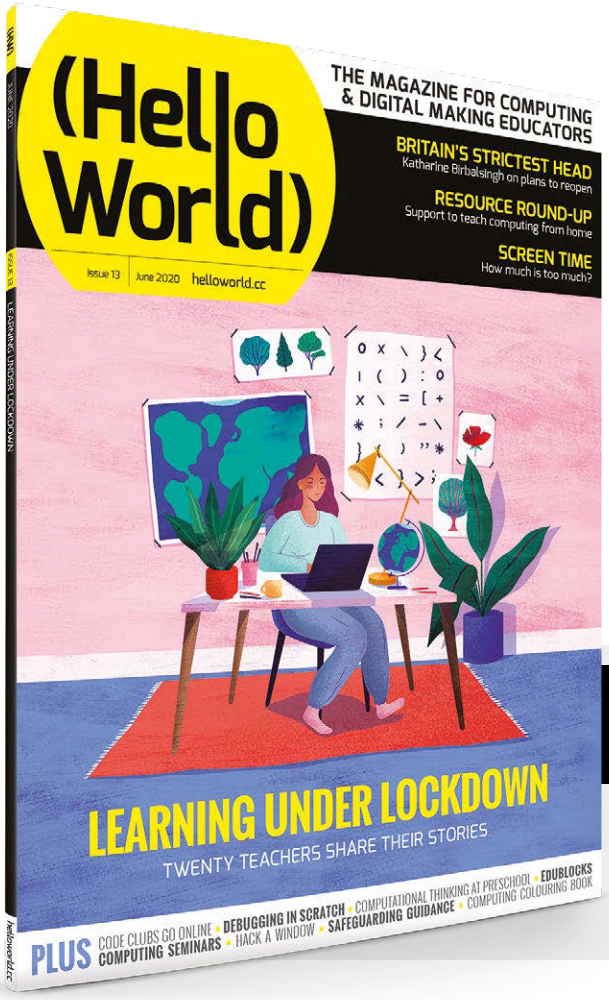
The reasoning demonstrates that the answer is unique.

"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).

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, both inside and outside the classroom.

Q WHEN IS IT AVAILABLE?

A Your 100-page magazine is available four 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.

GET IN TOUCH

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