

# (Hello World)

THE MAGAZINE FOR COMPUTING & DIGITAL MAKING EDUCATORS

**TEACH COMPUTING CURRICULUM**

Lessons for ages 5 to 16 available now

**THE BLOCK MODEL**

A framework for investigating code

**EQUITY IN COMPUTING EDUCATION**

A report from a global summit

Issue 14 | Sept 2020 | [helloworld.cc](http://helloworld.cc)



## COMPUTING IN THE WILD

FROM CONSERVATION TO GEOCACHING:  
IDEAS TO GET YOUR STUDENTS OUTDOORS

**PLUS**

FREE LECTURES • BREAKING ENGINEERING STEREOTYPES • SCRATCH ENCORE • AR • FAKEBOTS  
ESPORTS • VIRTUAL TRIPS • RECOVERY CURRICULUM • CLASS WEBSITES • LEEDS LIBRARIES



# Raspberry Pi

# Learn with the Raspberry Pi Foundation

Free for everyone anywhere in the world



## Teaching resources

Discover training, resources, and guidance to help you teach computing with confidence.

[teachcomputing.org](https://teachcomputing.org)



## Project library

Browse our 200+ online project guides that include step-by-step instructions for learners.

[raspberrypi.org](https://raspberrypi.org)



## Digital Making at Home

Tune into code-along videos and live streams for young people to create fun projects at home!

[raspberrypi.org/at-home](https://raspberrypi.org/at-home)



## Support for parents

Watch our support tutorials and receive engaging activities for your child.

Sign up at [rpf.io/parents-signup](https://rpf.io/parents-signup)

# (HW)

## EDITORIAL

### Editor

Sian Williams Page  
sian@helloworld.cc

### Assistant Editor

Amy O'Meara

### Subeditors

Louise Richmond and Amy Rutter

### Subscriptions

Joshua Crossman

Sophia Donovan-Spalding

### Social Media

Lizzie Jackson

## DESIGN

criticalmedia.co.uk

### Head of Design

Lee Allen

### Designers

Sam Ribbits, Ty Logan, James Legg

### Photography

Raspberry Pi Foundation, Adobe Stock

### Graphics

Rob Jervis

### Cover

© Owen Davey

## CONTRIBUTORS

Halima Bhayat, Claire Buckler, Helen Caldwell, Katharine Childs, Alasdair Davies, Sophia Donovan-Spalding, Tom Dore, Claire Duffield, Catherine Elliott, Samantha Feich, Will Franklin, Liam Garnett, Claire Given, Katie Gouskos, Sway Grantham, Tom Hadfield, Nic Hughes, Mark Kirby, Hayley Leonard, Wendy Lint, Matt Lovegrove, Peter Marshman, Siobhán Morgan, Alan O'Donohoe, Amy O'Meara, Yolanda Payne, Pam Popay, Emma Posey, Oliver Quinlan, Neil Rickus, Calvin Robinson, Chris Roffey, Hannah Sansom, Marc Scott, Sue Sentance, Natalie Shersby, Miriam Todino, Chris Vermeulen, Jane Waite, Matt Warne, Emma Whewell, Sian Williams Page, Tim Wilson, Matthew Wimpenny-Smith

### Hello World is a joint collaboration:



Raspberry Pi



Academy of Computing



This magazine is printed on paper sourced from sustainable forests and the printer operates an environmental management system which has been assessed as conforming to ISO 14001.

Hello World is published by the Raspberry Pi Foundation, 37 Hills Road, Cambridge, CB2 1NT. The publisher, editor, and contributors accept no responsibility in respect of any omissions or errors relating to skills, products, or services referred to in the magazine. Except where otherwise noted, content in this magazine is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported (CC BY-NC-SA 3.0).



# HELLO, WORLD!

**I**t has been a real joy reading stories of how young people are using technology to understand and interact with the environment for this issue of Hello World. From monitoring bees to creating a water-saving sprinkler system, Amy O'Meara has gathered some impressive outdoors-themed student projects. The photographs taken by Alasdair Davies' environmental monitoring cameras are truly breathtaking and it's great to learn how children from around the globe can get hands-on with such rich data sets. And closer to home, Natalie Shersby shares how your students can set up their own wildlife cameras.

A highlight for me this issue was the chance to meet with Shuchi Grover to discuss her new book, *Computer Science in K-12: An A-to-Z Handbook on Teaching Programming*. Shuchi has worked for years bringing together some of the leading voices in computing education to

produce an invaluable resource for teachers. I was really interested to hear her views on the extent to which open-ended exploration should be used in computing classrooms, alternatives to coding as a tool for assessment, and why programming can be a source of both joy and angst for students and educators alike.

This issue, we're sharing some of the feedback from our new monthly reader surveys. It's great to see that such a high proportion of readers use Hello World as a teaching resource. Consistently, it's lesson plans, ideas for activities, and examples from other educators that remain in demand. So as ever, if you have ideas to share in the magazine please do let us know at [contact@helloworld.cc](mailto:contact@helloworld.cc). We look forward to hearing from you!

Sian Williams Page  
Editor (@swilliamspace)



## FEATURED THIS ISSUE



### YOLANDA PAYNE

Yolanda, a research associate at the Georgia Institute of Technology, discusses why she has made equity in computing education a personal mission on [page 40](#).



### ALASDAIR DAVIES

Alasdair is technical director of the Arribada Initiative. On [page 19](#), he discusses how children all over the world can interact with environmental data thanks to low-cost technology.



### HALIMA BHAYAT

Halima is head of computing at a school in southwest London. On [page 42](#), she explains how a virtual classroom kept her classes engaged over lockdown and shares her plans for this term.

# (HW)

# CONTENTS

19

## COVER FEATURE



26



36



### 19 CONSERVATION

Using low-cost cameras to monitor wildlife across the globe

### 22 CODERDOJO OUTDOORS

Reflections on an open-air coding event held by CoderDojo Netherlands

### 25 SAVING THE ENVIRONMENT

A new project series with an environmental focus

### 26 GEOCACHING

Treasure hunts driven by online technology

### 28 SCOUTS

Introducing the Digital Maker Staged Activity badge

### 30 COOLEST PROJECTS

A look back at past projects with an outdoor theme

### 34 A REMOTE SUMMER SCHOOL

Learners used micro:bits to create well-being projects and explore nature

### 36 ACTIVE BODIES, ACTIVE MINDS

A video series that links computing concepts to everyday tasks

## NEWS, FEATURES, AND OPINION

### 6 NEWS

Moving towards equity in computing; Teach Computing Curriculum; screen-based GCSE assessments; This is Engineering; a free public lecture series

### 12 COLUMN

Supporting vulnerable learners with the return to school

### 13 INTERVIEW

Shuchi Grover on discovery-based learning and more

### 16 INSIGHTS – PROGRAMMING CONCEPTS OUTDOORS

Can coding be used to enhance outdoor play?

### 18 INSIGHTS – SCRATCH ENCORE

Making materials culturally relevant

### 38 SUBSCRIBE IN PRINT TODAY!

### 40 EQUITY IN COMPUTING

Reflections from an online global conference

### 42 AN INTERACTIVE CLASSROOM

How one teacher created an engaging online resource during lockdown

### 46 TEACH COMPUTING

Lessons learnt from designing a complete computing curriculum

### 48 CODE CLUB

How Leeds Libraries conducted a remote project with Code Club participants

### 50 THE I IN PRIMM

Exploring how the Block Model can create learning opportunities

### 56 VIRTUAL WORLDS

How a coding club explored the Roman cities of Bath and Exeter

### 60 IMMERSIVE TECHNOLOGIES

An international student collaboration incorporating AR and VR

### 62 MAKING CONNECTIONS

How to grow a professional learning network



72

**ZERUS & ONA**

Books for introducing children to computing concepts



54

**FAKEBOTS**

Using card representations of popular floor robots



58

**ASTRO PI**

The programme launches for 2020/21 with some exciting new changes

**64 GOBUBBLE**

A social platform to support new students

**66 CHOOSING THE RIGHT CURRICULUM**

Ensuring the quality of students' learning

**70 ESPORTS**

A growing phenomenon

**74 ABC**

A curriculum-design process that aims to help teachers create varied online lessons

**77 PROFESSIONAL DEVELOPMENT**

Finding time for professional learning while face-to-face courses are on hold

# CONVERSATION

**88 INSIDER'S GUIDE**

Inspire your students with a virtual school trip

**93 BEBRAS**

A fun challenge in computational thinking

**96 SURVEY RESULTS**

We share some insights and comments from our reader surveys

# REVIEWS

**94 BOOK REVIEWS**

A handbook on teaching programming; a reference for creating classroom visuals; and a classic text on graphics, tables, and charts

# LEARNING

## RESOURCES & LESSON PLANS

**78 SAVE THE SHARK**

A Scratch project with conservation in mind

**80 EXPLORING NATURE**

Unplugged activities to try outdoors

**82 MY NATUREWATCH**

Capture wildlife with a DIY camera

**86 SPHERO**

Students can harness data with these exciting activities



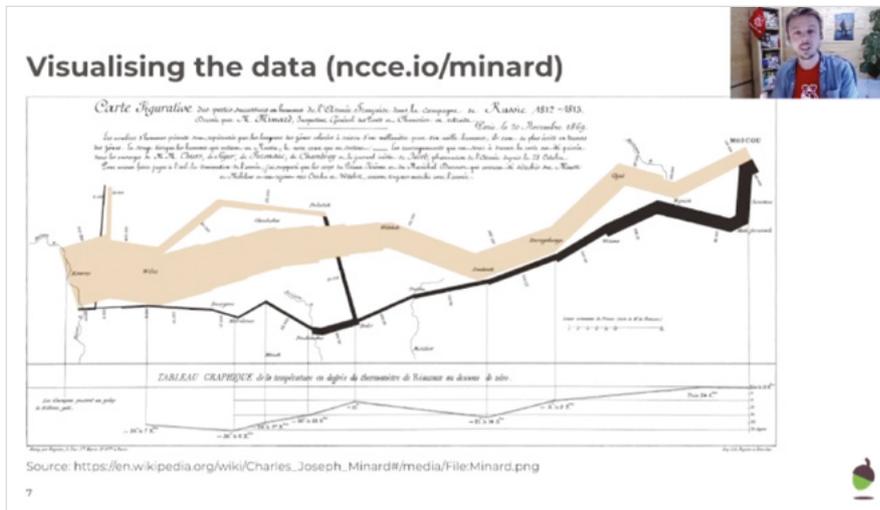
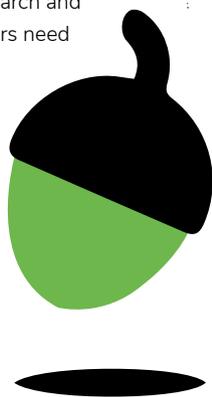
# OAK NATIONAL ACADEMY PARTNERS WITH TEACH COMPUTING

Computing teachers can support their students beyond the classroom with a dynamic new range of video lessons and resources

Amy O'Meara

As we look into the 2020/2021 academic year, teachers will likely be wondering how to best support their students during what is still an uncertain time. The coronavirus pandemic has forced educators to consider what formal learning looks like outside the classroom; as time has gone on, many organisations and individuals have recognised that remote learning may be with us for some time, and have made steps to improve and formalise this method of delivering lessons.

Teach Computing — an NCCE initiative — has over the past 18 months been developing a complete computing curriculum with approximately 500 hours of free content. The curriculum is based on recent pedagogical research and contains everything teachers need to teach computing at Key Stages 1 to 4. All Teach Computing resources, including lesson plans, slides, worksheets, homework, and assessment, are currently available on the Teach Computing website ([helloworld.cc/tc](http://helloworld.cc/tc)). The curriculum



Colleagues from the Raspberry Pi Foundation team were involved in the production and delivery of video lessons

team has been thinking hard about how to support students with this body of materials outside the traditional classroom, particularly those who may be affected by local lockdowns or otherwise have reduced access to a traditional computing lesson. This has led to an exciting new partnership with Oak National Academy. Oak National Academy is an online classroom and resource hub, created by education professionals, which delivers engaging and dynamic video lessons

across a range of subjects. The hub was developed as a response to the educational challenges presented by the pandemic. Delivering the curriculum content from Teach Computing through the platform of Oak National Academy has many benefits for both teachers and students. Director of Educator Support at the Raspberry Pi Foundation, Carrie Anne Philbin, said: "I hope that by providing video lessons based on our Teach Computing curriculum, delivered by experienced computing teachers from across the country, we can

help students who are affected by the long-term effects of the coronavirus pandemic, and lighten the load on schools and teachers."

### What resources are available?

Oak National Academy will present some of the Teach Computing lessons on camera, direct to students. These high-quality video lessons are designed to support teachers, parents, and students at home. Several members of the Raspberry Pi Foundation team were involved in the production and filming of the videos, with the aim of making them as useful as possible for teachers and students. Speaking about the opportunity, team member Rebecca Franks said: "It has been a great opportunity to use the materials that we have created for the NCE in a different context. I have really enjoyed the challenge of adapting the lessons for asynchronous learning. I hope that the lessons will be really useful for any learners that might be self-isolating or in local lockdown."

Rebecca's colleague Ben Garside spoke about how he hopes the materials will provide continuity for learners:

## VIDEO LESSONS BASED ON THE TEACH COMPUTING CURRICULUM CAN HELP STUDENTS AFFECTED BY THE PANDEMIC

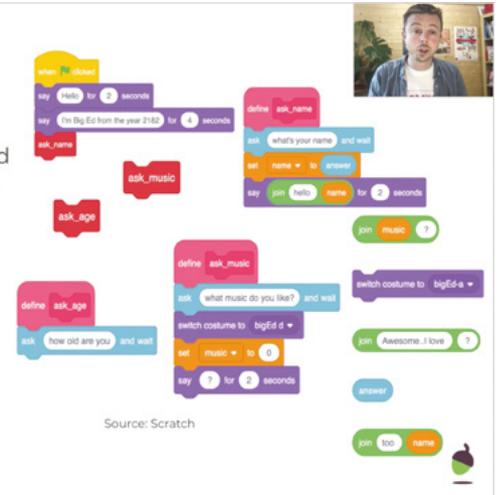
"We're really pleased to be able to present our resources directly to learners, knowing that despite the uncertainty of the coming months, there will be resources online that will present young people with the opportunity to continue with their learning outside the classroom. While nothing will replace face-to-face collaboration, hopefully these resources will form a bridge between home and school and reduce the impact of not being in the classroom."

The Teach Computing curriculum is divided into units, each containing six hour-long lessons. To give an example, the six lessons from Year 9 are: 3D Graphics,

### Task 2 - Investigate

Continue with the worksheet and complete all of the questions for Task 2.

Follow the instructions and investigate how the code works.



Source: Scratch

The hub was developed in response to the educational challenges posed by the coronavirus pandemic

Animation, Video Editing; Data Science; Cybersecurity; Representations: Going Audiovisual; Python Programming with Sequences of Data; and Programming Physical Computing. From September, students in Years 7, 8, and 9 will be able to access lessons from this curriculum via the Oak National Academy platform.

Furthermore, a number of GCSE computer science theory units will also

more units for Year 5 coming after half term, including Selection in Physical Computing and Chatbot Selection.

### How can teachers use the resource?

As with all of the resources from both Teach Computing and Oak National Academy, teachers can either adopt the full lessons designed for the classroom, or use the video lessons to complement their own teaching. Together, both sets of resources can be used inside and outside the classroom, and students will have continuity in their learning — whether this learning takes place in school, remotely, or a combination of the two.

### Relevant links

- Teach Computing curriculum: [helloworld.cc/tcc](https://helloworld.cc/tcc)
- Oak National Academy: [helloworld.cc/oak](https://helloworld.cc/oak)
- More details on year group lessons: [helloworld.cc/tc-blog](https://helloworld.cc/tc-blog) HW

become available in September, including Data Representations, Computer Systems, and Networks.

In addition, Teach Computing is providing six units of lessons for Year 6 learners from September, including Variable in Games and Sensing, with six

### Converting from binary to decimal

Use your **table** to help you answer the following quick fire questions.

128	64	32	16	8	4	2	1

The resources can be used both inside and outside the classroom, providing continuity to learners

# A NEW APPROACH TO COMPUTER SCIENCE ASSESSMENT

For their GCSE in computer science, Pearson Edexcel is making the transition from paper- to screen-based assessment

Amy O'Meara

**A** computer science GCSE qualification is setting out with a new approach to assessment. Available for teaching from September 2020, the awarding body Pearson Edexcel will allow students who take GCSE computer science to be assessed in 2022 by doing programming using a computer.

The awarding body believes that the move from paper- to screen-based assessment more accurately reflects how computer science is practised and taught, and hopes that others will follow suit. Subject advisor Tim Brady said that the new approach aims to “match the assessment with the learning and to make it relevant to how the outside world views computer science”.

## How will the assessment work?

To run the assessments, Pearson Edexcel will be taking a number of considerations into account.

### Exam security

No internet connection is permitted or needed during the assessment. An exam profile is set up in advance for each student, and each computer is set up to provide the students with the tools required to do their programming. These are the same tools that the students have been taught with during the two- (or three-) year programme of study. The qualification centres take responsibility for security and invigilation, with data files being released digitally to the centres on the morning of the exam and subsequently placed in each candidate's user area. There are a series of measures in place to ensure that files are transferred smoothly, even if issues arise.

### Assessment reliability

Pearson Edexcel decided to adopt just one programming language — Python — in order to set tasks for assessment that are fair and reliable. One reason the awarding body gave for using a single programming language is that they could reduce the reliance on a formalised pseudocode that was being used to facilitate paper-based assessment. Python is also free, easy to get started with, and widely used within the education community. Tim Brady is empathetic to the fact that some teachers will be unfamiliar with Python, and that there will be a learning curve involved. However, there are also opportunities for teachers to learn alongside their students: “Some teachers will be resistant to Python; perhaps they are skilled in another language and don't want to learn a new one (I was exactly this teacher at one time) but in the interests of the students I relented, and now enjoy the freedom and flexibility of Python. It took no time at all and it is really beneficial for an experienced programmer to learn a new language in parallel with their students.”

### Infrastructure

The Joint Council for Qualifications (JCQ) recommends that computer-based exams should have a wide separation between screens. While having a wide separation between students is now the norm in the era of coronavirus, other measures can also be taken, such as screen shades and desk dividers. In addition, the GCSE requires that every student is assessed using a computer in a single exam session (no window of time).

While there are considerations to take into

account, there may well be advantages to on-screen assessment and we may see more computer science qualifications following suit in the future. Simon Howe, ICT Coordinator at the Dean Trust, said: “Pearson Edexcel's GCSE Computer Science on-screen assessment will allow pupils to express and gain a deeper knowledge of Python and apply their programming skills in a practical way, which can only better prepare them for Post-16 study of computer science and future employment within the IT sector.”

You can find out more about Pearson Edexcel's GCSE in computer science (9-1) and plans for assessment at: [helloworld.cc/pearson-edexcel](https://helloworld.cc/pearson-edexcel). <sup>(H-W)</sup>



# “THE PEOPLE WHO SIT BACK AND SAY NOTHING ARE JUST AS DANGEROUS”

Leading figures in computing meet to discuss how the field can eradicate systemic racism

Sian Williams Page

**L**ast month, the Center for Minorities and People with Disabilities in IT (CMD-IT, pronounced ‘Command it’) hosted a panel discussion examining racial injustice from the perspective of leading Black professionals in computing. The panelists shared their own stories of overcoming racism, as well as suggesting the changes needed to make computing an equitable industry and academic domain.

Dr Nicki Washington, a Professor of the Practice of Computer Science at Duke University, stressed the need for non-minority voices in computing to become active anti-racists. “We’re experiencing right now in this country racism fatigue by a lot of non-Black and -brown people, where it’s kind of like, ‘OK, well, yeah, we got it in June... Are we still going to talk about this?’ Yes, we are, because racism takes no days off. And so if you are of that demographic where you’re starting to feel like, ‘This is a lot, this is too much’, imagine what your Black colleagues are feeling and doing, because we don’t get that luxury, and that in itself is a privilege, to be able to say, ‘I don’t want to deal with this.’

“Dr Beverly Daniel Tatum said it in *Why Are All the Black Kids Sitting Together in the Cafeteria?* The people who sit back and say nothing are just as dangerous as the people who do. Imagine you’re on a walking ramp in an airport. The people who are walking with the ramp are active racists. They’re

getting there quicker and they’re doing more. The people who just stand to the right, they’re going to the same destination, just getting there slowly. Those are the passive racists. They’re not saying and doing those things, but they’re allowing them. The people who turn around and force their way to walk back are the anti-racists. They’re refusing to go in the same direction as everybody else. And we have to get more of

we’ve gotten wrong?’ ...Acknowledgement is actually just the first part of it. What are you going to do about it? And what does it mean for really addressing the systems that perhaps you didn’t put in place?”

In response, Dr Joel Branch, Chief of Product at Lucid, Inc., stressed the importance of leaders taking the time to understand racism, without burdening Black colleagues with the task of educating them.

**“ LEADERS NEED TO TAKE THE TIME TO UNDERSTAND RACISM WITHOUT BURDENING THEIR COLLEAGUES WITH EDUCATING THEM**

white, and Asian, and everyone else who does not identify as a minority group in computing to start walking the opposite way and being anti-racist.”

When asked what can be done to address systemic racism and move towards equity in industrial spaces, Dr Jamika D. Burge, Director of Artificial Intelligence Design Insights at Capital One, highlighted the importance of decisive action for change, as well as meaningful conversations. “We’re seeing a lot of companies — even mine — having these conversations these days,” she explains. “‘What are you feeling? How are things going for you? Perhaps our Black colleagues can help us understand what

“One thing that I think is getting outdated in this conversation,” he says, “Is this kind of handicap of not understanding...”

“If you’re smart enough to be a director of distributed computing or something like that, then you’re smart enough to not go into this with these training wheels on... I think if you really tried, you know what links to look up, you know what book to read, you know what TV shows you should maybe start watching... You just can’t overburden the people who are at the wrong end of the spectrum with helping everybody to steer the ship.”

The full discussion is available to watch for free at [helloworld.cc/cmd-it](https://helloworld.cc/cmd-it). [\(HWW\)](#)

# LECTURES ON GREAT IDEAS FROM COMPUTER SCIENCE

A new series of free public lectures from Gresham College exploring algorithms and data will be a valuable resource for students wishing to study computer science at university

Sian Williams Page

**A** free public lecture series is starting this October on how ideas for computer science can be applied to the wider world. In *Great Ideas from Computer Science*, Professor Richard Harvey from the School of Computing Sciences at the University of East Anglia (UEA) will look at how ideas from computing influence our lives and ways of thinking.

The series will be hosted online for free by Gresham College, an institution that has been providing free lectures in the City of London for over 400 years. There are also tentative plans to provide free tickets to those students wishing to attend in person at the Museum of London in 2021. Recordings of all lectures will also be made available online.

Talking about his plans for the series, Richard Harvey explains: "I want to show how computer science is more important than people are giving it credit for. I also want to show how the ideas of computer science can be helpful in everyday life.

"It's kind of fascinating how dependent your life is upon all of these algorithms that run secretly in the background, and no one knows how they work; take sorting, for example. Sorting is a kind of tedious mental battleground for A level computing students who have to learn this sort and that sort. But it's incredibly important; almost everything we are doing relies on some sort of sort. You know, when you check your email, all these algorithms are pervasive.

"So I'm going to talk about algorithms, programs, data, the components of computer science, but I think I'm going to take two little twists on it, which might be kind of interesting for the general audience as well. Can you use these ideas to change your life? I mean if these algorithms are useful for computers, are they useful for humans?"

The lecture series will be helpful to

When asked if the lectures will touch on the recent UK exams debacle, in which an algorithm — based largely on previous school performance — was used to assign students' grades, Harvey says: "I could give a whole lecture on that algorithm... There's been a tendency in the press to blame algorithms. It wasn't the algorithm; it was the humans who chose the algorithm. The failings are human

## IT'S FASCINATING HOW DEPENDENT YOUR LIFE IS UPON ALL OF THESE ALGORITHMS

students wishing to undertake extracurricular projects such as the Extended Project Qualification, or in forming ideas to write about on university applications: "I'm director of admissions at UEA, and so I'm quite familiar with the sort of things people write on their personal statements. And when a kid has come from Eton, the personal statement is very well written and shows all sorts of extracurricular injection and activity, and you don't see that so much from state school kids, because they don't have the opportunities. Gresham doesn't have to be like that at all. Anyone can come.

"I'm aware that there are lots of students out there who are doing GCSE, AS level, and A level computing and there's only so much their teachers can cram in to lectures, so these should make a nice adjunct to that. They're not replacements for doing A level."

ones, of understanding what people would feel like... It was palpably unfair."

Lectures will be taking place from October through to May next year and will include *An Introduction to Algorithms* on 20 October; *Data: The Past, The Present and The Future* on 24 November; *An Introduction to Programs* on 2 February 2021; *Networks: The Internet and Beyond* on 20 April 2021; *The Future of Computer Security* on 25 May 2021. Gresham College will also host a one-off lecture on AI and Humour from Yorick Wilks, Emeritus Professor at the University of Sheffield, on 23 February 2021.

To book places for the online lectures and confirm availability for in-person tickets, visit [helloworld.cc/gresham](https://helloworld.cc/gresham) or sign up to the Gresham College mailing list at [gres.hm/schools](https://gres.hm/schools). 



■ Tanda Kabanda, part of 2020's This is Engineering #BeTheDifference campaign, works at ASOS as a software engineer

# TACKLING PRECONCEPTIONS ABOUT ENGINEERING

The Royal Academy of Engineering's highly celebrated This is Engineering Day takes place on 4 November with the theme #BeTheDifference

Katie Gouskos

**N**ow in its third year, This is Engineering is an ambitious year-round digital marketing campaign that aims to dispel common misconceptions about what engineering is, or what an engineer might typically look like. The celebrated day takes place on 4 November, with the theme #BeTheDifference. Its aim is to show how engineers make a difference to the world, and how we live in it, giving young people the opportunity to see the positive impact that engineering has on everyday life.

However, connecting with young people and trying to overcome preconceptions is by no means an easy task. Preliminary research from the Royal Academy of Engineering found that young people often associate engineering with cars, boilers, or fixing railway lines – a fairly narrow representation of the profession.

This is exacerbated somewhat by online searches for 'engineer' returning mostly images of white men in hard hats. To try and combat this, This is Engineering established a free image library where you can find more diverse images of engineers to better represent the profession.

## Inspiring role models

Using real role models and telling their stories is another way in which the campaign brings engineering to life for young people. Tanda Kabanda, who is part of the campaign, is an example of this. She started out as a fashion photographer for her friends and began using CSS and HTML to code and customise blogs.

After gaining an undergraduate degree in computer science and multimedia and a postgraduate degree in computing and internet systems, Kabanda found an internship overseas. Deciding to follow her passion and ignore advice to go into banking, she went on to land a job at online fashion retailer ASOS as a software engineer, thereby combining her love of coding and fashion. Talking about her experience as a young teenager Kabanda says, "I wish I had seen or heard more examples of women in engineering, like in movies such as *Hidden Figures*."

Dr Hayaatun Sillem, CEO of the Royal Academy of Engineering, says, "One of the main barriers to young people pursuing a career in engineering is deeply rooted cultural perceptions of the profession

being mechanical, too technical, and boring, an outdated view that's being reinforced online.

"Our This is Engineering campaign challenges these perceptions, and this year, the theme of Be the Difference is an opportunity to shine a light on the engineering that shapes our world for the better, whether that's by making our day-to-day lives easier or by tackling some of our biggest global challenges.

"Engineers have a positive impact on our present and future world in so many ways, from access to clean water and electricity, and technologies and transport that help us keep in touch with other people. We want more young people to see the potential in themselves to be a part of this."

On This is Engineering Day 2020, a virtual gallery dedicated to engineering feats will be launched on Google Arts & Culture. Free resources will also be made available for teachers to use in the classroom, highlighting the pivotal role engineering plays in the arts and entertainment industry. More details are available at [thisisengineering.org.uk](https://thisisengineering.org.uk). 

# A RECOVERY CURRICULUM FOR COMPUTING

**Catherine Elliott** shares ideas for supporting the most vulnerable learners as they return to school

**T**he latest reports on the learning loss that children suffered as a result of lockdowns suggest that there may be an even larger gap in learning for children with additional educational needs. Many pupils will be experiencing anxiety about returning to school; home learning will have been a positive experience for some students with special educational needs and disabilities, as they were able to learn at a time and pace and in a manner that suits them. There are added complications for teachers in schools that are prioritising core subjects, and where ICT suites and other devices are deemed unsafe to use because of the challenges of cleaning and social distancing. How do we adapt the curriculum to take all of this into account?

Writing on the website Evidence for Learning, Barry Carpenter, Professor of Mental Health at Oxford Brookes University; and Matthew Carpenter, principal of Baxter College in Kidderminster, call for a recovery curriculum. They outline five levers of recovery: relationships, community, transparent curriculum (identifying and addressing gaps in knowledge), metacognition, and space (space to be, and space for learners to rediscover themselves and their voices). They also talk about reigniting the flame of learning.

I will look at some simple computing activities to provide these levers below, while acknowledging the need for a socially distanced classroom.

## Relationships

Many schools are focusing on reinforcing and developing digital literacy and knowledge about online safety as pupils return. We can discuss the meaning of friendship both on and offline, and examine the positive uses of technology, including how it has been used during the pandemic for communication and modelling spread of the virus.

## Community and space

Consider setting up a quiet place with technology for pupils to record themselves talking about their experiences and worries. Many will find it easier to talk to an inanimate object. You could also take photos of different emotions to add to a class presentation about the time in lockdown.

## Transparent curriculum

Use this time to identify gaps in learning and ensure key concepts are embedded, using low-stakes assessment tools. Complete lots of engaging unplugged activities using varied contexts and incorporating physical objects, music, magic tricks, and so on. Spend time investigating code as a class, and identifying and addressing any misconceptions.

## Metacognition

Unplugged activities are great, but you can also use the time away from technology to build pupils' confidence by teaching them skills such as computational thinking and planning skills. Pupils can create paper prototypes for apps, or design a web page. Support learners with additional needs by providing planning templates.

## Reigniting the flame of learning

Computing lessons using limited technology can be tough, so try some outdoor learning (remembering social distancing): model networks on the playground, do a bubble sort of people (for example by height), or do a photography project around the school. Video call another class to share learning on a topic, or create and test a Bee-Bot or Lego robot maze around the classroom.

The return to school will be challenging, but a carefully planned recovery curriculum will help to support all students and reintroduce them to the joy of learning. [\(HW\)](#)



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



# SHUCHI GROVER

## “TINKERING IS AN EQUITY ISSUE”

Shuchi Grover tells **Sian Williams Page** about the limits of constructionism, the value of formative assessment, and why programming can be a source of both joy and angst

**H**ow much open-ended exploration should there be in computing lessons? This is a question at the heart of computer science education and one which Shuchi Grover is delicately diplomatic about in the preface to her new book, *Computer Science in K-12: An A-to-Z Handbook on Teaching Programming*. The book's chapters are written by 40 teachers and researchers in computing pedagogy, and Grover openly acknowledges the varying views around discovery-based learning among her diverse range of international authors.

“I wonder if I want to wade there,” she laughs. “The act of creating a program is in itself an act of creation. So there is hands-on learning quite naturally in the computer science classroom, and mistakes are made quite naturally. There are some things that are so great about computer science education. It lends itself so easily to being hands-on and to celebrating mistakes; debugging is par for the course, and that’s not the way it is in other subjects. The kids can actually develop some very nice mindsets that they can take to other classrooms.”

Grover is a software engineer by training, turned researcher in computer science education. She holds a PhD in learning sciences and technology design from Stanford University, where she remains a visiting scholar. She explains how the beginning of her research career

coincided with the advent of the block-based programming language Scratch, now widely used as an introductory programming language for children. “Almost two decades ago, I went to Harvard to study for a master’s called technology innovation and education, and it was around that time that I volunteered for robotics workshops at the MIT Media Lab and MIT Museum. Those were pretty transformative for me: I started after-school clubs and facilitated robotics and digital storytelling clubs. In the early 2000s, I was an educational technology consultant, working with teachers on integrating technology. Then Scratch came out, and I started working with teachers on integrating Scratch into languages, arts, and science, all the things that we are doing today.”

Do her formative experiences at MIT, the birthplace of constructionist theory of student-centred, discovery-based learning, lead her to lean one way or another in the tinkering versus direct instruction debate? “The learning in informal spaces is, of course, very interest-driven. There is no measurement. Children are invited to a space to spend some time after school and do whatever they feel like. There would be kids who would be chatting away while a couple of them designed a robot, and then they would hand over the robot to some others and say, ‘OK, now you go ahead and program it,’ and there were some kids who would just like to hang about. ▶



“As topics go, programming carries a lot of joy and angst,” says Grover



Grover wants to help teachers understand where children struggle

“When it comes to formal education, there needs to be more accountability, you want to do right by every child. You have to be more intentional. I do feel that while tinkering and constructionism was a great way to introduce interest-driven projects for informal learning, and there’s a lot to learn from there and bring to the formal learning context, I don’t think it can only be tinkering.”

“Everybody knows that engagement is very important for learning — and this is something that we are learning more about: it’s not just interest, it’s also culture, communities and backgrounds — but all of this is to say that there is a personal element to the learning process and so engagement is necessary, but it’s not a sufficient condition. You have to go beyond engagement, to also make sure that they are also engaging with the concepts. You want at some point for students to engage with the concept in a way that reveals what their misconceptions might be, and then they end up learning and understanding these things more deeply.”

“You want a robust foundation — after all, our goal for teaching children anything at school is to build a foundation on which they build their college education and career and anything beyond that. If we take programming as a skill, you want them to have a good understanding of it, and so the personal connections are important, but so is the scaffolding.”

“How much scaffolding needs to be done varies from context to context. Even in the same classroom, children may need different levels of scaffolding. It’s a sweet spot; within a classroom a teacher has to juggle so much. And therein lies the challenge of teaching: 30 kids at a time, and every child is different and every child is unique.”

“It’s an equity issue. Some children don’t have the prior experience that sets them up to tinker constructively.”

“ THERE NEEDS TO BE MORE ACCOUNTABILITY TO DO RIGHT BY EVERY CHILD

After all, tinkering is meant to be purposeful exploration. And so it becomes an issue of who are you privileging with the pedagogy.”

She points out that each chapter in her book that comes from a more constructionist viewpoint clearly speaks of the need for scaffolding. And conversely, the chapters that take a more structured approach to computing education include elements of student engagement and children creating their own programs. “Frameworks such as Use-Modify-Create and

PRIMM just push that open-ended creation a little farther down, making sure that the initial experiences have more guide rails.”

**Approaches to assessment**

Grover is a senior research scientist at Looking Glass Ventures, which in 2018 received a National Science Foundation grant to create Edfinity, a tool to enable affordable access to high-quality assessments for schools and universities. In her book, she argues that asking students to write programs as a means of formative assessment has several pitfalls. It is time-consuming for both students and teachers, scoring is subjective, and it’s difficult to get a picture of how much understanding a student has of their code. Did they get their program to work through trial and error? Did they lift code from another student?

“Formative assessments that give quick feedback are much better. They focus on aspects of the conceptual learning that you want children to have. Multiple-choice questions on code force both the teachers and the children to experience code reading and code comprehension, which are just so important. Just giving children a snippet of code and saying: ‘What does this do? What will be



■ Grover talks through programming concepts with schoolchildren

the value of the variable? How many times will this be executed?’ — it goes down to the idea of code tracing and program comprehension.

“Research has also shown that anything you do in a classroom, the children take as a signal. Going back to the constructionist thing, when you foreground personal interest, there’s a different kind of environment in the classroom, where they’re able to have a voice, they have agency.

That’s one of the good things about constructionism.

“Formative assessment signals to the student what it is that you’re valuing in the learning process. They don’t always understand what it is that they’re expected to learn in programming. Is the goal creating a program that runs? Or is it something else? And so when you administer these little check-ins, they bring more alignment between a teacher’s goals for the learners and the learners’ understanding of those goals. That alignment is important and it can get lost.”

### The joy and angst of programming

The title of her book, which could be thought to imply that computer science education consists solely of teaching students to program, may cause some raised eyebrows. What about building robots or devices that interact with the world, computing topics like binary, or the societal

impacts of technology?

“I completely agree with the statement and the belief that computer science is not just about programming. I myself have been a proponent of this. But in this book I wanted to focus on programming for a couple of reasons. Programming is a central part of the computer science curriculum, at least here in the US, and it is also the part that teachers struggle with the most.

“As topics go, programming carries a lot of joy and angst. There is joy in computing, joy when you get it. But when a teacher is encountering this topic for the first time there is a lot of angst, because they

themselves may not be understanding things, and they don’t know what it is that the children are not understanding. And there is this entire body of research on novice programming. There are the concepts, the practices, the pedagogies, and the issues of assessment. So I wanted to give the teachers all of that: everything we know about children and programming, the topics to be learnt, where they struggle, how to help them.” (H-W)

“ I WANT TO SHOW WHERE CHILDREN STRUGGLE AND HOW TO HELP THEM

*Computer Science in K-12: An A-to-Z Handbook on Teaching Programming* (Book Reviews, p.94) is edited by Shuchi Grover and available now: [helloworld.cc/CSK12AZ](http://helloworld.cc/CSK12AZ)

## #INSIGHTS

# ENHANCING OUTDOOR PLAY THROUGH CODING

STORY BY Hayley Leonard



**T**here is often discussion in the media about the increase in children's screen time and the adverse effect that this can have on outdoor play. But not all screen time is created equal, as discussed in the last edition of Hello World. A recent research study looked at whether coding could in fact be used to enhance outdoor play.

Ofer and colleagues (2019) drew on similarities between coding and outdoor play to understand whether children's experiences of both activities could be

## HARDWARE AND SOFTWARE

The hardware device resembles a stick, allowing children to throw and catch it. It comprises 3D-printed and rubber elements to protect it from damage. The device uses a Feather M0 Arduino-compatible board, an nRF51822 Bluetooth Low Energy for communication, a BNO055 inertial measurement unit (IMU), a push button for sensing, and 27 LEDs arranged in three columns to present feedback to the user. The coding platform included five block categories: event blocks, action blocks, control blocks, timer (sensing) blocks, and operator blocks.

## GAME RULES AND CODE RULES

The first game the children were given as an example was a modified version of a traditional outdoor game.

The Game Rules required all of the players to cross the play area with their device, without setting off an LED animation based on a predefined acceleration threshold. If the animation was set off, all of the players had to start again.

The Code Rules were: 'When device in motion > 3 for 0.3 seconds', 'Repeat'; 'Play

animation' 'five times'.

The researchers assessed how well the children's Game Rules and Code Rules matched up. (A) meant that all Game Rules were represented and all the code was relevant to the game; (B) meant that not all the code was meaningful to the Game Rules, or some Game Rules were not represented.

The results? 16 out of 24 children achieved (A) and eight achieved (B).



improved by bringing them together. They identified that rule-making is central both to how children play outdoor games and to learning to code. Using a block-based coding platform and a hardware device, they tested whether children aged 9–12 could use programming rules to develop a novel game.

### Making the rules

Using the Scratch 3.0 codebase, the authors developed 20 custom drag-and-drop blocks to control the function of a custom hardware device. Programming the device requires four steps: 1) children select blocks and produce a coding sequence; 2) children press the green flag; 3) the code is sent to the device; and 4) children experience their code through physical interaction with the device.

Children were asked to think of the Game Rules (the goal and objectives of the game, and how children would play it) and the Code Rules (how they would program the device for use in the game). They were given an example of a game they could play and shown how to put together the code needed for that game.

### Playing the game

Children found the task very engaging and spent a long time planning their games and

working out how to configure the code to program the device. They went through multiple iterations of trialling the code to perfect their games. They sometimes added a digital element to a standard game (such as keeping score, or introducing an object that needed to be found); sometimes they produced a new game that would not be possible without the device (such as keeping track of whether an individual was 'in' or 'out' by creating a network).

Children were able to understand how the Game Rules and Code Rules corresponded to each other, and had to think about the logical structure of the game in order to code it.

### Bringing code to life

Children were enthusiastic about having the opportunity to express themselves and produce code that was meaningful to them: "It's like making your own game: you make it however you want, and you go outside with the game that you wanted and made, instead of buying a game."

By introducing this creative element, and linking coding to other subjects that children are already familiar with, educators can encourage their pupils to see computing as an important and integrated part of life.

Using coding in this way can also

enhance outdoor play and develop social problem-solving. This can help to reduce the misconception that computing is a heads-down individual activity, and make it a discipline that is attractive to a more diverse range of students. (HW)

## BRINGING TOGETHER CODING AND OUTDOOR PLAY CAN ENHANCE BOTH

### FURTHER READING

- ✓ Ofer, N., David, I., Erel, H., Zuckerman, O. (2019) Coding for Outdoor Play: A Coding Platform for Children to Invent and Enhance Outdoor Play Experiences, in CHI Conference on Human Factors in Computing Systems Proceedings, paper no. 164, pages 1-12 [helloworld.cc/of-er-et-al](http://helloworld.cc/of-er-et-al)
- ✓ A video clip from the study can be viewed on YouTube at: [helloworld.cc/of-er-video-clip](http://helloworld.cc/of-er-video-clip)
- ✓ An article from The Independent on the impact of screen time on children: [helloworld.cc/screen-time-independent](http://helloworld.cc/screen-time-independent)

# SCRATCH ENCORE: A CULTURALLY RELEVANT SCRATCH CURRICULUM

STORY BY Katharine Childs

**Y**oung people from minority groups can sometimes feel excluded in the computing classroom because learning resources use real-world examples that they cannot relate to. Educators can make use of culturally relevant materials to foster a sense of belonging in the classroom, and this can support learners to view computing as a subject where they fit in. One resource that educators can use is Scratch Encore, a US-designed curriculum for students aged 10 to 14 in which equity is valued as much as learning outcomes. This equitable ethos translates into a set of culturally responsive themes and topics for students to create Scratch projects and learn computing concepts.

## How does the curriculum work?

Scratch Encore consists of 15 different modules covering a variety of different computing topics. Educators can teach each module using one of three strands: Multicultural, Youth Culture, and Gaming. The strands and themes within them were developed through participatory design sessions with educators, students, and parents. Teachers can choose the strand that they think will best resonate with their learners. For example, they might choose to teach events in Scratch using a multicultural context, and then teach conditional loops using projects themed around youth culture.

The resources are written around the Use-Modify-Create approach, whereby learners begin by investigating existing projects, and then move on to applying what they have learned by creating their own project. The resources were piloted with a small group of teachers, who suggested that they were useful in terms of student engagement. An automated

assessment tool analysed the projects made in the Create section and compared the frequency of blocks used by students in their projects against the blocks that had been taught in the Use and Modify sections. These initial results indicate that the curriculum may indeed be balancing equity with learning outcomes.

## Overcoming barriers to equity

The structure, content, and materials used in Scratch Encore have been designed to overcome several barriers to equity in the computing classroom. The Use-Modify-Create approach means that the beginning of each module is heavily scaffolded, ensuring that learners feel confident before moving on to a more open-ended approach. This approach also recognises that teachers have varying levels of experience and confidence. The curriculum makes provisions for the diverse prior experiences



■ The Scratch Encore curriculum offers teachers a choice of contexts for teaching computing concepts

a curriculum. It does this by carefully considering the inequities and barriers to learning computing and putting in place strategies to overcome these. Teachers who are preparing their own schemes of work for learners may benefit from considering the learning materials from an equity perspective and identifying ways in which they can engage learners by using culturally relevant contexts. **(HW)**

**“ SCRATCH ENCORE HAS BEEN DESIGNED TO OVERCOME BARRIERS TO EQUITY**

that students may have of using Scratch, and provides a review of introductory computing concepts in the first three modules. Learners' cultural backgrounds are represented through the diverse themes present in the three different strands; furthermore, learners are given autonomy in the Create section of each module. Finally, the resources are freely available so that schools working within stretched budgets are not excluded.

Although it's still in the early stages of research and development, Scratch Encore provides a new approach to creating

## FURTHER READING

✓ You can read the full paper at:

[helloworld.cc/franklin-et-al](https://helloworld.cc/franklin-et-al)

✓ The Scratch Encore curriculum (including remote teaching versions) is available at:

[helloworld.cc/scratch-encore](https://helloworld.cc/scratch-encore)



■ Raspberry Pi camera traps have been deployed around the world to monitor wildlife, including South Georgia to monitor king penguins for Penguin Watch



# RECONNECTING WITH NATURE IN YOUR CLASSROOM

Scientists and researchers use low-cost cameras to monitor wildlife across the globe; **Alasdair Davies** explains how young learners can get involved

**I**t may come as a surprise to many, but educational computing hardware commonly found in a classroom setting is equally of use when strapped to a tree 50 metres up in the Amazon rainforest – or lashed to a pole in Antarctica ready to take on the Antarctic winter.

As a conservation technologist, my day job is to develop solutions that enable field conservationists and researchers to conduct field research. Educational hardware, such as the micro:bit, Raspberry Pi, or Arduino, often matches my requirements in terms of the size, cost, and functionality I require to develop affordable time-lapse cameras,

miniature passive acoustic sensors, and other versatile wildlife monitoring tools. DIY cameras now watch over Adélie penguin rookeries to assess penguin populations, while a Raspberry Pi Zero has been used as an optical green sea turtle tag to monitor whether plastics are being ingested by turtles beneath the waves.

Developing similar cameras within the classroom can be an exciting activity, exposing students to the wonders of observing wildlife within their local environment, such as their gardens or school grounds, and enabling them to explore hands-on digital making.

## Connected classrooms

I'm lucky, as my work lets me experience working with local communities and wildlife conservation projects in some truly breathtaking places, one of which is Príncipe island. With a population of less than 8,000 people, the volcanic island is home to several endemic species and is a stronghold for the green sea turtle. As part of a conservation education programme run by the Arribada Initiative, we wanted to explore what it would look like connecting the schoolchildren of Príncipe to other schools globally by establishing an after-school conservation technology club. ▶



■ A conservation project is underway in Ittoqortoormiit, Eastern Greenland

► In the summer of 2017, we renovated an abandoned building on the island and established such a club for 9–11 year olds. A programme of basic computer literacy and STEM activities was subsequently developed, all designed around unlocking access to the same conservation technology

hardware used in the field by professionals within a classroom environment. To date, 240 students have attended the club in groups of 10–15 students over the past three years, with a 53 percent female to male ratio and over 770 classes delivered. Of particular interest was exploring how

data collected on the island, such as camera trap photographs and video from the sea turtle tags, could be analysed by the children, annotated, and shared with other schools via Skype or traditional video conferencing software to discuss and present the results (internet access on the island is surprisingly good). Connected classrooms, regardless of location, could then physically construct the same hardware tools locally for a hands-on experience via digital making activities, yet also access actual field data, discuss results and insights together, and benefit from the social experience of connecting with other cultures and schoolchildren, undertaking shared digital making activities together.

We now hope to replicate the club in Príncipe on the neighbouring island of São Tomé, and are also exploring how other clubs could be established to support additional conservation projects in remote communities — one of which is in the town of Ittoqortoormiit, Eastern Greenland. With a population of only 345 people, it is one of the most remote inhabited settlements on the planet. A human–wildlife conflict programme there aims to detect the presence of polar bears and generate an early warning alert to inform

## “ DEVELOPING A CAMERA EXPOSES STUDENTS TO THE WONDERS OF OBSERVING WILDLIFE



■ A class explores a Raspberry Pi Zero that will be attached to a green sea turtle



## HOW IT WORKS: A WILDLIFE CAMERA TRAP

Wildlife camera traps work by detecting the presence of wildlife and taking a photograph of the event. There are usually two methods of detecting if an animal is in front of a camera: detect movement within a video frame, or use a passive infrared (PIR) sensor to detect a change in infrared radiation (radiant heat). A warm-blooded mammal or bird moving past a PIR sensor will trigger a camera in the same way as a garage light detects body heat or a warm car engine.

Because we want to power the camera using batteries (so that it can be taken outdoors), running a camera continuously to monitor for movement would consume the available power supply quickly. A PIR sensor connected to a single-board computer works well as an alternative, only snapping photos when a warm-blooded object is detected and keeping the camera off when there isn't any activity.

Watching bird feeders is particularly rewarding, as there can be lots of activity. School gardens can often reveal night visitors too, such as foxes, badgers, or hedgehogs. For computing clubs and after-school groups looking for a more technical challenge, there are also plenty of physical and software-based activities to enhance the camera. Adding an infrared light and switching the camera module for a Pi NoIR allows students to capture photos at night when

there is nocturnal activity. Additionally, computer vision software such as OpenCV can be introduced to highlight how computer-aided vision and machine learning can be used to detect different colours (especially true with garden birds), automatically identify species using object detection algorithms, or count how many different types of species visited a bird feeder at a certain time of day.

As it can be time-consuming to source all the required components to build a wildlife camera, Naturebytes ([naturebytes.org](http://naturebytes.org)) was founded as an educational digital making company in 2014 to help deliver wildlife conservation digital making kits, experiences, and activities. A complete Wildlife Cam Kit is available that contains everything needed to get started along with step-by-step instructions. For teachers who already have most of the parts, a stand-alone waterproof case is also available. Python scripts and software to run your camera can be downloaded from the Naturebytes repository ([helloworld.cc/NbRepo](http://helloworld.cc/NbRepo)).

A detailed resource for setting up a wildlife camera is also provided on page 82 of this issue of Hello World.

## “ CAMERAS CAN BE USED TO DETECT POLAR BEARS AND ALERT THE LOCALS

the local community. Development of a low-cost camera trap and thermal sensor by the Arribada Initiative to address the community's need is underway, again using traditional educational hardware to lower the cost and increase ease of development. In the future it would be fantastic to explore establishing a similar after-school club for the children of Ittoqqortoormiit to access the same hardware, and to discuss and share the conservation project's aims and outputs with other schools and technology clubs globally.

### An introduction to citizen science

You may be thinking, what do researchers do with all the photos captured from wildlife camera traps? With tens of thousands of photos to look at, it's a good question to ask. The answer is citizen science. The Penguin Watch programme run by the University of Oxford uploads photos captured by their cameras at the end of each season in

Antarctica and asks the public to count how many penguins they see in each photo. Over 16,000 volunteers have made over 100,000 classifications to date. The sheer number of people helping to assess what's in each photograph saves hundreds of hours of effort and can help reconnect people to nature conservation in a unique way.

There are also plenty of local citizen science projects to contribute to using cameras built in the classroom. The British Trust for Ornithology's Garden BirdWatch asks for contributions each week, running a year-round survey of garden birds. The RSPB also hosts the Big Garden Birdwatch every January. Nearly half a million people contributed last year and it's a good event to contribute to together with other schools. Results from the 2020 survey highlighted that house sparrow sightings are down 53 percent since the survey began in 1979, with robins and blackbirds down 46 percent and 32 percent respectively.

By introducing students to both digital making and purposeful citizen science, their efforts contributing data to similar wildlife observation surveys in a hands-on way should help reconnect them with nature, reinforce the benefit of STEM-based learning, and highlight the need to conserve and protect the environment. <sup>(HW)</sup>



### ALASDAIR DAVIES

Alasdair Davies is Technical Director of the Arribada Initiative and a Co-Founder of Naturebytes. He develops conservation technologies for the National Geographic Society and is an advisor to the Zoological Society of London and a Shuttleworth Foundation Fellow.



■ CoderDojo volunteers welcome children to the event

# ORGANISING AN OUTDOOR CODERDOJO EVENT

**Chris Vermeulen** of CoderDojo Netherlands shares learnings about an outdoor, unplugged CoderDojo event that was held in Leiden in 2016

**E**ver since we established the CoderDojo Netherlands regional body several years ago, co-founder Tiemen and I have always been looking for new collaborative opportunities. The way we saw it, the more we can work together with other parties, the more reach we will have and the more we can spread the CoderDojo name and phenomenon. The outdoor, unplugged Dojo we held in Leiden was a great opportunity for collaboration.

## An unmissable opportunity

In January 2016 I became the champion of the CoderDojo club in Leiden. This Dojo was a lot smaller than my previous one in Rotterdam, so I had my work cut out for me and I started to look for local collaboration opportunities. That summer, Leiden demolished some

buildings in the city centre as part of a local renewal project around the central station. A few people saw this as a great opportunity to turn the open space into a temporary summer hotspot with an event space, theatre, shops, food stands, and even a beach! It was all subsidised by the municipality and open to all kinds of organisations who wanted to collaborate.

This was exactly what we needed! At first, I saw it as an opportunity to simply do a local Dojo over there — instead of at the library — but after meeting them and seeing just how big the space was I quickly changed my mind and set it up to be a national event. The space lacked power and WiFi, but there was an abundance of sunshine and space — and we saw this as a chance to mix things up even more.



## CHRIS VERMEULEN

Chris is a web developer with a background in design. He is the founder and chairman of CoderDojo Nederland. In this role he is responsible for driving and supporting the work of the Dutch CoderDojo community. He has been the founder and champion of the Dojo in Rotterdam and at the time of this event he was champion of the Dojo in Leiden.



■ Preparing for the unplugged activities



■ Collaborating and having fun at the unplugged event

## THE EVENT ROAD BOOK

We created a road book to plan out the event. It outlines the volunteer roles, games, and venue details and includes a schedule. You may wish to use it as a template for planning your own outdoor event: [helloworld.cc/roadbook-nl](http://helloworld.cc/roadbook-nl).

09:00	Arrival Volunteers (2h time for set up)
<b>10:00 - 10:45</b>	<b>Entrance + Registration</b>
<b>10:45 - 11:00</b>	<b>Kick-off @ Theater</b>
11:00 - 11:40	Round 1
11:50 - 12:30	Round 2
12:40 - 13:20	Round 3
<b>13:20 - 14:30</b>	<b>BREAK</b>
14:30 - 15:10	Round 4
15:20 - 16:00	Round 5
16:10 - 16:50	Round 6
<b>17:00 - ??</b>	<b>Closing Or Something Interesting</b>

■ The event ran on a timetable to ensure everything went smoothly

## KEY LEARNINGS

Please follow the appropriate public health advice for your country or region before planning in-person activities. Here's what we learned from planning our event:

- **Check-in:** Registering 96 kids in 45 minutes is quite a challenge. Have four people do this at a rate of around two kids per minute. In our case, almost everybody showed up late: by the time we were supposed to start we only had about 30 per cent of kids in attendance.
- **No-shows:** When estimating the amount of swag we needed, I had presumed 96 kids would be present, but we were not fully booked. On the day, we had an astonishing 17 no-shows. I recommend confirming and reconfirming with parents that their kids can attend, especially as the good weather might make the beach or park more appealing than a free Dojo!
- **Timing:** Even though the schedule was very well planned and gave clear guides for kids, mentors, and parents, in practice the games did not take up 30 minutes. Mostly, the games would finish after 15 or 20 minutes and then the kids would get bored. This caused us to shorten the program, which annoyed a few parents. To avoid this, test the games out and time them beforehand.
- **Hot weather:** This worked out well. The weather forecast was 30°C with clear blue skies. We ordered about 200 bottles of water to hand out to the kids to keep them hydrated. In the afternoon we also went out to buy icicles to cool them down.
- **Groups and schedule:** Another challenge was to put all the kids in groups that adhered to their wishes to be with friends or family. I created a spreadsheet with 24 groups and the game orders per group, before filling it in. This greatly helped in keeping things structured. The day before, I printed badges with the kids' names, their group numbers, the game order, and the parents' phone numbers.



■ Chris and team plan the day ahead

“ AN UNPLUGGED DOJO ENABLES KIDS TO BE SOCIALLY INVOLVED WITH EACH OTHER AND BE OUTDOORS AT THE SAME TIME

### ■ A social environment

Although parents are already pleased with the social opportunities that CoderDojo provides, they still sometimes look for ways to get their kids outside and away from the computer screen. This works great when programming with hardware like Makey Makey or Arduino — but most of the time even this will still be taking place indoors. By setting up an unplugged Dojo we could enable kids to be more socially involved with each other and be outdoors at the same time. I had seen a few pictures from other Dojos, and heard about CS Unplugged before, but never really did anything with it. This was the perfect opportunity!

### The setup

In keeping with magical computer numbers, there would be room for 96 kids. The beauty of this number is that it divides very nicely into groups of four. We planned to have six games, with four groups at each game at the same time. Every game would have a Game Master, who would be responsible for preparing and guiding the game. They had full control over how they wanted to run their game and the freedom to purchase materials.

The games we played were:

- Living Programming
- Real-Life Algorithms
- Sorting Machine
- Minimal Spanning Trees

### ■ Routing & Deadlock

#### ■ Binary Numbers

All the games would last 50 minutes, which consisted of 10 minutes' explanation and 30 minutes' playtime. The next 10 minutes would be used to allow the groups to switch games. We also gave each group a specific order in which to do the games: even-numbered groups would switch clockwise and odd-numbered groups would go anti-clockwise. This way, kids could remain with familiar club peers, but still be switched up a little at the same time. (HFW)



■ The children took part in a variety of unplugged games



# SAVING THE ENVIRONMENT WITH A NEW PROJECT SERIES

The Raspberry Pi Foundation is creating new Scratch projects to collect, interpret, and communicate all kinds of data on the environment

**T**he Raspberry Pi Foundation's new series of digital making projects focuses on the environment. Through the projects, learners are introduced to five environment-orientated goals from the United Nations' 17 Sustainable Development Goals (SDGs). These are: Affordable and Clean Energy; Responsible Consumption and Production; Climate Action; Life Below Water; and Life on Land.

- An animated data visualisation to track the movement of individual turtles

These projects will all be available from October this year at [projects.raspberrypi.org](https://projects.raspberrypi.org).

We're really excited to develop a theme that is cross-curricular at its heart. In addition to getting ahead with computing, learners will discover how computing can be harnessed to collect data on

Goals: Life Below Water and Responsible Consumption and Production.

Through the Save the Shark project learners are introduced to Scratch and start working with key computing concepts such as selection, variables, and random numbers, to create a fantastic and informative game.

Despite its serious theme, Save the Shark is a fun project that piques learners' interest in gaming. Using the step-by-step resources, learners are supported in creating a dynamic, interactive game that they can share with peers, friends, family, and the wider Scratch community. Every Scratch project has a unique web address that can be accessed on mobile devices. Sharing an online product which learners have created themselves really inspires them to find out more about coding. [\(HW\)](#)

## LEARNERS DISCOVER HOW COMPUTING CAN BE USED TO COLLECT ENVIRONMENTAL DATA

The series includes these environment-themed projects:

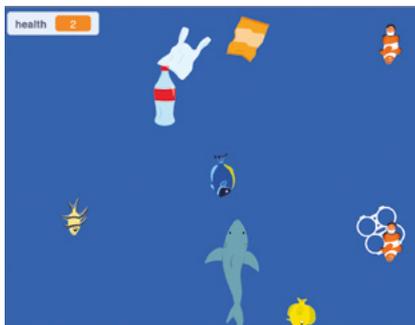
- A digital story focusing on the UN's SDGs
- An app simulating an automated survey of birds and collecting data in real-time through camera detection
- An interactive data visualisation to demonstrate the benefits of planting trees
- An animated data visualisation that compares the waste production of countries, using real data

the environment, explore the causes of environmental degradation, and analyse the ways in which humans influence — and can mitigate — the effects on the environment. Technology, science, maths, geography, and design all play their part in the projects.

By its very nature, the environment is an international concern. Our team here in the UK is working closely with colleagues in India and the USA to ensure that new projects include environmental and cultural references that are relevant to learners internationally. We've also made sure learners are drawing on a range of data from across the world.

### Save the Shark project available now

Save the Shark is a digital game in the project series that explores sharks' favourite food source (fish, not humans) as well as the impact that plastic has in the water, causing great harm to the sharks' natural ocean habitat. The game engages with two of the UN's Sustainable Development



■ Save the Shark is a fun new project that engages learners in game building and teaches them to be environmentally conscious



### EMMA POSEY

Emma is a Learning Manager on the Informal Learning team at the Raspberry Pi Foundation. She is part of a lively and hugely creative team generating online digital making resources for learners in clubs and at home. Emma also develops content for the National Centre for Computing Education's research project, Gender Balance in Computing ([@emmaposey](#)).



■ Geocaching apps are available for smartphones and tablets, or you can use a dedicated GPS receiver

# GEOCACHING: A REAL-WORLD TREASURE HUNT USING ONLINE TECHNOLOGY

Combine technology with outdoor adventure by searching for one of the millions of geocaches hidden across the globe

**0**n Wednesday 3 May 2000, the day after accurate GPS (Global Positioning System) data became widely available for public use, a bucket containing videos, books, a slingshot, and a tin of baked beans was hidden in the woods of Beavercreek near Portland, Oregon. The container's coordinates were posted online, and people were encouraged to seek it out and share their experiences on discussion forums. This process was subsequently repeated worldwide and today there are millions of containers available to find across the globe, which provides us with an excellent opportunity to combine technology with exploring the great outdoors.

## What is geocaching?

Geocaching involves seeking out hidden treasure using GPS technology — either by using a smartphone or tablet app, or a dedicated GPS receiver. The treasure usually takes the form of a physical plastic box containing a logbook and various goodies such as small toys or badges, although individuals placing geocaches are increasingly using their creativity to make more interesting containers, including hollowed-out logs, fake pine cones, and magnetic street signage. Upon discovering a geocache, the finder signs the logbook, replaces the container, and records their find online. Geocaches are listed on [geocaching.com](http://geocaching.com) and each one has a

rating for its difficulty and terrain, which helps identify suitable treasure to search for and provides an overview of the location.

## Supporting the teaching of computing

So, how does geocaching relate to the teaching of computing? One of the aims of the computing national curriculum is to ensure all pupils “can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems”. The use of GPS on a digital device enables children to see how technology can be used for navigation and other practical applications, along with providing a brilliant opportunity



for examining how the underlying technology functions.

The curriculum also asks that teachers should ensure pupils “are responsible, competent, confident and creative users of information and communication technology”. By examining the properties of a geocache, planning a route, and preparing for an adventure, children are taking responsibility for the use of technology and developing

World framework’s statements related to ‘Managing online information’ and ‘Privacy and security’ could be explored through the use of the geocaching website too.

Much of the subject content covered by the national curriculum relates to understanding the internet, such as how data is transferred between devices, and the functionality of network components. As the information for each geocache

## FINDING YOUR FIRST GEOCACHE

There are likely to be geocaches near you right now! To get started:

- Download the Geocaching® app on your smartphone or tablet
- Open your app, choose a nearby cache, and navigate to it
- Find the cache and sign the logbook
- Share details of your hunt by logging your find

Make sure you undertake the activity safely and follow the ‘Getting started’ guidance from the Geocaching.com website: [helloworld.cc/Geocache](http://helloworld.cc/Geocache).

You can also watch the Treasure Hunt video from the CAS #CASInspire20 series, where I hunt out a local geocache with my daughter: [helloworld.cc/SummerCAS](http://helloworld.cc/SummerCAS).

## “ CREATIVE TREASURE CONTAINERS INCLUDE HOLLOWED-OUT LOGS AND FAKE PINE CONES

their independence. In addition, by participating on the geocaching community pages, such as by reporting details of a recent find, children are experiencing how to contribute appropriately to an online forum and suitably manage their online safety. A number of the Education for a Connected

is stored online, terms such as ‘server’ and ‘packets’ can be used in discussions with primary schoolchildren, while older children can examine the process of digital communication and how data is represented in more detail. Finally, finding geocaches and participating in the community groups enables us to develop many areas of computational thinking. For example, in order to find a geocache, children need to use their logical reasoning and perseverance.

## STAYING SAFE

Geocaching is undertaken at your own risk, and you should take suitable precautions before commencing the activity, including, but not limited to, a consideration of:

- **Appropriate online behaviour:** guidance should be given to children about how to stay safe online and what to do if they feel unsafe
- **Device usage:** GPS can drain the battery quickly and geocaching may increase your data usage; it would be beneficial to take a backup device or a physical map with you
- **Safety:** tell someone where you are going
- **Clothing and footwear:** check the weather before you set off and ensure appropriate clothing and footwear are worn and additional items carried with you
- **Equipment and provisions:** appropriate food and drink should be taken, along with a first aid kit and mobile phone

The National Trust has a number of safety tips for exploring outdoors: [helloworld.cc/SafeOutdoors](http://helloworld.cc/SafeOutdoors).

Geocaching.com also has guidance on staying safe: [helloworld.cc/SafeGeocache](http://helloworld.cc/SafeGeocache).

### Cross-curricular links

Geocaching can be used to develop pupils’ knowledge and understanding of a range of curriculum subjects. Temporary containers can be placed around the school grounds or the local area, which could contain items or information to collect. For example, pieces of a floor plan for a historical building could be collected, which would be put together back at school. The topic could then be researched further and sections of the building developed as part of Art or DT, or even using free 3D modelling software such as SketchUp or Tinkercad.

To locate geocaches, children can be given mathematical problems to solve, or



■ Geocaching gives children an opportunity to use technology in an outdoor environment

be provided with tasks to develop their understanding of directional language. Geocaches can also provide a focus for a tour of the local area, or as part of outdoor learning or forest school.

So, how can you begin geocaching in your school? Read the ‘Finding your first geocache’ and ‘Staying safe’ boxes, locate a few geocaches yourself, and log your finds online. The Geocaching® app is free for both Apple iOS (iPad/iPhone) and Android, which means it could be installed on your school’s existing tablet devices to be used by children.

Have you used geocaching in the classroom, or perhaps have other ideas for curriculum links? Do get in touch on Twitter at [@computingchamps](https://twitter.com/computingchamps). <sup>(HW)</sup>

### 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](https://twitter.com/computingchamps)).



# EXPLORING THE WORLD OF DIGITAL MAKING WITH SCOUTS

A set of projects supports young people in connecting digital making with outdoor pursuits

**W**hen you think of Scouts, what comes to mind? For most people, the word conjures images of forests and tents, fires built from sticks and kindling, troops of young people walking, climbing, and rowing through the great outdoors while singing, bonding as a group, and going on adventures great and small.

But what if there were a way to combine this spirit of adventure, love of learning new skills, and group camaraderie with the world of technology, to give young people involved in Scouts the confidence and ability to read computer code as well as map coordinates, and the ability to build robotic devices as well as campfires?

The Digital Maker Staged Activity badge does just that. Developed in partnership with the Raspberry Pi Foundation, the badge has been awarded to almost 50,000 young people in the two years since its inception.

## Developing digital making skills

Scouts working towards the Digital Maker badge can learn how to solve problems, build resilience, help their communities, and express themselves. At the same time, they learn computing skills that will serve them well in their adult lives and future careers. In an increasingly technology-driven society, the core principles that have guided the UK Scouts movement since its inception in 1908 are helping Scouts to adapt quickly to a new world, where the ability to read and write computer programs is as valuable as any other form of literacy.

Sarah Kerry, Corporate Partnerships Account Manager at Scouts, said, “These activities help young people and the adult volunteers who support them develop real-world skills that are essential in the current job market. Our partnership has been going for a couple of years now and it’s getting

better and better as we learn more about each other and develop the activities we undertake together. The bottom line is that we know there is a real desire for digital making in our young people.”

## The Digital Maker Staged Activity badge

The Digital Maker badge is divided into five stages and is designed to support a Scout as they make their journey from a complete beginner with no experience of using programming languages, into a coder who can design and prototype a working product that can benefit their community or society as a whole.

- Stage 1 is designed for digital making beginners and is often undertaken by young people involved in Cubs and Beavers (ages 6–10). It gently introduces computational thinking concepts and gives them hands-on experience of block-based programming languages such as Scratch.
- Stages 2 and 3 introduce coding languages such as Python and HTML and CSS, and physical computing using the Raspberry Pi and BBC micro:bit. Projects include creating music and games, websites, and video presentations, as well as activities that use technology to solve outdoor tasks, such as designing a map or identifying species of plant life. Stages 2 and 3 tend to be taken by older Scouts (aged 10–14) and intermediate coders.
- Stages 4 and 5 feature fewer guided projects and are designed to allow Scouts who have developed their digital making skills during the badge to show off their creativity and problem-solving by designing, building, and evaluating their own projects.

It is possible to earn the Digital Maker badge by doing any activity that fulfils the requirements, but to help Scouts achieve their

badges, the Raspberry Pi Foundation has created a set of free resources that teach key concepts and digital skills. Scouts volunteers are being supported to embrace digital making themselves through Scouts-themed projects, in activities such as Compass Coding and micro:bit Campfire Music. Scout leaders are encouraged to work with their young people to adapt the recommended projects to suit their needs, and as the volunteers’ confidence with digital making increases, so does the ability to customise and modify the resources.

There are several offline activities that can be done without using any technology at all — this is especially important for Scout groups with limited access to equipment or in areas of socio-economic deprivation — and many of the online activities can be adapted to run unplugged. This customisation has proven popular during the coronavirus pandemic, as all face-to-face Scout group meetings have been put on hold.

Eleven-year-old Amelia, from Sutton Coldfield, said, “Having a go at the Digital

## ACTIVITIES TO TRY OUT

All of the Digital Maker Staged Activity badge resources are available at [rpf.io/digital-maker-badge](https://rpf.io/digital-maker-badge) and are free for anyone to use; you don’t need to be a Scout leader or a young person who is involved in Scouts.

The Great Indoors initiative from Scouts features several Raspberry Pi activities that can be done at home. Since the lockdown, the initiative has received over 1 million page views! Visit [rpf.io/scouts-great-indoors](https://rpf.io/scouts-great-indoors).



■ Scouts work towards achieving the Digital Maker badge

Maker badge during lockdown gave me the chance to learn some new skills and practise some of the ones I already have. It was a bit of a challenge but that's great. If it was easy everyone would do it, and it's given me some great skills that will be helpful in later life."

### Supporting volunteers with digital making

The world of computer programming can seem daunting to some volunteer Scout leaders, and this can present a barrier to young people in undertaking the Digital Maker badge. The best solution to this — which is also the simplest — is for volunteers to try out a beginner Scratch project. Nine times out of ten, this leads to a eureka moment when the volunteer realises that digital making isn't as intimidating as it first appears and that creating things with technology is a lot of fun.

In addition to developing resources, the Raspberry Pi Foundation has also run face-to-face Scout leader training sessions across the UK. In 2019, 150 Scout leaders in Belfast, Dundee, Newport, Sheffield, Birmingham, and Surrey attended training days on which they got an overview of the Digital Maker badge and advice on how to lead sessions with their Scout group. They also got hands-on experience with physical computing components — this was a new experience for many. The coronavirus pandemic has put face-to-face Scout leader training sessions on hold for the time being, but there are plans underway to reinstate them in some form in the future.

## “ WHAT IF WE GIVE SCOUTS THE ABILITY TO BUILD ROBOTS AS WELL AS CAMPFIRES? ”

### A hackathon for social good

One of the biggest in-person events was a Social Action Hackathon held in November 2019 at the Scout Association's national headquarters at Gilwell Park in Epping. At the event, two Scout groups from Sheffield and London came together to practise their digital making skills, along with a team of educators from the Raspberry Pi Foundation.

The hackathon directly supported Scout's A Million Hands project, whereby Scouts engage with UK-based charities to 'leave the world a little better than they found it'. Scouts were tasked with designing and prototyping a technological solution that might benefit one of these charities, or the people and communities that they support. By completing the hackathon, the young people would also be fulfilling the fifth and most complex stage of the Digital Maker Staged Activity badge.

The groups were previously unknown to each other and included young people of mixed age and ability; the majority were complete beginners. Over the two days, the young people developed a host of skills alongside coding and robotics, such as project management and agile development techniques. As their final task, the young people had to present their work to a panel of experts, which was a great opportunity

for them to develop communication skills and confidence.

Projects developed by the attendees included a drone to help the World Wildlife Fund combat climate change using temperature sensors; a self-esteem robot that displayed positive messages to passersby for the mental health charity Mind; and a digital diary for people with autism.

Considering that some attendees had never heard of digital making before the event, their ability to quickly take up new concepts was even greater than anticipated.

Elyas, group leader of seventh Newham Scouts, said, "This is one of the best things we've done as a group. I'm so impressed by the teams facilitating this. I thought one or two Scouts might drop out, but they've all

really enjoyed it. I was going to leave them to it, but I've been so inspired I've stuck around all weekend too."

The dedication on the part of young Scouts to embrace digital making skills highlights a key point: once you demonstrate to a young person that digital making can have a real-world impact on their lives, inspire their imagination, and give them a few basic tools to achieve their vision using technology, the possibilities are endless.

For more information on the Raspberry Pi Foundation's partnership with Scouts and the Digital Maker Staged Activity badge, contact [scouts@raspberrypi.org](mailto:scouts@raspberrypi.org) <sup>(HW)</sup>



**TOM HADFIELD**  
Tom is the Youth Partnerships Coordinator at the Raspberry Pi Foundation, working across youth programmes such as Scouts, Astro Pi, CoderDojo, and Raspberry Jams.

# EXPLORING THE OUTDOORS THROUGH THE LENS OF COMPUTING

**Amy O'Meara** speaks to Coolest Projects participants about their outdoor-themed projects and learns about the aspects that are most meaningful to them

**C**omputing is often thought of as an indoor subject, with all activities taking place in front of a screen, far removed from the natural environment or the surroundings beyond our doorstep. In truth, there is a great deal of interaction between computing and the outdoors in everyday life, from irrigation systems and temperature-controlled greenhouses to street lighting.

Most educators will agree that valuable learning can take place outside of the classroom, and this is true of computing education too. There is a wealth of

held yearly in Ireland, UK, and USA. The main event was held online this year due to the pandemic.

## Preserving fragile ecosystems

Amy, 16, attended Coolest Projects International in Dublin back in 2017 with her project, Amy's Buzzy Hive. The project involved placing a Raspberry Pi with multiple sensors inside a real beehive in order to track bee numbers and identify potential causes for their decline. Amy spoke about the importance of harnessing the power of code in order

me, and the ideas began to grow from there. I think bees are a perfect example of animals in nature that do so much for us in our everyday lives. To see [their numbers] decreasing is very sad."

Speaking specifically about the challenges of creating an outdoor computing project, Amy shared: "One challenge of designing a project intended for outdoors was building something that could withstand the different weather, and would be so waterproof that you could have non-waterproof materials in it, for example the Raspberry Pi. I overcame these challenges with the help of my Dojo to find solutions, such as placing the Raspberry Pi in the beehive, instead of outside."

**“ IT'S A GREAT OPPORTUNITY FOR YOUNG CODERS TO FIND WAYS OF HELPING OUR ENVIRONMENT AND NATURE**

inspiration to be drawn from the outdoors, as well as opportunities for students to engage with themes that are meaningful to them.

I spoke to a handful of young people who have explored themes of outdoor landmarks, conservation, and fragile ecosystems, among others, and woven these themes into computing projects. The ideas were all presented at various Coolest Projects events between 2017 and 2020. Coolest Projects is a technology showcase for young people, with flagship events

to address environmental issues:

"I think it's a great opportunity for young coders [...] to find ways of helping our environment and nature, and also to educate young people about the problems facing them.

"When we were all coming up with our Coolest Projects ideas, there was a lot of talk in the media about bees and how they are dying out. I was very lucky that a volunteer at our CoderDojo was a beekeeper and was able to help

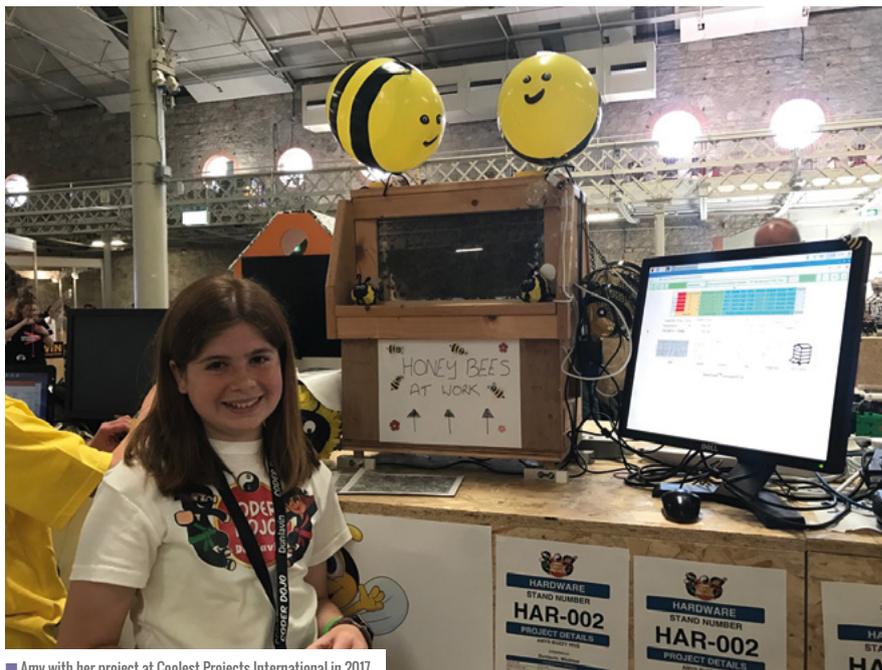


**AMY O'MEARA**

Amy is the Communications and Engagement Coordinator at the CoderDojo Foundation and has attended several Coolest Projects events. She is a nature lover and budding gardener.



■ Amy worked with a beekeeper to place the Raspberry Pi and other project components inside the beehive



■ Amy with her project at Coolest Projects International in 2017



■ Lara at Coolest Projects USA 2019

Everyone can play a part in the protection of wildlife, and this was the aim of Lara’s web-based project, Another Purpose for Eggshells. Lara, 13, was a participant at Coolest Projects USA in 2019. She was concerned about the diets of pond birds — due to well-intentioned people giving them bread and other unsuitable feed — and the resulting negative effects on the birds themselves and their natural habitat.

“Many people feed suburban and urban wildlife (especially waterfowl and other birds) human foods with good intentions. Human foods are unnatural and harmful to birds and other wildlife; [...] they cause health problems, from malnutrition to botulism. Feeding wildlife can also cause problems in our parks and ponds.”

## “ INFORMING PEOPLE TO MAKE SMALL CHANGES CAN LEAD TO A LARGER IMPACT

Computing projects can open the door to new ways of communication and engagement. In Lara’s case, this took the form of an educational website where people can learn about a specific environmental issue. This type of project brings computing and the outdoor environment together by encouraging people to engage with their surroundings in more positive ways. As Lara shared, informing people to make small individual changes can lead to a larger impact:

“It is important to create projects about nature and the environment to raise awareness and inform people. Many people have good intentions and want to do good for the environment. [...] Policy change by our government is very important, but individual actions can also collectively make a huge impact. When the public is informed, their actions will push our policymakers to pass laws and acts to protect the wildlife and nature for people now and in the future.”

### Creating memories with code

Capturing memories of iconic landmarks is something that is central to 13-year-old

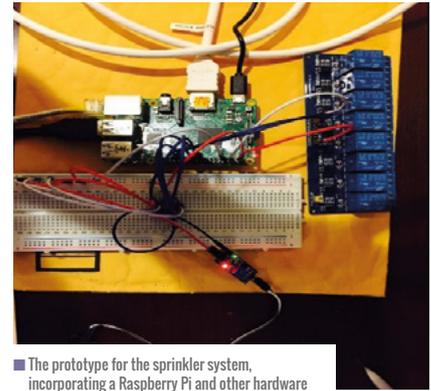
Dillon’s project, Anseo Digital Passport. Anseo is “a digital logging service for the Wild Atlantic Way” — a scenic 2,500 km tourism trail spanning the west coast of Ireland. Using the service, visitors can log locations along the famous coastal route, upload images, and write comments, creating a personalised digital memento of their trip. Dillon first presented Anseo — which means ‘here’ in the Irish language — at Coolest Projects International in 2019, and has continued the journey at Coolest Projects 2020. As well as being an enthusiastic coder, Dillon is a keen mountaineer, having completed Ireland’s ▶



■ Dillon at Geokaun, the highest point of Valentia Island



■ Showcasing the Robotic Garden at Coolest Projects USA 2020



■ The prototype for the sprinkler system, incorporating a Raspberry Pi and other hardware



■ The About page of Dillon's Anseo website

## “ THEY ENJOYED LEARNING HOW TO USE ROBOTIC MECHANISMS AND CODE TO MIMIC HOW INSECTS MOVE IN NATURE

➤ 32-County High Point Challenge for charity at age nine. Dillon's passion for the outdoors and engagement with the local environment are reflected in his project, highlighting the importance of young people working with themes that are meaningful to them.

“I enjoyed the idea of promoting the outdoors that I myself love so much. I think that Anseo will help promote people to get out and discover what Ireland really has to offer. I also think that Anseo's feature which allows people to write comments and upload images for each individual log would help people create memories that will last a lifetime.”

You can see Dillon's website at [anseodigitalpassport.com](http://anseodigitalpassport.com).

### Bringing the outdoors inside the classroom

A team of five students from California brought a programmed 'garden' to life with their project, Robotic Garden — a diorama using Scratch, servos, vibrating motors,

lights, and craft supplies. Jayden, Tatiana, Nattaly, Noah, and Nicolas attended Coolest Projects USA 2020, along with their teacher, Tonya Coats. Tonya shared how the Robotic Garden was a cross-curricular activity inspired by a real garden they had been nurturing in the classroom.

“We have a small indoor greenhouse in our classroom. Our class loves to work as a team to take care of plants and watch them grow throughout the year. Gardening gives students real-life meaning... This garden was an exciting way to make our curriculum come alive.”

As Tonya explained, creating the Robotic Garden was an extension of what the students had been learning about nature. The project was a creative and engaging opportunity to express what they had learned, both in the classroom and outdoors.

“Using their background knowledge of how insects and plants behave in nature, students pushed themselves to engineer and design real-world elements. They

enjoyed learning how to use different robotic mechanisms and code to mimic how insects and plants move in nature. Bringing outdoor elements inside the classroom was exciting.”

### Conservation in action

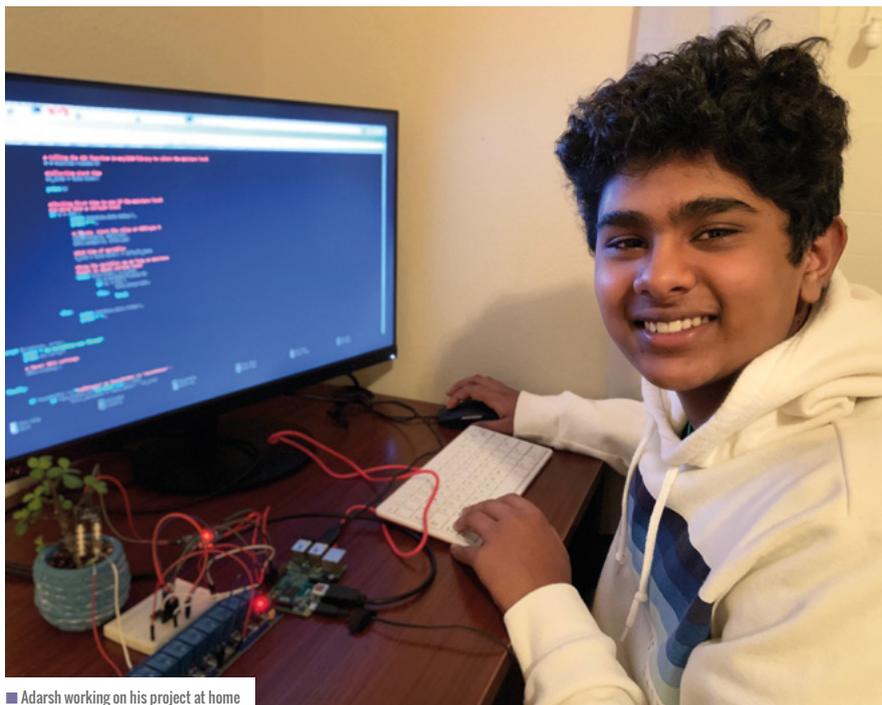
Many young people are combining computing and conservation as a response to growing environmental concerns. One such project is A Smart Community Sprinkler System, which was developed by 15-year-old Adarsh and presented at Coolest Projects USA 2019. Adarsh built the project as a way of conserving water during drought conditions in California. Using a Raspberry Pi, he built a moisture sensor-based smart sprinkler system that integrates real-time weather forecast data and Twitter feeds to dispense appropriate amounts of water in compliance with city water regulations.

Like many young people, Adarsh is concerned about destruction of the environment and the negative consequences that this may have for his generation if actions are not taken.

“I would implore all young innovators today to pursue environmental projects, as the destruction of the environment will affect our generation the most. If we as youth choose to ignore the problem, it will only magnify until it can no longer be



■ Adarsh enjoying the outdoors



■ Adarsh working on his project at home

solved. By setting our minds to developing innovative solutions that help the environment without drastically changing one's life, we can little by little overcome such worldwide issues. It is imperative that we start to create projects aimed to help, protect, or sustain our planet immediately."

Creating an outdoor computing project is not without its challenges, and Adarsh needed to prototype the sprinkler system at

system-wide failures in your project that would require you to start all over again. By being careful and deliberate with your setup, you can design an elegant and functional project that is sustainable and scalable."

### Supporting students with outdoor-themed projects

Educators can support their students by encouraging them to explore what

sought support from many birding and conservation groups, such as, "Sea & Sage Audubon, the Southern California Bluebird Club (SCBC) and its members, who have supported my project by allowing me to monitor nest boxes, and Cavity Conservation Initiative".

Adarsh received valuable feedback from mentors and educators in his community regarding the importance of research: "They coached me on the importance of conducting research before embarking on such projects. They advised me to research the internet, join forums, and interview people from regular households and water company management. If it was not for them, I would have just been content with a moisture sensor-based sprinkler system. While they pointed out a problem, they also showed a path forward."

Whether a project is designed to exist outdoors, like Amy's beehive and Adarsh's sprinkler system, or aims to get people outside, like Dillon's digital passport, there is opportunity for engagement. I hope that these stories will inspire educators to design outdoor-themed computing projects with their students. As Tonya Coats from the Robotic Garden project shared, "It is exciting to bring outdoor elements into the classroom." (HAW)

## “ USING A RASPBERRY PI, ADARSH BUILT A SMART SPRINKLER THAT INTEGRATES WEATHER DATA TO DISPENSE WATER

length. "I set up a simulated environment in my home using a potted plant and an LED. The LED light represented the sprinkler, and it turned on instead of the sprinklers when the moisture content was low."

Adarsh shared some further advice for creating outdoor-based projects: "For designing projects intended for the outdoors, my advice would be to first isolate parts of your system or circuitry that need to be protected, and ensure that the design takes into account protecting these parts. This extra step of planning is crucial to preventing

interests them about the world outdoors. As we have seen from these examples, there are a huge number of themes being explored that are specific to each child's individual interests and local environment.

Many projects with an outdoor focus, particularly those relating to nature and the environment, also require research, and this is another area where educators can provide support, either by reaching out to local specialists or by arranging site visits or talks. For her Another Purpose for Eggshells project, Lara

# A REMOTE SUMMER SCHOOL TO SUPPORT WELL-BEING

In August, **Peter Marshman** led a remote summer school where pupils used micro:bits to explore nature

**T**he Park House NCCE Computing Hub, an advisory school for developing self-efficacy in computing, delivered a remote micro:bit summer school for pupils in Year 6. The programme was run in West Berkshire and was the product of a collaboration between Park House School and the West Berkshire Council Education Service. The summer school was delivered over two weeks in August and the children involved came from 43 different primary schools.

The aims of the summer school were to

## DESIGNING HYBRID LEARNING

- Create engaging content for live webinars that are fun and light-touch, but also have a high impact. Ensure that these are kept to less than 15 minutes long
- Provide step-by-step guides that allow children to extend their learning and provide ideas for tinkering and opportunities to explore other subject areas
- Provide synchronous sessions using a platform such as Zoom, which will allow children to share their solutions and get advice on adapting their solutions to their needs; it will also allow teachers to give additional support to those who may need it

fill educational gaps in computing created during the pandemic, and also to prepare pupils for their transition to secondary school by allowing them to work with experienced secondary computing teachers. The local news publication Newbury Today reported: "With many pupils missing out on transition activities and large parts of the science, technology, engineering, and mathematics (STEM) curriculum over the last four months, the summer school aims to provide new opportunities to try coding and extend the knowledge and skills of those who have tried before."

The theme of the summer school was Code In, Keep Fit & Love Nature. The programme was designed to support pupils' well-being through getting active, staying healthy, and exploring nature. Six sessions were delivered over the two-week period through a combination of synchronous and asynchronous methods. This included live webinars, online support resources, and synchronous Zoom support sessions. This hybrid delivery approach ensured that pupils

were provided with a range of resources including step-by-step guides, pre-recorded instructional block coding videos, and direct support via screen sharing.

To equip the pupils for the sessions, micro:bits were posted to them upon enrolment. They needed to have a laptop, tablet, or device, as well as internet access at home. Over the six sessions, pupils learnt to program a micro:bit in order to create: a step counter; a digital pet; a species counter; a beep test; a workout organiser; and a plant moisture monitor.

All of the resources were made freely available on the Park House Computing Hub website ([helloworld.cc/parkhousehub](http://helloworld.cc/parkhousehub)) and the pupils were also able to share their achievements on this platform.

### Reflecting on the experience

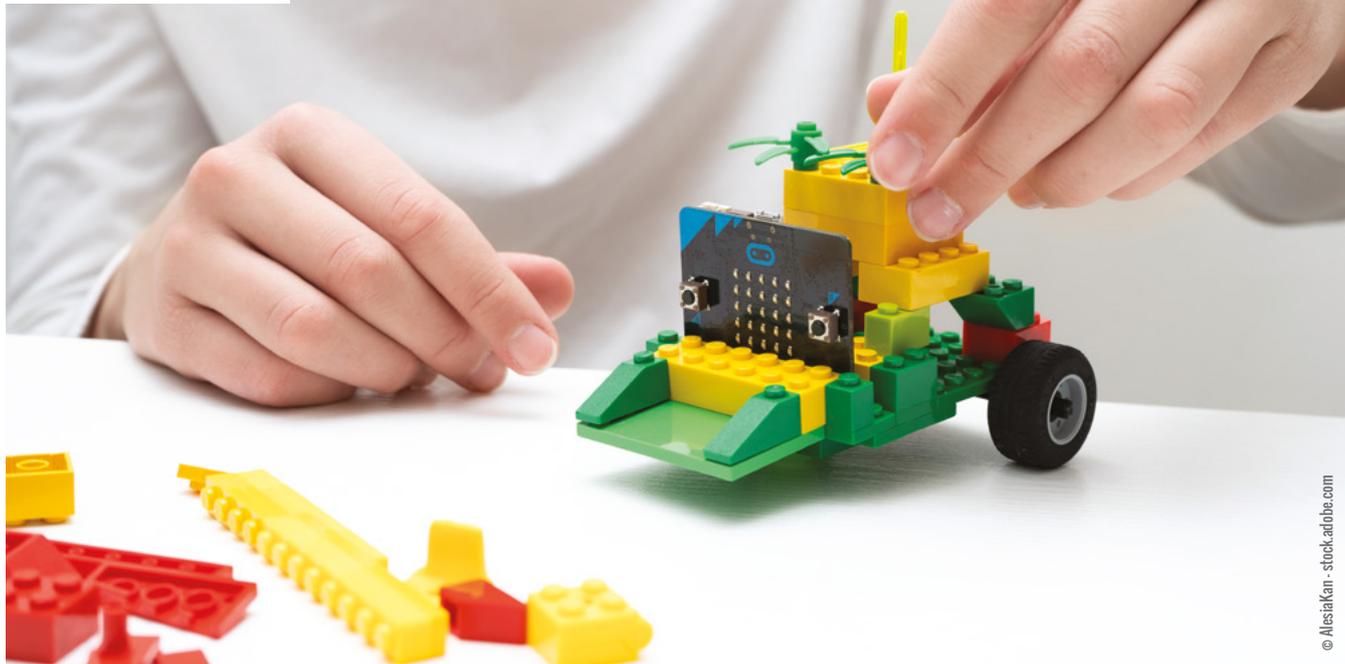
It was wonderful to see parents capture their children's adventures in coding, even while it was the summer break. One instance of this can be seen in this video ([helloworld.cc/microbit-species-counter](http://helloworld.cc/microbit-species-counter)),



■ One of the projects children could create was a plant moisture monitor



■ Pupils learnt to program a micro-bit to create a range of exciting projects at home



© AlesiaKan - stock.adobe.com

where a parent recorded their child happily working on the species counter activity at home. Another parent posted the following report from their child on social media: "I made the animal counter to count bugs and birds. It was really fun... I can't wait to do some more coding :o)"

Such was the success of the summer school, I was able to share about the importance of coding in relation to the summer school on BBC Radio Berkshire ([helloworld.cc/radio-berkshire](http://helloworld.cc/radio-berkshire)).

During the radio segment, I spoke about the importance of keeping young people engaged and providing them with

“ I MADE THE ANIMAL COUNTER TO COUNT BUGS AND BIRDS. IT WAS REALLY FUN”

opportunities during an uncertain time: "It was wonderful to work with children across many primary schools in West Berkshire and to provide free access to micro:bits, sent to each family in the post. The focus of the project was to keep children active whilst having fun with technology and making a difference. The most memorable moments were when the children joined the Zoom support sessions just so they could show us their achievements and to talk about what they wanted to do next."

Thomas Ng, schools ICT strategic lead at West Berkshire Council, spoke about how the opportunity and subsequent benefits arose from a challenging situation: "Coronavirus social measures have presented us with an unprecedented opportunity to introduce logical approaches to fun-loving young program designers. The outcome is indeed amazing."

Derek People, former head teacher of Park House School in Newbury, mentioned how the programme inspired young

people to get outdoors and get active: "The micro:bit summer school provided children across West Berkshire with the chance to develop their coding skills and then take their devices outside to keep active with activities such as a step counter and a digital workout assistant. With children learning at home, this opportunity allowed them to continue to develop their independent digital learning skills whilst embracing the outdoors." (Hw)

## LOOKING TO NEXT YEAR

The Park House NCCE Computing Hub wishes to provide this opportunity for many more pupils nationally next year. We are looking for people to support this initiative by volunteering to do Zoom support sessions with young people, or by providing sponsorship. If you'd like to get involved, please contact us at: [teachcomputing@parkhouseschool.org](mailto:teachcomputing@parkhouseschool.org).

### PETER MARSHMAN

Peter is the Teach Computing Hub Lead, Subject Matter Expert, and Advanced Skills Teacher at Park House School. He is also a Community Outreach Manager for Computing at School.





■ Tim Wilson created a video and worksheet looking at how drumming can be used to teach computer skills

# VIDEOS TO INSPIRE

A new video series from the CAS team shows us how young people can learn computing skills from everyday activities – without the need for a computer

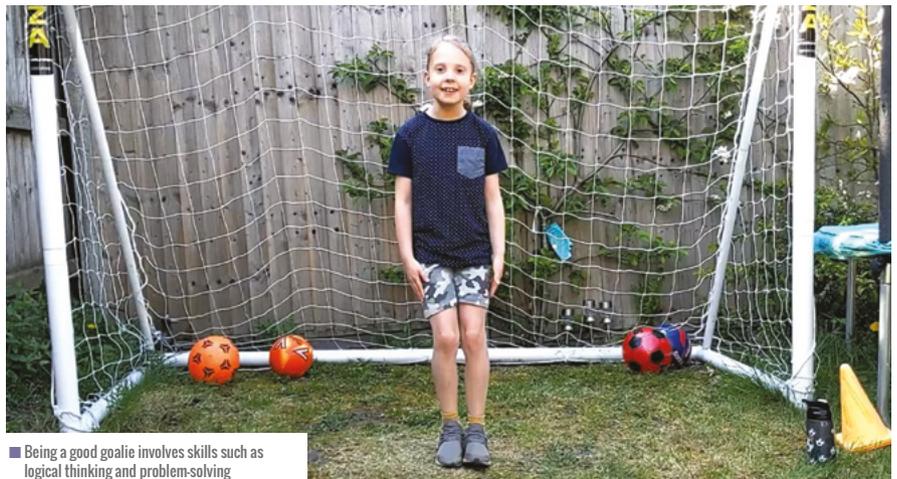
**C**omputing skills can be learnt in all kinds of fun ways, and as well as developing computational thinking skills, young people can also get active in the process. This was the inspiration behind the CAS team’s innovative Active Bodies, Active Minds video series, created as part of our ongoing CAS Inspire programme run by the CAS outreach team to support our community, teachers, and parents.

We started thinking about the idea for Active Bodies, Active Minds at the start of the lockdown — we wanted to keep young minds active while they were stuck at home. We also wanted to provide fun, creative activities that would involve parents, and that teachers could pass on to students to help them to learn computing skills without a computer. The series completely smashes the idea that computing is all about being indoors. It makes young people realise the essence of computing and logical thinking and how these are important in every

aspect of life. My video on drumming, for instance, makes direct parallels between drumming and computing. A drumbeat requires logical thinking, such as an ability to count and repeat a set number of times, much like when we write an algorithm.

We built on the concept of unplugged

learning, without explicitly doing unplugged computing exercises, using ‘camouflaged learning’. Young people had the chance to learn or demonstrate a skill while learning about computing at the same time. To take an example, in one of our videos, CAS national community manager



■ Being a good goalie involves skills such as logical thinking and problem-solving



To make chocolate brownies, you need a set of specific ingredients, tools, instructions, and guidance, as Beverly Clarke demonstrates in her video

Beverly Clarke cooks chocolate brownies. The idea was to take young people through an everyday activity — such as baking — with prompts and thought points to encourage conversation and thinking. These are ‘camouflaged’ in the activity and are linked to computational thinking concepts and approaches, enabling computing to be taught through everyday activities.

### Getting young people involved

We felt that it was important to have young people involved in making the videos too. We were grateful to all the children of CAS staff who shared their expertise and enthusiasm to help make the videos. Young people taking part at home have to plan, design, and think logically about what they want to achieve. Then they can reflect or think about how to do the task differently. It comes back to those core ideas about giving young people the confidence to express themselves. A computer enables things to happen, but the creative ideas come from the person.

Ben and Beth worked with their dad, CAS outreach manager Peter Marshman, to make a football video. Beth talked about goalkeeping, and the different positions and decisions you make when a ball is heading straight at you. Computer science concepts were woven in, such as sequencing, order, execution, and selection. It was all about having a set of decisions to make. We also spoke about different variables, such as where a goalkeeper can position themselves. It involved all the tasks associated with goalkeeping, such as logical thinking and problem-solving. At the end of the video, Beth asks viewers to design a

workout themselves and to develop a flow chart for different workout sessions. It was great to see the children driving the content and the ideas of this project.

Young people can understand that everything has a set of processes and rules, and that it’s just about understanding how you communicate those set of rules to a computer. Another crucial part of this is that it helps parents understand it as well. One of the last videos we made was with

## JOIN THE DISCUSSION

We’d love to hear about other experiences of computing outdoors, using camouflage learning, and computing in other contexts. You can join the discussion on the CAS website and also share ideas and activities on social media using the hashtag #CASInspire20.

learning outcomes, and tips for parents and teachers to help them advance young people’s computing skills.

My role was to edit the footage and put the worksheets together, and it was great fun watching young people and colleagues making things and going outdoors. It was also fascinating seeing what my colleagues do outside of work and how they relate that to computing as well. Active Bodies, Active Minds will hopefully also encourage

## “ THE FUN, CREATIVE ACTIVITIES IN THE SERIES COMPLETELY SMASH THE IDEA THAT COMPUTING IS ALL ABOUT BEING INDOORS

CAS computer champion Neil Rickus. He spoke to his parents and in-laws about their weekly online quiz night — not only is it important to them, but it uses tech. We also featured the child of CAS outreach manager Wendy MacLeod, who chatted to their grandparents about tech. It was all about engaging parents and families in everyday tasks and then relating them to computing.

### A resource for teachers

We’ve had a great reaction to the Active Bodies, Active Minds video series. They are great fun and at their core is a sense of trying new activities and being uninhibited — just go for it and see what happens. It also helps parents and children realise this stuff is not that difficult, and that they needn’t get bogged down in terminology. Each video comes with a downloadable help sheet that has instructions, guidance,

teachers to try these activities with their students. Lockdown has led to a real sea change in how we can do things. We thought hard about how to keep young people, parents, and teachers engaged and excited about learning something new during this time. I think the series has been well received because we’ve all been sitting in front of laptops every day, and it’s important to step away from the computer now and then.

You can find the Active Bodies, Active Minds series on the CAS website at [helloworld.cc/cas-active](http://helloworld.cc/cas-active). (HW)

**TIM WILSON**  
Tim is a Community Outreach Manager for Computing at School (@casmidlands).



(HW)

# SUBSCRIBE TODAY



**FREE  
IN PRINT**  
for UK-based  
educators

## Why subscribe?

- Teaching resources and ideas used by over 90% of our readers
- Exclusive news, research findings, and in-depth features
- Delivered to your door, quarterly



**TO SUBSCRIBE VISIT:**  
[helloworld.cc/subscribe](http://helloworld.cc/subscribe)



## Not a UK-based educator?

- Subscribe to receive the free PDF on the day it is released
- Read features and news at [helloworld.cc](http://helloworld.cc)

**FREE PDF**  
 for anyone, anywhere



# A GLOBAL CONFERENCE TO ADDRESS EQUITY IN COMPUTING

**Yolanda Payne**, one of the facilitators of the Constellations Virtual Computer Science Professional Development Summit, talks about equity in computing education

**A**s a former classroom teacher with 21 years of experience, I know that teachers are tasked with hundreds of decisions daily. As a decision maker with the power to change lives, it is essential to reflect personally upon why equity in education should be a part of your classroom. Giving students an opportunity to experience computer science is a personal mission for me.

After growing up in rural Mississippi and then teaching in disadvantaged schools, I know that having access to traditional computing devices is a luxury that is out of reach in many homes. Hard-working parents and families work to provide life's basics, and computing devices may not be a priority. Having grown up in such a household, with family members who made sure that I had all that I needed and some of what I wanted, I realise, in hindsight, what a keen investment my mom and dad made when they purchased a Tandy computer from Radio Shack on a payment plan. That one purchase helped launch me on my life's professional

trajectory. To this day, I recognise what a randomly orchestrated divine intervention that was for me.

I understand how easily an unexpected emergency situation, an unanticipated hike in a utility bill or a sick day off work, could have derailed the purchase of the machine that has helped me realise my potential. I am also viscerally aware of how this is still a reality in the households of many of the students I work with, and I don't think that it should be left up to chance whether they are afforded experiences with the technology that is embedded in the society around them.

As a ten year old, my life was forever changed when my parents gave me access to a computing device that did not have the computing capacity of my current cell phone, but held the power to propel me from poverty into the middle class.

Some 34 years later, there are thousands, if not millions of students still in similar situations, with minds waiting to be unlocked to the power that they have when meaningfully connected to computing

resources. It is up to the decision makers to realise that equity in the computing field may yield as yet untold advances for all of us if we give students the tools needed for success.

Everyone understands that people need to understand subjects like English and Maths to succeed. As technology has become more and more prevalent in our everyday lives, it's imperative that educators teach the next generation how to create and handle technology responsibly, so that they not only succeed later in life, but thrive.

## **We built it, but would the people come?**

The Constellations Virtual Computer Science Professional Development Summit was created in collaboration with the Georgia Department of Education, Computer Science Teachers Association (CSTA), and Computer Science for Georgia (CS4GA). It was originally intended to be held in-person on Georgia Tech's campus during the summer of 2020 for teachers across Georgia and the surrounding states.

With the coronavirus pandemic making in-person events unsafe, the organising

team quickly pivoted to creating an online experience. While the transition was extremely challenging, we felt it was important to accomplish our goal of helping teachers of all experience levels acquire skills and information that would increase their content knowledge.

A call was sent out to potential speakers to create sessions that would be engaging and informative for educators at all experience levels. We also wanted a diverse cohort of voices—something that is often overlooked in the field of computer science. Within a couple of weeks, we received over 45 proposals from teachers across the country that were geared towards the elementary, middle school, and high school tracks. Topics ranged from creating culturally-relevant pedagogy to why artificial intelligence can and should be taught at the elementary school age.

Once we had our speaker line-up, we were feeling confident, but still unsure of how many attendees we would have. With it being the first year of the summit, we set a goal of 250 participants, and were blown away when more than 730 people from around the world attended. The majority of these attendees would not have been able to participate in the in-person event because of travel and budget constraints, or any number of other issues. Educators from Oregon to Italy to Scotland to New York attended and were able to add diverse and unique perspectives to the conference conversations.

As a centre focused not only on computing education, but also on equity issues in STEM, we wanted our sessions to reflect these dual priorities. As proposals came in, panellists

## CONSTELLATIONS SUMMIT RESOURCES

The archived sessions from the Constellations summit are available at [helloworld.cc/constellations](http://helloworld.cc/constellations).

More information about the Constellations Center for Equity in Computing can be found at [constellations.gatech.edu](http://constellations.gatech.edu). Opportunities for collaboration and resources on current initiatives are also available.

were eager to share stories of their work in the field, pitfalls they've encountered, and how to rise above discrimination or systemic issues and make real change. Content session leaders provided interactive and engaging sessions that introduced educators to new products or ways of approaching content in the classroom.

### What does equity have to do with computing?

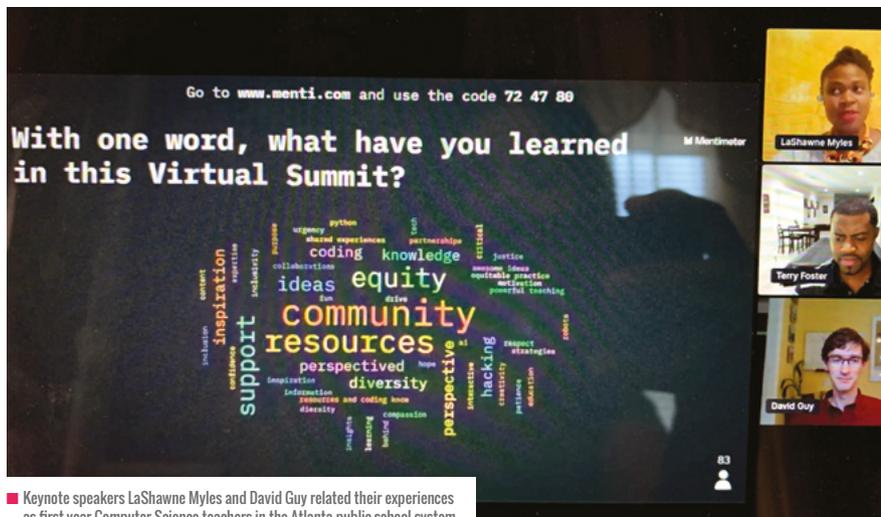
In a word: everything. As a fellow at the Constellations Center for Equity in Computing at Georgia Tech (Constellations) this question is central to the mission of the work I engage in on a daily basis. Our team is partially embedded with teachers in the Atlanta Public School district, where we work to bring advanced computing courses to students in

disadvantaged communities. Of our students, 75 per cent are on a free or reduced lunch plan and 72 per cent are students of colour.

It's no secret that the field of computer science is lacking in diversity. When we look at the number of diverse people entering the STEM workforce and contrast them to the number of students in school education who lack access to a computer science course, the pipeline problem is clear. While there is certainly a lack of diverse students in the pipeline, it is Constellations' mission to ensure that all students — especially students of colour, women, and others disadvantaged in school and post-secondary institutions — have access to quality computer science education, a fundamental life skill in the twenty-first century.

The pipeline is not dry because women, students of colour, or economically disadvantaged students don't enjoy computer science or aren't good at it; it's dry because they haven't even had the opportunity to try or experience the field.

It's important to have difficult, uncomfortable conversations about what we are doing to give every student the chance to experience computer science and to potentially change the trajectory of their life. The Constellations Summit actively engages in these conversations and we believe it's important to continue doing so, and for other conferences to encourage similar conversations in the future. [\(HW\)](#)



Keynote speakers LaShawne Myles and David Guy related their experiences as first-year Computer Science teachers in the Atlanta public school system



### YOLANDA PAYNE

Yolanda is a research associate at the Georgia Institute of Technology and a fellow at the Constellations Center for Equity in Computing. She facilitates a Code Club and Girls Who Code chapter while still finding time to tinker at home with her two sons (@ydep).



# THE INTERACTIVE COMPUTING CLASSROOM IN LOCKDOWN AND BEYOND

**Halima Bhayat** shares how an interactive classroom can enable pupils, parents, and OFSTED to learn about the full computing curriculum from Key Stages 3 to 5

**W**hen lockdown came and schools closed with no certain date of return, I wondered what I could best do to support my students in their remote learning. As head of computing and director of digital learning, I was also aware that I needed to help my colleagues with engaging their students remotely — whatever we established in my faculty could be rolled out across the school. All eyes were on IT and it was an opportunity to showcase how IT can enable learning in this time of pandemic,

and how it can be integrated into the school long-term. For staff — and to a lesser extent students — lockdown provided the perfect opportunity to set aside their fears or uncertainties about virtual learning and to gain new skills. An interactive classroom can be an excellent resource, which can be shared on the school website for parents to access and be directed to. In this article, I will share how I created an interactive classroom for my students, and hope it will inspire others to do the same.

## What did I envisage for my students?

I wanted to create an engaging resource that provided a sequence of what is offered in my department from Key Stage 3 through to Key Stage 5 and beyond. I planned to try it out first with my students, and then roll it out to the rest of the school so that everyone could thrive during lockdown.

The interactive classroom was created as a primary resource for parents and students to learn more about the subject and to get support. It is designed to be used independently by students, but can also be

used by parents to find various resources to support their child. Students engage with the product by opening it and clicking on the image that best describes their course, or anything else they want to know more about. I built the interactive classroom as a PowerPoint, which I then saved as a slideshow. It requires an internet connection so that images can be found and links made. I recorded and added sound to the presentation to allow anyone interacting with the product to hear my instructions. Similarly, videos can be prerecorded using the same or other devices and then embedded into the presentation. I also created a cartoon image of myself using the Bitmoji app.

For teachers, the advantage of an interactive classroom such as this is that all resources are placed in the same area, and



■ The interactive classroom recreates a realistic learning environment

## “ LOCKDOWN PROVIDED THE PERFECT OPPORTUNITY FOR STUDENTS TO SET ASIDE THEIR FEARS ABOUT VIRTUAL LEARNING

this can be changed or built on over time. Questions on the subject from parents and students can easily be addressed in the shared slideshow. For OFSTED, there is a clear curriculum sequence with the added advantage of enrichment resources and careers information about the subject.

### Designing the interactive classroom

OFSTED has been encouraging us all to consider and know our department's pedagogy. It was when I was giving thought to this that I came across teachers using Bitmojis (personalised emojis), and this led me to the idea of the interactive computing classroom.

I started by creating a Bitmoji avatar version of myself. I felt that having 'me' in the classroom would reassure students that I am still there for them, and would also add some humour, to support students' well-being (I also enjoyed creating my rather cool avatar!).

I then moved on to start designing my classroom, which was really fun. I was able to search and add a background, as well as furniture, carefully planning what I would like to have in my classroom. All of this was done using PowerPoint. I moved on

to find images of items that students can recognise, such as books they are studying, and added images with links.

One of the big features of my interactive classroom has been the use of everyday objects to make the classroom as realistic and alive as possible. This was achieved by putting on my creative hat and thinking about all the things you may see lurking in the classroom. I wanted the room to be not just a place to find answers, support, and links from lessons, but also a place for students to explore and see what they can find. I added items such as a sandwich, a handbag, and a cupcake.

Since its launch with students, I have found that the virtual classroom is the first place students want to explore. It has allowed them to be independent and take responsibility for their own learning. It has also been popular with parents, who have told us that it is easy to navigate and makes them more inclined to engage with their child's education and support them in it. If parents are talking to their children about their learning, this in turn helps to reinforce what the students are learning. In this way, the interactive platform helps

to enhance the student-school-parent triangle of communication. Comments from students have included, "This is so helpful"; "I now know I want to do Computer Science at GCSE"; "You look so real, Miss, and it's nice to see you"; and "It's funny but I think it's useful."

### New opportunities for students

Before the coronavirus pandemic, our school's Computing department had always offered students opportunities for enrichment, such as trips, workshops, competitions, and wider reading lists. I wanted to keep this momentum up. I was also aware that many opportunities came about during lockdown that were not previously available. For example, many learning establishments, museums, and places of education opened up and shared their expertise in new ways, which they would previously not have had such an incentive to do. That meant that our students could now attend lectures live-streamed from other towns, cities, and countries. They could 'visit' museums and art galleries, and engage with a whole host of new ideas as everyone adapted to a digital way of learning. I didn't just want our students to stay on top of things during lockdown; I wanted them to get ahead and seize the opportunities that now presented themselves!

The interactive classroom allows students to find resources easily, for example by clicking on images from

## CREATING YOUR OWN INTERACTIVE CLASSROOM

1. Open PowerPoint and add a background; you can use the internet to find one. The background should only include a wall and a floor.
2. Search for and save or copy images of furniture that you would like in your classroom, and position them in your PowerPoint slideshow.
3. Do the same to add images of items that you would like to have in your classroom.
4. Select the images you would like to link and add hyperlinks. If you would like to embed anything, use the PowerPoint embed feature.
5. Create your Bitmoji, send it to yourself, and add it to the classroom.
6. Check your slideshow to make sure everything is working and you are happy with it.
7. Save your work as a PowerPoint slideshow and share it with others. This can be through a virtual learning environment/cloud system, or by email.

books they are reading. There are also some unlabelled objects in the classroom, which allow them to explore what else is available in the presentation. When creating an interactive classroom for students, teachers can easily save videos and talks and embed them in PowerPoint. When viewed as a slideshow, it will automatically have these links, without the need for separate files saved alongside the presentation. One of the links I included in mine is a virtual tour of a computing museum, which students can click on and be routed directly to the website. I have also included links to talks by female Computer Science students at Oxford University, as well as a link to the BBC Technology newspaper. This allows students to read around the subject and encourages them to select the subject at Key Stages 4 and 5.



It's important that all students be enabled to achieve their best

“ THROUGH THE INTERACTIVE CLASSROOM I AIM TO SHOW MY PUPILS THE REACH OF THE SUBJECT AND HOW FAR IT CAN TAKE THEM

### Access for all

The school where I work is an all-girls school in south London with a diverse range of students. As a BAEM woman, I am particularly conscious of the importance of being a role model to my students. I am especially keen that Computer Science, which is so male-dominated both at school and in the STEM employment sector, is seen by my students as attractive and empowering. Through my face-to-face teaching, and recently through the interactive classroom, I aim to show them the reach of the subject, the huge impact it has, and how far it can take them. IT should no more be seen as a male subject than arts and humanities should be seen as female subjects. But, as they say, “You have to see it to be it”, and I want to show our students that this is as much for them as for anyone — all students should be enabled to

achieve their best, and our school has high expectations of all of them.

The choices the students make about their GCSEs, A levels, BTECs, and T levels, and then their jobs, apprenticeships, or universities, are key as they allow opportunities to open up for them. If you can grab a student's interest now, you help them on a path of many, increasing opportunities.

### The interactive classroom in action

At Key Stage 3, our students usually complete a module on how to create an animation using the Scratch programming language. Using the interactive classroom, pupils can find a Scratch object that then directs them to the actual project page. This helps to minimise questions to the teacher, as students often tend to ask where to find things. Students can also use the interactive classroom to complete



■ Mrs Bhayat's avatar in the interactive classroom with a range of resources

tests, as there are direct links to Seneca and to the BBC Bitesize Computing section for example.

When Key Stage 3 pupils are ready to make option choices for Key Stage 4, they can easily click on Key Stage 4 resources, where there is a direct link to the specification and books that are studied as further development. With permission, students in Key Stage 4 can record a short introduction about what they are studying and why, for Key Stage 3 students to hear.

During the year, we take part in the Hour of Code, Ada Lovelace Day, and Safer Internet Day. Students can easily click on a link that directs them to the page where they can access this information. At Key Stage 5, we offer a range of computing pathway opportunities, such as Level 2 iMedia, BTEC IT, and T levels in Digital Technology. Having such a range of subjects means that students require specific support, and the interactive classroom has been able to provide this. At Key Stage 5, students can not only use the interactive classroom to support their learning, but can also avail themselves of wider reading opportunities

## “IMAGES OF EVERYDAY ITEMS CAN BE ADDED TO MAKE THE INTERACTIVE CLASSROOM AS REALISTIC AND ALIVE AS POSSIBLE

whereby specific free books or links to Radio 4 technology talks are shared. Students at this stage can also click on links to find out which universities are rated 1–10 for the computing curriculum, as well as where apprenticeships relating to the subject can be found, and the career fields that are available. This allows a full and wider picture of the computing curriculum.

### Looking to the future

In September, all students will have the opportunity to explore the resource and become reacquainted with it. It will be an ideal resource for introducing students in Year 6 to the curriculum. Students in Year 9 will be starting to think about their subject options in September, and by introducing this resource, it will allow them to see what Computing can offer if they select it. From September 2020, we will also be offering a new T level course in Digital Technology, which I will be teaching. The interactive classroom will support students in Key Stage 4 to start thinking about other options that are a direct path from the computing curriculum. Students in Key Stage 5 will be able to find links to YouTube channels where they can be supported on practical IT

skills that they may need from September onwards. Over time, the interactive classroom can be expanded to include new links, videos, and messages. Students can be included, too, by creating prerecorded tutorials for others to view. At my school, we look to support students in becoming leaders, and one of the tasks chosen by our digital student leaders was to create video tutorials for the interactive classroom.

The classroom can also be broken into Key Stage-specific rooms to provide students with the most relevant content. It would be an excellent resource to share with new trainee teachers, or those new to the subject who are not subject-specific teachers. Staff who leave also leave a legacy behind. For schools to expand the interactive classroom to other subjects would be amazing. I have in my own school trained staff on how simple and effective this resource can be, and how to create it. So give it a go and create your own interactive classroom today! (HW)



■ Students can access direct links to online tests



### HALIMA BHAYAT

Halima is Head of Computing and Director of Digital Learning at the Ursuline High School in Southwest London. She has a BSc degree in Computer Science as well as a Masters in Leading Education and Change. She is the CAS Lead for Merton Secondary and Primary Schools, a Raspberry Pi Certified Educator, and a Microsoft Innovative Educator Expert (MIEE).

# WRITING A COMPLETE COMPUTING CURRICULUM: LESSONS LEARNT

**Sway Grantham** and her colleagues began writing the Teach Computing Curriculum 18 months ago. She shares some insights into what they learnt along the way

**D**esigning curricula is a huge part of education. Whether you're choosing a scheme of work to buy into, deciding which topics will be covered in which year groups, or considering what learning objectives you need for a certain lesson sequence, you are designing a curriculum. These decisions form the basis of how learners will experience the content you're delivering, as well as how successfully they will understand it, and, potentially, how successfully other teachers can use it. These are all tasks that our team has undertaken in the last 18 months while designing the Teach Computing Curriculum. Here are some of the things that the team learnt along the way.

## Consider the whole picture

When designing a curriculum, it can be tempting to break it into specific parts — either to make it seem less overwhelming or to share the workload more easily. These specific parts could be year groups, topics within the curriculum content, or units within year groups. While it is true that the parts eventually add up to the whole, a huge amount of work has to be done first, to ensure that everyone is working towards the same goal and with the same expectations. This is something that we learnt early on, particularly as so many people were involved in helping us to develop the curriculum. With the national curriculum as our starting point, we knew what the learners had to

achieve by the end of each Key Stage. However, the journey between those points — where they fell and what they looked like — was unknown. Equally, even when we knew the topic or key ideas that needed to be taught, we had to work down to the objective level, ensuring that both teacher and learner were able to measure their success. This journey to a thorough mapping of progress throughout a unit, year group, Key Stage, and school was vital to the work we needed to do. One colleague described the documents we have created as the 'tip of the iceberg', because they are actually the output of a large amount of time, work, and effort that had to be put in before anything was created.

**Top tip:** Don't rush the initial stages to get to the main event (creating lesson plans). The more work you do before anyone starts, the stronger your planning will be.

## Varied collaboration

There are many proverbs about both the values and challenges of having lots of people involved in one project. The biggest difference between the process of designing the Teach Computing Curriculum and the planning we had worked on previously in our own schools was the ability to work with a range of colleagues. We had colleagues involved from academic backgrounds, practising teachers, former teachers, specialist teachers, non-specialist teachers, and industry connections — all adding to our understanding of the subject, how best to teach it, and sharing a wealth of experience that no one person could possess.

By the time we had finished, this rigorous



## WHAT'S NEXT FOR THE TEACH COMPUTING CURRICULUM?

Now that the Teach Computing Curriculum has officially launched, here are our next steps to ensure that it continues to be as useful as possible to teachers:

1. Create a curriculum overview document of all the content.
2. Create teacher guides to support teachers' understanding of our approaches throughout the curriculum, for example, our approaches to assessment and differentiation.
3. Review and implement units that were piloted in schools in 2019.

and collaborative process had ensured that every unit had passed through many hands before it was completed. Each person added their own insight into the topic; they all contributed to the progression, pedagogy, and accessibility of the planning to ensure it was continually improving.

**Top tip:** Work with peers outside of your direct colleagues. Try those in different phases or year groups, or even contacts in different schools, to gain from the experiences they have had.

### Read, reflect, revisit

One thing teachers are always short of is time. There's never enough of it, and sometimes we use this as a reason to accept the first attempt. While this may work for tomorrow's lesson, lots of teachers out there are always thinking about the next time that content is being taught and how it can be improved. It is through this approach that we have realised that the curriculum we have written will never be 'finished'. Each time we return to a unit, we have more experience and have had more conversations about it, and so each time we have another perspective.

This approach is particularly important with a subject as young as computing, in which thoughts and understanding about approaches are still evolving. We have worked hard to integrate the most recent research approaches for pedagogy and curriculum content into the resources, but the next time we revisit it, I am sure there will be more understanding still, and extra things we want to include.

Already, at the stage of launching the live curriculum, we have revisited each unit three or four times, making changes based on feedback and the collaborations

mentioned previously. However, when teachers use it in their classrooms from September, we look forward to learning exactly how it is being used in settings across the country.

**Top tip:** Creating a curriculum should be a process, and not a destination: it will never be 'finished'.

### A toolkit or a script?

The end result — or the tip of the iceberg, as we mentioned earlier — is a huge body of work to create over 500 hours of lessons to meet the needs of the national curriculum from Year 1 to Year 11, including GCSE specifications. It provides all the planning, resources, slide decks, assessment, and

to become more confident, there are tools within the Teach Computing Curriculum to help. Equally, there are tools to support teachers looking to evaluate and enhance their work, and those who are already effective in the classroom but need support with the computing subject matter and how to approach it with learners.

Working on the Teach Computing Curriculum, we have been offered the opportunity to develop a curriculum with a lot more time and resources than the average teacher will have access to. This has allowed us to share this first draft and offer it as a starting point for teachers looking to design a curriculum suited to their school. The first draft incorporates all the things we learnt in creating the curriculum: opportunities for making links across year groups, phases, and schools; collaborating with colleagues from different backgrounds; and content that has already been frequently reviewed. The curriculum is now live on [teachcomputing.org/curriculum](https://teachcomputing.org/curriculum) and we're excited to see how teachers and schools adopt it from September 2020. Do leave us feedback on the website to share how you're finding it, so that we can continue to learn more about what is working and what we could do better. [\(H/W\)](#)

## “ WE HAD TO DESIGN A CURRICULUM THAT WOULD SUPPORT A RANGE OF TEACHERS

homework support that teachers should need. However, it is a toolkit, not a script.

We needed to design a curriculum that would support teachers of all levels of experience, working in schools with access to various resources, and for learners from a range of different experience levels. To achieve this, we have created a comprehensive curriculum that teachers can either use as it is, or edit and adapt to their needs. It has everything teachers should need; how they use the tools we have provided is entirely up to them.

Whether someone is an experienced specialist who wants to use the learning graphs to reflect on their own approach to progression, or a teacher completely new to computing who wants to use the plans



### 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).

# CREATING A REMOTE CODE CLUB WITH LEEDS LIBRARIES

How Leeds Libraries linked coding and literature through an engaging project with their Code Club participants

**W**hen our city went into lockdown, we at Leeds Libraries wanted to make sure that we stayed connected to the families across Leeds involved in our Code Clubs. In the past year, we ran a series of challenges for our young attendees, including Moonhack, Arcade Games, Silly Games, and most recently the 13-Storey Treehouse Platform Game that is the focus of this piece. We teamed up with CityFibre — who are rolling out the next generation of full fibre broadband across Leeds — to support the prizes for these challenges.

Our 13-Storey Treehouse platform project was one of the first challenges we'd run as a remote club. The idea for the

project came about because we wanted to bring the club together by working on something collaborative. We also wanted to find an activity that would help to establish this new online coding community.

## Linking literature to coding

As librarians, we thought about how to link coding to literacy and reading for pleasure. We also wanted to link in our wider online #LibrariesFromHome offer at Leeds Libraries, in particular our e-borrowing service and our Lego club. We were keen to create a project inspired by a book that was available via our e-borrowing service, so that Code Club participants would be encouraged to borrow and explore the book to get ideas for their

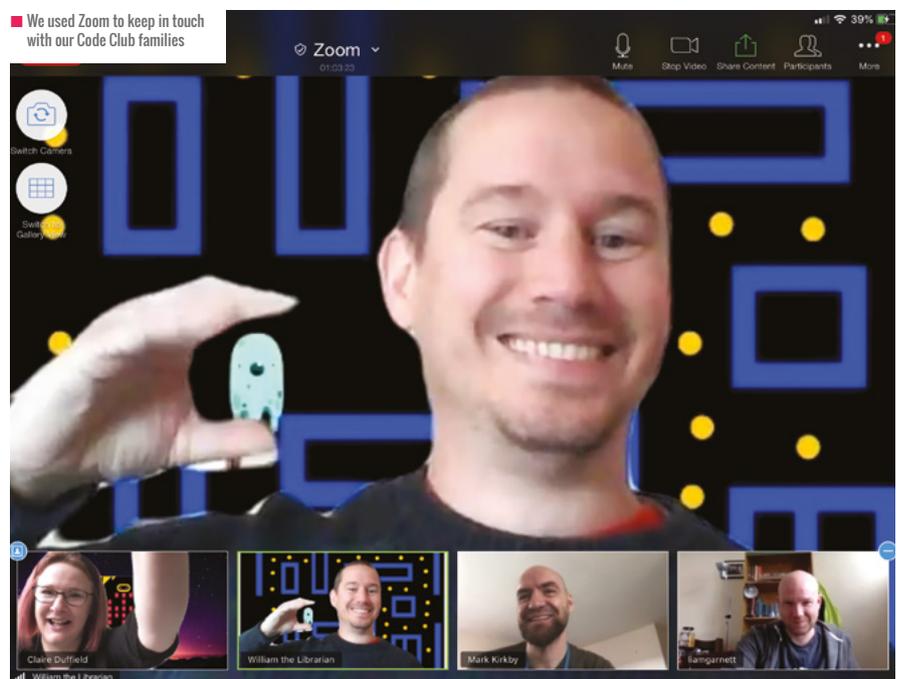
code. From this came the idea of using the children's book *The 13-Storey Treehouse*, by Andy Griffiths and Terry Denton, as inspiration to create a multilevel platform game. As part of the project, each Code Club participant would create their own level, or levels, of the treehouse.

The different levels of the treehouse in the book *The 13-Storey Treehouse* offered an ideal structure for a platform game project. Creating a multilevel game also meant that this could work as a collaborative project, showcasing all of our Code Club participants' code together in one game. The book was selected as the theme for our online Lego club that month too, so there was an opportunity for cross-promotion of our online

## TOP TIPS FOR RUNNING A REMOTE CODING CLUB

- Collaborate with other learning, cultural, and digital organisations
- Tap into volunteers' knowledge and experience
- Make content available in various formats to improve accessibility, e.g. videos, PDFs, Facebook event pages, Scratch Classroom, and Zoom calls
- Create projects with flexible goals to allow for different skill sets
- Encourage creativity: if students want to try something different, let them run with it!

■ We used Zoom to keep in touch with our Code Club families





■ A young Code Club participant working on the Treehouse Challenge

offer for children and young people. We encouraged our Code Club participants to take setting and game narrative ideas from the book, and to draw on Code Club projects to help them with game mechanics.

## Planning the project

We decided on a loan availability date for *The 13-Storey Treehouse* that meant children had time to borrow and read the book before coding. The e-book was available on simultaneous download status, meaning there was no restriction on the number of children who could borrow it.

From there, we looked at projects from the Code Club projects site that would support the idea. We focused on using elements from the project Dodgeball — where the player has to dodge moving balls to reach the end of the level — for the platform game content, and the Create Your Own World project for creating multilevel games. We prepared instructional PDFs and videos in advance, ready for when the project was launched. Realising this project may be more time-consuming, we allowed four weeks for it (the previous challenge had been two weeks). We also added in a two-week catch-up Zoom session to debug and answer any questions the families had.

## Bringing the project together

We created a Scratch Classroom with a Treehouse Challenge studio for our students to upload their levels to. The classroom also included Mark's intro level from his instructional video, and Liam's two-level game from his video that kids with more advanced coding skills could use for inspiration. We included a variation on gravity code using

colours, as well as a level from our volunteer, Viktor, which demonstrated how to use power-ups and lives. The classroom could also be used by students to ask for help if they got stuck, and gave librarians an opportunity to track progress.

Once all of our families had created and uploaded their levels to our Leeds Libraries Scratch Classroom, we set about bringing them together into one multilevel platform game. While the prospect of joining 13 separate projects of 19 levels into one project was daunting, a methodical approach helped to keep things simple. This process

“ THIS PROJECT WAS A REAL JOY... THE SHEER CREATIVITY OF OUR STUDENTS AMAZED US

was made possible by the backpack function, which can be used to transfer sprites, backdrops, and code between projects — simply drag and drop into the backpack, open another project, and reopen the backpack to find your code waiting. Firstly we transferred all of our students' backdrops into the main project, renamed each one Level 1, Level 2, and so on, and made sure that each platform was black to fit with the gravity code. Next came the obstacle sprites. We added code so that each sprite would only show if the backdrop equalled the level it was supposed to be on. Placing this code in the backpack allowed us to quickly add it to each sprite — rather than having to rewrite it — which saved a lot of time. Once the backdrops and sprites were in place, we simply added code to our main character,

Pico, so that touching an obstacle sent them back to the beginning, or reaching an objective changed the backdrop to the next level. You can play the finished game here: [helloworld.cc/13-storey-treehouse](http://helloworld.cc/13-storey-treehouse).

## Completion and future projects

This project was a real joy; having the book as a source of inspiration and seeing the crossover of reading and coding in action was a special highlight. Furthermore, *The 13-Storey Treehouse* became the most popular children's e-book in our libraries, with 187 loans. The sheer creativity of our

students — whether through drawing their own backdrops or creating their own sprites and obstacles — amazed us. We had shark-infested waters, flying marshmallow monsters, toxic waste, burp bubbles, pterodactyls, zombies, and more! Nothing has been more satisfying than adding that final block of code to complete the project and bringing all that hard work together.

For our next project, we will create animated stories using sprites from the collections of Leeds Museums and Galleries and their world of learning resources. Backdrops have been chosen from Leeds Libraries' photographic archive, Leodis. In September, our aim is to incorporate the Reading Agency's Summer Reading Challenge by creating a game inspired by our favourite silly books. (HAW)



## LIAM GARNETT

Liam is an Assistant Communities Librarian at Leeds Libraries. He has been running a Code Club at Seacroft Community Hub and Library for the last few years. (@ttenz)



## MARK KIRKBY

Mark is a Communities Librarian at Leeds Libraries. He has been running Code Clubs since 2016, and now facilitates the club at Headingley Library. (@KatoKirkby)



# THE I IN PRIMM

**Sue Sentance** explores how the Block Model – a framework for program comprehension – can create opportunities for students to investigate code fully

**T**here are several reasons why some students find programming difficult to grasp. Combining understanding the syntax of a programming language with the need to work out logical solutions can lead to high cognitive load. Students can also become easily disheartened when faced with errors or programs that don't work. And copying code without understanding it can lead to students developing misconceptions.

To address some of these issues, I developed the PRIMM approach to teaching programming. Following the approach, teachers can structure programming lessons with five elements: Predict, Run, Investigate, Modify, and Make.

- **Predict** Students discuss a program and predict what it might do, drawing or

writing out what they think will be the output. At this level, the focus is on the function of the code.

- **Run** Students run the program so that they can test their prediction and discuss in class.
- **Investigate** The teacher provides a range of activities to explore the structure of the code; this involves activities such as tracing, explaining, annotating, and debugging.
- **Modify** Students edit the program to change its functionality via a sequence of increasingly challenging exercises; the transfer of ownership moves from the code being 'not mine' to 'partly mine' as students gain confidence by extending the function of the code.
- **Make** Students design a new program that uses the same structures but solves a new problem (e.g. has a new function).

There are three key principles underlying PRIMM, all emerging from research in computer programming education. The first is that students should read before they write. The excitement of writing a new program and creating something that works means we don't spend enough time reading and learning from simple, well-written programs. In literacy, we learn to read first, and at a level beyond what we can write. We learn from reading examples of the written word. The same can apply to programming. There is a substantial body of research around tracing and reading programs that has shown that reading first is beneficial for novice programmers.

Secondly, students should talk about their programs. This works at three levels: we need to find the right language

## THE BLOCK MODEL

<b>(M) Macro structure</b>	Understanding the overall structure of the program text	Understanding the algorithm underlying a program	Understanding the goal/purpose of the program in the current context
<b>(R) Relationships</b>	Relationships between blocks	Sequence of function calls, object sequence diagrams	Understanding how subgoals are related to goals
<b>(B) Blocks</b>	Regions of interest that build a unit (syntactically or semantically)	Operation of a block or function	Understanding of the function of a block of code
<b>(A) Atoms</b>	Language elements	Operation of a statement	Function of a statement
	<b>(T) Text surface</b>	<b>(P) Program execution</b>	<b>(F) Function</b>
	<b>Architecture/Structure</b>		<b>Relevance/Intention</b>

or terminology to use to articulate our understanding; we are helped by verbalising what may be a complete mishmash in our head, and we also share in the creation of understanding through dialogue with others.

Finally, students should start with code that isn't their own. Using a starter program, written by somebody else who takes responsibility for any bugs, reduces the emotional strain caused by our programs failing. We often hear that students in computing should build up resilience because their programs will always fail. I believe we don't need to accept this, and that by providing code written by somebody else as a stepping stone we protect our students from the disappointment, anxiety, and frustration that we've all felt when our programs fail. This is especially important for young learners, but applies to anyone learning to code.

The Investigate phase of PRIMM gives us the opportunity to devise creative activities and ask insightful questions about a program. In this way we are moving from thinking about what the code does to how it does it. Armed with this knowledge, learners should be more confident to tackle their own programs.

In the Investigate phase, we often use a range of activities. Here are some examples,

## STUDENTS SHOULD START WITH CODE THAT ISN'T THEIRS — THIS REDUCES THE EMOTIONAL STRAIN CAUSED BY FAILING

numbered so that we can refer to them later:

1. Ask the question, "What would happen if those two lines were the other way round?"
2. Ask the question, "What would happen if the input to the program was \_\_\_\_?"
3. Ask students to draw on the program to identify blocks of code or type of construct.
4. Draw the flow of control on the program showing what line is executed when a loop is exited, for example.
5. Ask students to identify the scope of a variable.
6. Identify the purpose of a single statement.

## MORE ABOUT PRIMM

PRIMM was established from a combination of experience and research, so not surprisingly, many experienced teachers will recognise elements from their own practice. It's very useful if you are new to teaching programming, or are struggling to get your students to understand a particular concept. Many teachers have been using the PRIMM approach in their lessons; if you've never heard of it, here are some resources to have a look at:

- Teach Computing Quick Read on PRIMM: [helloworld.cc/primmquick](http://helloworld.cc/primmquick)
- PRIMM: Something for your programming pedagogy toolkit? Sue Sentance, Hello World issue 4, p.62-63
- Programming pedagogies: PRIMM. Oliver Quinlan, Hello World issue 5, p.25
- Reusing familiar techniques. Jane Waite, Hello World issue 6, p.74-75
- An overview of PRIMM: [primming.wordpress.com](http://primming.wordpress.com)
- Sentance, S. et al. 2019. Teachers' Experiences of using PRIMM to Teach Programming in School, SIGCSE '19: Proceedings of the 50th ACM Technical Symposium on Computer Science Education



➤ These activities can be varied and added to, and many teachers have been very innovative in how they ask questions of students that really get them thinking. However, we can fall into the trap of asking the same questions about the code all the time, and we can then find that we are not really supporting understanding as much as we could.

### The Block Model

So this is where the Block Model comes into play! The Block Model was created by Carsten Schulte in 2008 and gives us some insight into the various granularities of skills that new programmers need. The Block Model is a grid with two axes — one showing the size of the programming element under consideration, and the other the distinction between the structure of the program, the execution of the program, and the function of the program. Last year, Cruz Izu and Carsten Schulte led research that mapped classroom activities using the model, leading me to link the idea to PRIMM. The Block Model ensures that the Investigation stage of PRIMM addresses a range of skills required to thoroughly understand a program.

### From atoms to macro structure

At the bottom of the Block Model is the Atom: a single language element such as a variable, or the word 'if'. The top is the least granular end of the scale, where

'for' in Python to indicate the beginning of a loop. There is one more column: program execution. This relates to the flow of control and values of variables when the program runs, or what code is called when.

“ IN THE INVESTIGATE PHASE WE DEVISE ACTIVITIES AND ASK INSIGHTFUL QUESTIONS ABOUT A PROGRAM

we have the macro structure: the whole program. Between these two extremes we have blocks of code, and relationships between blocks of code. Using the Block Model enables us to reflect on whether our questioning spans all these four levels.

### Structure versus function

When we ask students to predict, we ask them what a program might do. This relates to the function of the program or piece of code. In contrast, the structure of the program relates to the syntax and how the program is constructed. For example, we might be using the keyword

## FURTHER READING

- Schulte, C. (2008). Block Model: an educational model of program comprehension as a tool for a scholarly approach to teaching. *Proceedings of the Fourth International Workshop on Computing Education Research*, p.149-160
- Izu, C. et al. (2019). Fostering Program Comprehension in Novice Programmers - Learning Activities and Learning Trajectories. *ITiCSE-WGR '19*, July 15-17, 2019, Aberdeen, Scotland, UK

## THE BLOCK MODEL

(M) Macro structure			2. Ask: "What would happen if the input to the program was ___?"
(R) Relationships	5. Ask students to identify the scope of a variable	4. Draw the flow of control on the program	
(B) Blocks	3. Ask students to draw on the program to identify blocks of code or types of construct	1. Ask: "What would happen if those two lines were the other way around?" 4. Draw the flow of control	
(A) Atoms			6. Identify the purpose of a single statement
	(T) Text surface	(P) Program execution	(F) Function
	Architecture/Structure		Relevance/Intention

### “ AN AWARENESS OF THE TYPES OF ACTIVITIES WE USE WILL HELP US UNDERSTAND STUDENTS’ DIFFICULTIES

For example, if we have a ‘for’ loop in Python, the program execution level helps us to understand the flow of control back through the loop code a given number of times, and the impact this has on the value of the stepper variable.

#### Twelve zones of understanding

Looking at the Block Model in its entirety, we can see that it gives us twelve zones of program comprehension. So the question is, can we devise activities or ask questions about a program that develop knowledge in each of these twelve zones? It’s a challenge to do this, but if we don’t, we may not totally support students’ full understanding of the program.

If we take as an example some of the questions and activities I outlined above, we could start to put some of them into the Block Model and identify the gaps. The

exact placement of each task in the table above may vary depending on the views of the teacher, but in this case, it’s clear that there are definitely gaps. For example, I can see that there is a gap at the bottom left: Atoms/Text surface. To address this, I could add the following — “Can you locate a function call in the program?” — to my list of questions to ask the students.

What I’ve outlined here would take a lot of time and effort to do in every lesson, but an enhanced awareness of the types of questions and activities we use will help us understand our students’ difficulties with programming. I haven’t tested this widely but I believe that it may help us develop a language to use to understand our own practice as programming teachers. The approach adds to our pedagogical content knowledge (PCK) and increases metacognition relating to the teaching of programming.



#### 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.

I’m keen to hear from any teachers who try to apply the Block Model in their PRIMM lessons! Do contact me via Hello World at [contact@helloworld.cc](mailto:contact@helloworld.cc) or on Twitter at [@HelloWorld\\_Edu](https://twitter.com>HelloWorld_Edu) and let me know how you get on! 



# FROM FAKEBOT TO BEE-BOT

Jane Waite and Pam Popay share how laminated card representations of popular floor robots can help students learn to program

**A**s a resource to help pupils learn to program, the Bee-Bot floor robot has been a success in primary classrooms and clubs in the UK. A present-day simplified version of Seymour Papert's Logo turtle robot, the plastic device looks like a 20-cm bee with a smiling face, bright colours, and simple buttons on its back to control its motion. Over three quarters of a million units have been sold by the education providers TTS since the product's launch in the early 2000s, with other similar products on the market also being used by educators.

Each Bee-Bot has a left and a right button, and straight on and reverse buttons, which can be combined to write a program which, when run, causes the robot to move around the room. There is also a Clear button and a Go button. The Go button executes the

sequence of commands that were most recently entered since the last time Clear was pressed. The Clear button wipes the device's memory, and if it's switched off, the memory is also cleared.

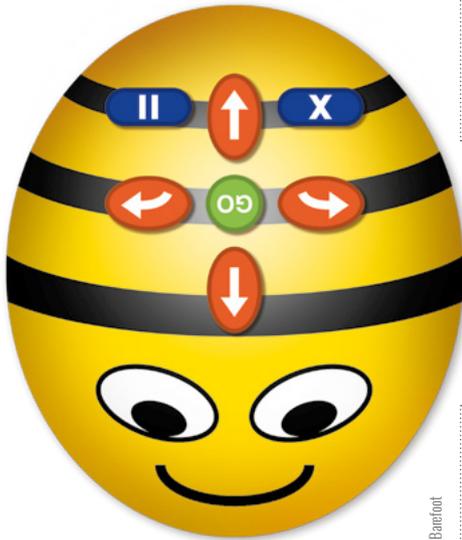
## The birth of Fakebots

In 2013, Pam Popay and a colleague at BT were spending a lot of their time developing and trialling resources to support the newly proposed computing curriculum in schools in Suffolk. When they discovered that all the schools they were visiting had Bee-Bots, it seemed obvious that they should develop some resources to be used with the devices which could support the delivery of the new intended computing curriculum across different year groups.

The BT team started with 'having a go' sessions that introduced children to the

Bee-Bots. Rather than randomly playing with the device, pupils were encouraged to think like scientists and examine what each button did. By doing this more guided activity, the students gradually discovered the functionality of the Bee-Bot.

As the team from BT developed more tasks, they realised that students needed a way to record their planned sequence of instructions: it was hard for children to debug their intended instructions without it. After experimenting with different methods they introduced a set of arrow cards along with Go and Clear. These were used by the children to construct a command list, which could then be tested. Finally, when students thought that the sequence was correct, they were then given the Bee-Bot to program. However, it soon became clear that the physical robot was a distraction from the thinking process



■ Barefoot Fakebots are available on the Barefoot website, but you can get your children to make their own

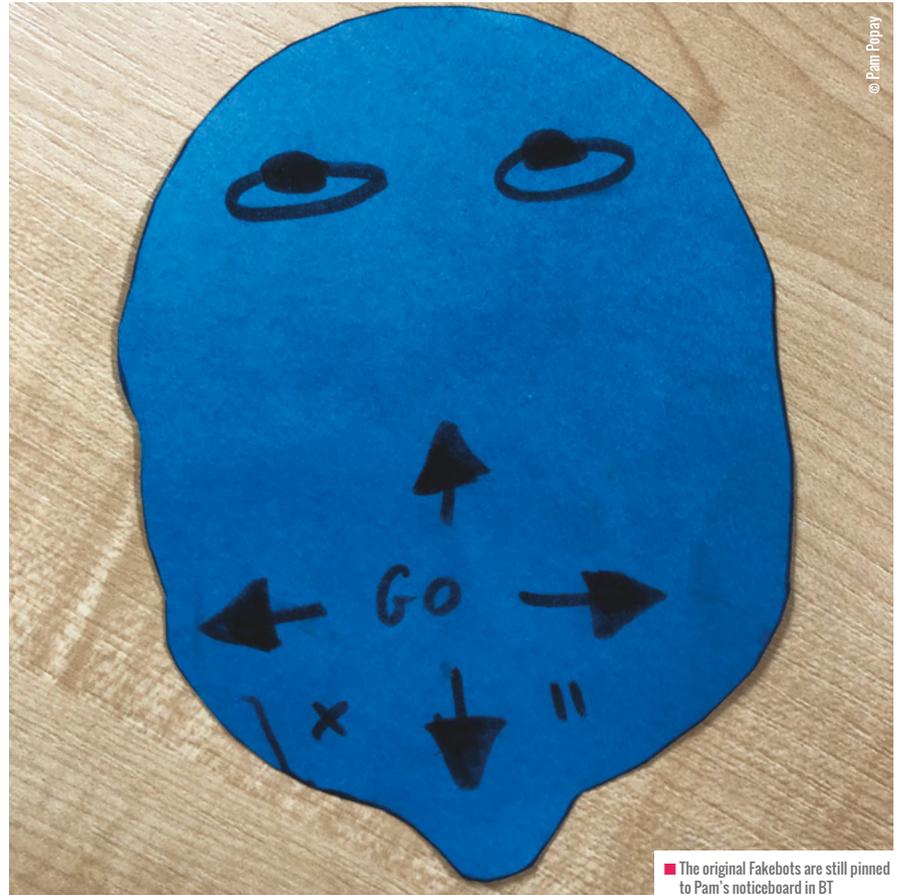
© BT and BCS Barefoot

“ PUPILS WERE ENCOURAGED TO THINK LIKE SCIENTISTS

and that pupils wanted to use trial and error instead of thinking ahead to work out the solution to the problem.

During a lesson break, Pam had an idea. She found some card in the classroom, drew around a Bee-Bot, and added buttons and a smiley face. She then introduced this paper-based representation of a Bee-Bot to the class. Pupils were now asked to complete activities with the card bee, while the Bee-Bots rested safe in their beehive. One of the students in that class called the card bee a ‘Fakebot’, and this is what they have been called since.

Pupils used the Fakebot to test their planned sequence of commands. They worked in teams: one pupil was the sequence designer and could organise the sequence of commands using the arrow cards, and another pupil controlled the Fakebot, using it to test the arrow card command sequence. Once the team thought all was well, they could collect a real Bee-Bot and a third member of each team, the programmer, entered the commands into it. The group then waited to see what happened. During this time, they followed the arrow card sequence



■ The original Fakebots are still pinned to Pam’s noticeboard in BT

as the Bee-Bot moved around.

Through working with Fakebots, Pam has recognised several essential features that can impact on their successful use. Firstly, they must be the correct size so that their tested movements are relatively accurate. Secondly, depending on the activity, it can be useful to have Bee-Bots with distinguishing features, such as different eyes, so that each group knows which Fakebot is theirs. Thirdly, if required, a Fakebot can have L (left) and R (right) written on them to help children recall vocabulary for discussing movement.

**Fakebots as a widespread resource**

Around the time of introducing Fakebots in teaching resources, Pam shared her findings about the Fakebot with Jane Waite, who was very excited by the idea. Both Pam and Jane were involved in the development of the Barefoot Computing programme at the time, and included Fakebots in the Barefoot resources. Set up by BT and Computing at School, Barefoot helps to empower primary school teachers across the UK to deliver the computing curriculum brilliantly with free and engaging

lesson plans, online guides, and workshops.

It would be fantastic to hear how educators are using Fakebots in their classrooms and how they affect pupil learning. Please share your experiences with us on Twitter (@janewaite). (HW)

Bee-Bot is a trade mark registered in the UK by RM Education Limited.

**FAKEBOT RESOURCES**

You can find Fakebot activities such as Barefoot’s Bee-Bot Basics Activity and Bee-Bots 1, 2, 3 Programming, at [barefootcomputing.org](http://barefootcomputing.org) along with a range of other downloadable resources that help bring computing to life in the classroom.

Bee-Bots and Fakebots are also used in resources from the Teach Computing Curriculum ([helloworld.cc/tcc\\_robot](http://helloworld.cc/tcc_robot)) and TTS ([helloworld.cc/tts](http://helloworld.cc/tts)).



# EXPLORING VIRTUAL ROMAN WORLDS DURING LOCKDOWN

When lockdown put a stop to the weekly Minecraft club at **Siobhán Morgan's** school, they rebooted it remotely, and pupils explored virtual Roman worlds of Bath and Exeter

**A**fter we introduced our popular lunchtime Minecraft club at the start of the current academic year, Exeter Junior School went into lockdown. It was an advantage that pupils were already familiar with Minecraft, which we had been practising in the club, and knew how to use it. The pupils' experiences with Minecraft, and their enthusiasm for it, meant that it made sense to provide an opportunity for them to connect from home. By the time we set up our virtual club, pupils had already become accustomed to using technology in different ways and were regularly engaging in video conferencing software through Google Meet. It therefore seemed viable to add in Minecraft, a familiar piece of software. Other than a few technical issues, everyone adapted fantastically to using it from home. Restarting our club as a weekly event throughout lockdown

was a popular addition to the remote learning timetable, with pupils working collaboratively to build our school in the virtual world.

Prior to lockdown, Minecraft had been used for a range of projects, including building the pyramids of Ancient Egypt (Year 3); looking at farming innovation (Year 4); school pupil librarians building a book realm to celebrate World Book Day (Years 4 to 6); and building the world of *The Tempest* (Year 6).

These projects allowed pupils to demonstrate their understanding of a topic by representing it within Minecraft. Actively creating models is a fantastic way for pupils to present their knowledge in a new and exciting way. These projects were completed in creative mode, which allows pupils to access all the tools and materials in the Minecraft inventory — their imagination is the only limit to what they can build.

## Exploring in adventure mode

Another game mode that can be used to great effect is adventure mode. This restricts pupils so they can explore prebuilt worlds without worrying that they may damage them. While teachers may prefer for their class to explore worlds created by themselves or their pupils, it is worth knowing that there is a good selection of prebuilt worlds that have been built by Minecraft world-building experts, many of which can be downloaded from the Minecraft Education Edition library. One of the worlds that our pupils in Year 3 interacted with in adventure mode was based on the children's book *Fantastic Mr Fox*, by British novelist Roald Dahl, which they were studying in their English lessons.

When exploring virtual worlds with my pupils in school, their excitement is instantly apparent. Pupils are active learners and whenever they explore something new, they are keen to share it with their peers.

## SETTING UP YOUR CLUB

- Create rules for players to follow in Minecraft
- Watch Ben Spieldenner's *Minewhat?* YouTube series and complete the free 'My Minecraft Journey' tutorials provided for teachers via the Microsoft Educator Centre
- Install and use classroom mode to control the play
- Learn some commands from the Minecraft Education Edition website
- Don't wait until you know everything about Minecraft before starting your club: just jump in and start having fun!

When someone asks how to achieve something, someone else will often have an instant answer and be keen to share the knowledge with them.

With the *Fantastic Mr Fox* world, pupils were able to explore the world confidently, teleporting to various locations from the book or following the helpful signs and paths to locate them independently. Playing in adventure mode gave more confidence to some learners because they knew that they couldn't accidentally break anything.

learning remotely in all of their lessons, and so relocating this part of Roman Day to be accessed from home seemed realistic.

Two sessions were held on the day. The first enabled pupils to explore the massive world of the Roman baths in Bath, in a build created by US-based teacher Ben Spieldenner and downloaded from the Minecraft World Library. Playing this in adventure mode meant that pupils could enjoy inspecting this realistic representation of Bath and were focused on exploration.

## “ OUR WEEKLY VIRTUAL MINECRAFT CLUB WAS A POPULAR ADDITION TO THE REMOTE LEARNING TIMETABLE

It also gave pupils clear targets of finding and exploring the various locations from the book, without becoming distracted by building. Linking to their English lessons, the pupils gathered adjectives as they explored. They recorded these on whiteboards and then used them in their story writing.

### Discovering virtual Roman worlds

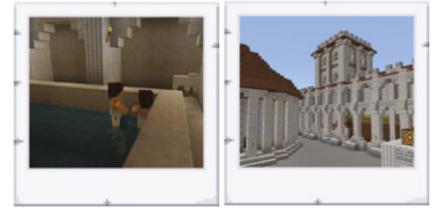
Before lockdown, the school had planned an exciting selection of cross-curricular activities for Roman Day, an annual school event that would be celebrated by all pupils in Year 3. It had originally been planned that pupils would spend time in their lessons exploring their own city, Exeter (*Isca Dumnoniorum*), within Minecraft, using a prebuilt world created as part of a project by the city's Royal Albert Memorial Museum. The museum had created a series of historically accurate maps of Exeter within Minecraft. Fortunately, this included a Roman map. By this point, pupils were

The second session explored Roman Exeter, and was created by Adam Clarke and Minecraft world-builders Blockworks as part of a project with the Royal Albert Memorial Museum. Being able to explore these worlds one after the other helped pupils to compare and contrast the Roman cities, and to learn about local history.

Teachers may wish to take advantage of a few tools from the game inventory that they may not be familiar with. The camera allows pupils to take photographs (or screenshots) as they travel. The portfolio tool allows them to store photos instantly, and they can be downloaded as PDF files for future reference. The book and quill tool allows pupils to add text before downloading it.

### Getting started with your pupils

It is easy to feel out of your comfort zone when contemplating the use of Minecraft in lessons, but the best way to get involved is just to start playing. The official website provides



■ Pupils wandered through the streets of Roman Bath. Photo credit: The world was created by Ben Spieldenner and Bonnie Graves; the screenshots are from the Minecraft Education Edition website

some helpful interactive tutorials, and teachers will probably find that their pupils are keen to share their own experiences. As teachers explore Minecraft with their pupils, they are bound to learn other useful hints and tips. Watching Ben Spieldenner's *Minewhat?* series and learning some of the keyboard commands helped me to develop my skills and knowledge.

Classroom mode gives the teacher control over pupils' actions. Destructive items such as TNT and lava can be turned off, to avoid pupils' creations being damaged, and if players get lost, the teacher can simply teleport them to another area. The text chat is a valuable feature, and has become a necessary tool when playing from within our own homes, with many pupils using it to offer or ask for help. Anything written in the text chat is recorded in chat logs, so it is also an excellent tool for promoting good online behaviour.

We teachers are always looking for ways to engage pupils, and exploring existing worlds in adventure mode is a great starting point for anyone keen to get involved in the exciting world of Minecraft and steadily build their confidence. (HW)



### SIOBHÁN MORGAN

Siobhán leads computer science at Exeter Junior School. She is a CAS Master Teacher with a keen interest in robots, Kodu, and Minecraft (@koduclassroom).



■ ESA astronaut Thomas Pesquet is this year's ambassador of the European Astro Pi Challenge

# ASTRO PI: READY FOR LAUNCH

**Claire Given** and **Tom Hadfield** share how young people can run their computer programs in space with Astro Pi

**T**he European Astro Pi Challenge gives young people in 26 countries the opportunity to write their own computer programs and run them on two special Raspberry Pi units — each called an Astro Pi — on-board the International Space Station (ISS).

Astro Pi is a collaboration between the Raspberry Pi Foundation and the European Space Agency (ESA). This year's ambassador of the European Astro Pi Challenge is ESA astronaut Thomas Pesquet. Thomas will accompany the Astro Pis on the ISS and oversee the programs while they run.

In the last challenge, a record 6,558 Astro Pi programs from over 17,000 young

people ran on the ISS, and even more young people are invited to take part in the new 2020/21 challenge.

There are two different Astro Pi missions — Mission Zero and Mission Space Lab — and participants can choose based on their level of coding experience.

## Mission Zero

In Mission Zero, the challenge is to write a simple program to take a humidity reading on-board the ISS. The reading is then displayed to the ISS astronauts for 30 seconds alongside a personalised message.

Mission Zero is designed for beginners and younger participants up to 14 years old. It can be completed online in around an

hour and doesn't require any previous coding experience or specific hardware. It's a perfect activity to introduce beginners to digital making; the time frame makes it ideal for a coding club activity or for children at home.

All Mission Zero participants who follow the challenge rules are guaranteed to have their programs run on the ISS in 2021 so the astronauts are able to see their messages.

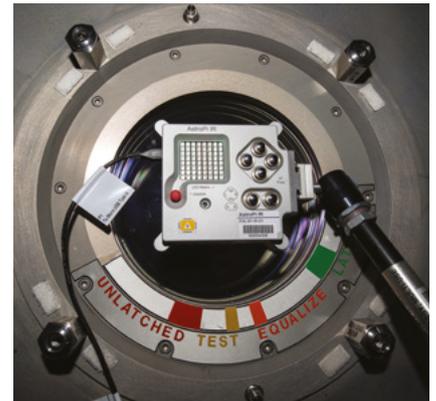
There are some exciting changes to this year's Mission Zero challenge:

- Participants will measure humidity on the ISS, instead of temperature
- Individual entries will be allowed, as well as teams of up to four people

The challenge will be open for entries until 19 March 2021.



■ The challenge offers young people the opportunity to conduct scientific investigations in space



■ An Astro Pi taking photos of Earth from the ISS

## Mission Space Lab

Mission Space Lab is aimed at more experienced or older participants aged up to 19 years old. It takes place in four phases over the course of eight months.

Teams of two to six young people will design and program an experiment, which will run for three hours on-board the ISS, to answer new scientific questions. These could relate to how being in space changes processes we are familiar with on Earth, or they could exploit the unique observations of Earth that can be made from ISS. The best experiments will be deployed on the ISS itself, and the winning teams will be able to analyse their experimental data and report on the results.

A member of one of the winning teams, from Lycée International de Londres Winston Churchill, a bilingual international school in the United Kingdom, explained why he enjoyed the project: "The best thing about taking part in Astro Pi was working together with my friends as a team to take my dream — space and coding — and put it all together."

There is a 23 October 2020 deadline for team registration for Mission Space Lab 2020/21, with an outline of an idea for an experiment. Teams must be supervised by a teacher or mentor.

## Who can take part?

For both missions, each participant has to be at least one of the following:

- Enrolled full time in a primary or secondary school in an ESA member state (see the full list at [astro-pi.org](http://astro-pi.org)), or Slovenia, Latvia, Canada, or Malta
- Homeschooled (certified by the national ministry of education or delegated authority in an ESA member state or Slovenia, Latvia, Canada, or Malta)

“ IT'S A PERFECT ACTIVITY FOR BEGINNERS TO DIGITAL MAKING

- A member of a club or after-school group (such as Code Club, CoderDojo, or Scouts) located in an ESA member state, or Slovenia, Latvia, Canada, or Malta

## Get involved today!

More information about taking part in the European Astro Pi Challenge 2020/21, including guidance for Mission Space Lab ideas, is available at the new and improved Astro Pi website, [astro-pi.org](http://astro-pi.org). <sup>(HW)</sup>

## SOME OF THE WINNING MISSION SPACE LAB ENTRIES FROM LAST YEAR

- Vidhya's code from the UK aimed to answer the question of how a compass works on the ISS, using the Astro Pi computer's magnetometer and data from the World Magnetic Model (WMM)
- Unknown from Externato Cooperativo da Benedita, Portugal, aptly investigated whether influenza is transmissible on a spacecraft such as the ISS, using the Astro Pi hardware alongside a deep literature review
- Space Wombats from Institut d'Altafulla, Spain, used Normalised Difference Vegetation Index (NDVI) analysis to identify burn scars from forest fires: they even managed to get results over Chernobyl
- Liberté from Catmose College, UK, set out to prove the Coriolis effect by using Sobel filtering methods to identify the movement and direction of clouds
- Pardubice Pi from SPŠE a VOŠ Pardubice, Czech Republic, found areas of enormous vegetation loss by performing NDVI analysis on images taken from the Astro Pi and comparing them with historic images of the location

# USING IMMERSIVE TECHNOLOGIES TO SUPPORT CHANGEMAKING

The Digital Learning Across Boundaries (DLAB) Developing Changemakers project is a pioneering three-year Erasmus+ project that combines digital making and changemaking

**T**he DLAB project is in its first year. It addresses the need to align European educational practice with ways in which digital technology is changing how and what we learn, and how this can be applied in education. It draws inspiration from the changemaker movement, which seeks to build the skills and attributes for individuals to find innovative solutions to society's challenges. We have worked with immersive technologies, such as augmented and virtual reality (AR and VR), to blend physical and digital learning

## FURTHER READING

Best, J. R. (2012). Exergaming immediately enhances children's executive function. *Developmental Psychology*, 48(5), 1501-1510. [helloworld.cc/exergaming](http://helloworld.cc/exergaming)

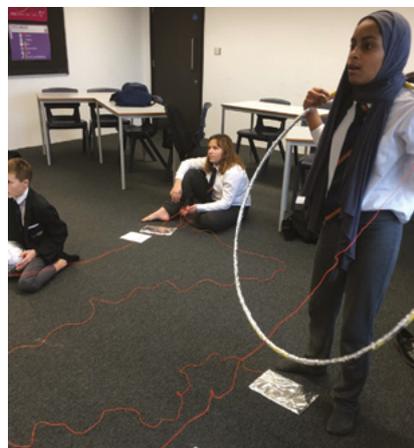
Faric, N., Yorke, E., Varnes, L., Newby, K., Potts, H.W., Smith, L., Hon, A., Steptoe, A., and Fisher, A., 2019. Younger Adolescents' Perceptions of Physical Activity, Exergaming, and Virtual Reality: Qualitative Intervention Development Study. *JMIR Serious Games*, 7(2), e11960.

Lin, C.Y. and Chang, Y.M., 2015. Interactive augmented reality using Scratch 2.0 to improve physical activities for children with developmental disabilities. *Research in developmental disabilities*, 37, pp.1-8.

Oh, Y. and Yang, S., 2010. Defining exergames & exergaming. *Proceedings of Meaningful Play*, pp.1-17.

environments and provide powerful and creative opportunities for international collaboration. There is a distinction to be made between VR, which completely immerses users in a digital world, and AR, which superimposes digital information or virtual objects onto the real world. AR allows for a reality in which virtual objects appear to co-exist in the same space with the real world. Recent advancements in these technologies have meant that they are now more accessible and more mainstream, and they are particularly well suited to children's learning.

This piece describes just one of four 'crossing physical boundaries' strands based on a subgroup of Danish, Norwegian, and English teams of university lecturers, teachers, student teachers, and Year 7 pupils working together on the theme of exergaming — using technology to facilitate physical exercise. Pupils and university students collaborated in



■ Pac-Man is being controlled by movements performed with foil-covered apparatus connected to electric fence wire, completing the Makey Makey circuit

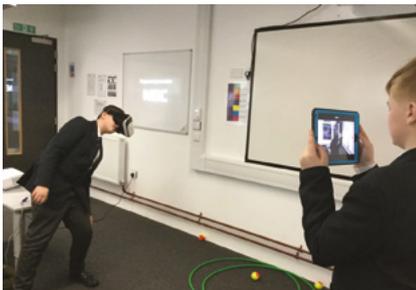
international teams with a partner classroom in another country to make games that stimulate physical activity and address the social issue of physical inactivity.

The English group explored the use of technologies with pupils at Northampton International Academy, working during designated international days and using video calls and TweetBeam to communicate with their partners in Norway and Denmark. The pupils developed the digital skills they needed to be creative with AR and VR, beginning by swapping 360° video and stills to gain immersive experiences of each other's spaces, and then combining a range of apps and tools to invent exergames for each other.

## What is exergaming?

Exergaming is particularly appealing to young people, and there have been many success stories including the Wii Fit, the Nintendo Switch, Pokémon Go, and Xbox Kinect. It has been mooted as a means by which physical activity levels can be improved (Oh, 2010 – see Further reading).

Best (2012) claims that as well as enhancing physical activity levels, exergaming develops children's cognitive function and that the immersive qualities of AR are more likely to distract participants from the physical exertion (Lin and Chang, 2015; Faric et al., 2019). Best (2012) noted that because of the whole-body gaming experience, cognitive functioning was required throughout the experience because of the rules, speed, and demands of the games. Participants are required not only to move their body to control the games, but also to partake in decision-making, problem-solving,



■ Playing virtual table tennis using a VR headset

categorisation, reasoning, and the use of logic.

We explored the potential for VR and AR in combination with other technologies to enhance the exergaming experience and provide a motivating medium for children to invent innovative solutions to problems they identified and cared about. In this sense, it is allied with social innovation education, linking the social problem of physical activity with the potential solution of exergaming as a context for changemaking.

### Technology to design exergames

One of the aims of the first international day of the project was to introduce the theme of technology supporting physical activity. We gave the pupils a carousel of choices so that they could explore the potential for designing their own games. This phase included:

- Making step counters using the micro:bit app on iPads
- Building exercise circuits using Makey Makeys, electric fence wire, and conductible materials
- Programming motion-sensing games in Scratch
- Using balance boards via the Plankpad app
- Designing gaming environments in CoSpaces Edu that can be viewed in VR or AR

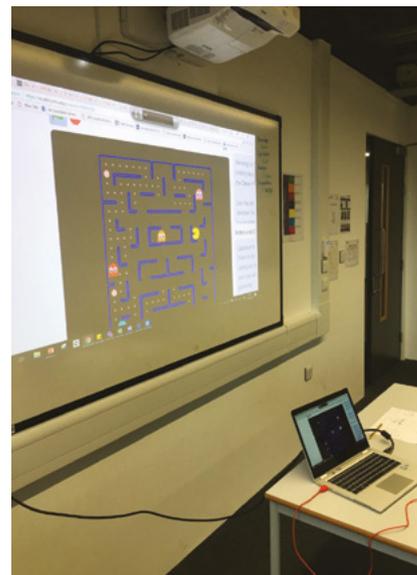
On the second day pupils added VR and AR to some of these technologies to

design their own immersive exergames. This resulted in a range of invented exergames to swap, test, and evaluate, such as:

- Virtual reality table tennis
- Balance boards in combination with VR
- Basketball coaching videos in VR using 360° cameras
- Makey Makey games
- A physical movement challenge using the Cardboard Camera app
- A micro:bit and Scratch remix of a balance board challenge
- A soccer video sensing game in Scratch

### Prototyping innovative solutions

The plan for the third day was for pupils to visit the university and work with a set of HTC Vives and CoSpaces. Unfortunately,



“ IT LINKS THE SOCIAL PROBLEM OF PHYSICAL ACTIVITY WITH THE SOLUTION OF EXERGAMING FOR CHANGEMAKING

the visit was cancelled due to coronavirus, and so just the students and lecturers trialled the combination of technologies. We wanted to use VR apps to design 3D objects within 360° environments; the aim was to develop our prototype solution of an imagined exergaming environment with an embedded physical challenge.

We trialled a combination of five VR tools and apps using the HTC Vive. First, we opened the app Tilt Brush to paint in 3D space using the handsets. This could be combined with imported sculpted 3D objects from Google Blocks, objects and scenes from the Google Poly library of 3D resources for VR and AR, and our own objects and scenes from CoSpaces. The

result was an imagined world containing an exergaming challenge that we could interact with in VR using the handsets.

Overall, we think the exergaming strand of the DLAB project this year has shown that the use of VR and AR tools in combination with other technologies can help pupils towards becoming creative digital makers and changemakers. Through collaboration with their international partners, they showed that they could use technology to have an impact and develop empathy and understanding of each other’s cultures. As one pupil said: “We haven’t changed the world forever, but we have made a difference and we have shown people that we can help with the future”. (HW)



### HELEN CALDWELL

Helen is a Senior Lecturer in Educational Technology, Teacher Education, and Online Learning at the University of Northampton, where she leads the Online Education MA and the PGCE Top-Up programmes. She is a member of the Technology and Pedagogy in Education Association (TPEA) committee (@helencaldwel).



### EMMA WHEWELL

Emma is a Senior Lecturer in Initial Teacher Education at the University of Northampton. She leads on physical education and is part of an Erasmus+ project, Digital Learning Across Boundaries (DLAB), an immersive technology-based project working with schoolchildren, student teachers, and lecturers across five European countries (@UONPEmma).



# HOW TO GROW A PROFESSIONAL LEARNING NETWORK

Whether you are newly qualified or an established educator, there are numerous benefits to growing your connections through an online professional learning network

**N**ewly qualified teachers may have heard the term 'professional learning network' (PLN) being thrown around during their training. A professor or a peer may have spoken of the benefits of getting connected on social media. Likewise, it is a term that established teachers may have heard, but may not be familiar with. These teachers are probably asking themselves, "What is a PLN?"

In short, an individual's PLN is a group of people in their professional field whom they follow online, particularly on social media. For teachers, these are peers with whom they can share resources and interact in order to grow as an individual and educator. Teachers can think of this network as their professional friend group that they can go to specifically for advice, resources, and development.

## Why do I need a PLN?

Teachers who are new to the idea of a PLN may wonder why they need one. They may feel daunted by setting up more than one social media account, not having enough time, or the fear that nobody will follow them.

We go to college or university to learn and grow, and learning from our peers is a big part of this. In a way, an individual's PLN could be considered to be their peers in the virtual learning realm, particularly with the instant connectivity of social media at their fingertips. These peers will all share similar passions, interests, goals, and endeavours. A teacher's PLN can become a source of inspiration and a place to fuel their passion for the profession. You can use your PLN to: ask questions; share ideas and resources; participate in discussion; participate in book studies; and support and encourage others.

## Growing a PLN

Most educators will probably have a professional home team already — those colleagues and work friends who they can bounce ideas off and share resources with. But, as the old saying goes, the more, the merrier! So, how to expand and grow a PLN? Social media is the key! I recommend creating separate professional and personal social media accounts. For an educator, this will help to promote them as a professional and to highlight those key teaching reflections. While this may seem daunting, most platforms make it easy to switch between accounts.

Some examples of platforms to get started with include: Twitter, Voxer, Instagram, Facebook, LinkedIn, and blogging platforms such as WordPress. Following relevant hashtags can be a great way of staying up to date with what's going on in a particular

field. Many platforms also facilitate 'chats', which are online discussions at a specific day and time using certain hashtags. There are chats specifically for education, and a schedule of these chats on Twitter can be found at [helloworld.cc/edu-chats](http://helloworld.cc/edu-chats). I recommend following other educators and hashtags in order to get inspired and gather resources from #eduawesome educators. Happy growing!

### Advice for student teachers

Firstly, we all need people to support, encourage, challenge, and push us to become an educator of excellence. A student teacher who is at college or university can often get that support from classmates, professors, or their friend down the hall. While this support is great, there may be times after graduation when these contacts can't be reached — they will be busy with their own lives, or at a different stage in life — and that's OK too. That's why having a PLN is so important. A PLN can provide help and support to teachers, as well as providing a platform to bounce ideas off. Student teachers can get one step ahead by creating their PLN now, thereby

third-grade (Year 4) class. It's important for teachers to share their areas for improvement too — employers are interested in seeing how candidates cope with challenges. Teachers might share their reflections on a biology lesson that didn't go so well and ask for suggestions, or pin a meaningful takeaway from a class to document their learning. Sharing learning far and wide is key!

Finally, having a PLN is like having access to a teaching mentor around the clock. For student teachers, this is particularly useful for getting ideas, resources, tools, and tips, anytime and anywhere. By posting a question, joining a Twitter chat, or engaging in a conversation, a student teacher will probably find someone there to guide them. Current educators and administrators are excited to help new teachers along the path of becoming educators of excellence. They want to share their knowledge and train up the next generation of educators!

So there we have it — three reasons for student teachers to start a PLN today. Of course, many of the above points can also be applied to established teachers. It is never too late to connect with others and learn something new. <sup>(HW)</sup>

## WHAT'S IN A NAME?

Creating a professional social media account needn't be a chore. Follow these tips to make your account stand out.

### Your account name:

- Choose a name as close to your real name as possible
- Make it professional, clear, and fun

### Choosing a bio image:

- It should just be you in the photo!
- It doesn't need to be glamorous: just make it fun and professional

### Bio info:

- This should be clear and concise, and show who you are as an educator
- Add some personality, such as your hobbies
- Add a header image
- Glitter! OK, so you can't literally put glitter on your page, but you can jazz it up with your header image
- Jazz up your bio with hashtags
- Consider adding emojis

You can find a free PDF guide on how to create a professional Twitter account at [helloworld.cc/rock-your-twitter](http://helloworld.cc/rock-your-twitter).

## “ FOLLOWING RELEVANT HASHTAGS CAN BE A GREAT WAY OF STAYING UP TO DATE

having that support system available to them immediately after graduation.

Secondly, a PLN can help students and newly qualified teachers with their job search. Hiring managers will often do a quick search on potential job candidates and applicants — and it is usually a person's social media accounts that come up first in the search results. Student teachers can make their online presence appear as positive and professional as possible by harnessing the power of their PLN. A hiring manager wants to see what a candidate is learning about and how they are applying that knowledge to help kids. A student teacher could demonstrate their imagination and competency by tweeting out a great bulletin board they made, or by sharing an image on Instagram from a hands-on activity they did with their

### SAMANTHA FECICH HANNAH SANSOM

Samantha has been a professor of education for over seven years. She is a podcast host, author, and co-author of several guidebooks for educators, including *EduMagic: A Guide for Preservice Teachers* and *EduMagic Shine On:*



*A Guide for New Teachers*. Most days, you can find Samantha in her office at Grove City College, Pennsylvania, working with students or teaching preservice teachers about educational technology or special education (@Sfecich).

Hannah teaches the third grade (Year 4). She is a certified elementary and special education teacher with a Master of Education in Reading and Math. Hannah is also co-author of *EduMagic Shine On: A Guide for New Teachers*, and co-creator of the *EduMagic Future Teacher Planner*. She loves the outdoors, donuts, and a good cup of coffee (@HannahJSansom).



# USING GOBUBBLE TO SUPPORT TRANSITION

With social distancing in place, helping new students to feel part of the school community presents a challenge; **Matt Lovegrove** shares how GoBubble has supported his students

**T**he importance of having a quality transition for primary school students who are starting secondary school is well known. Due to social distancing and other measures, the usual transition process wasn't possible this year. Although we hosted a video tour of the school and live events on Zoom for students and parents to meet staff, we wanted to find a way to help our students — who are joining us from over 40 different schools — to connect safely before they started.

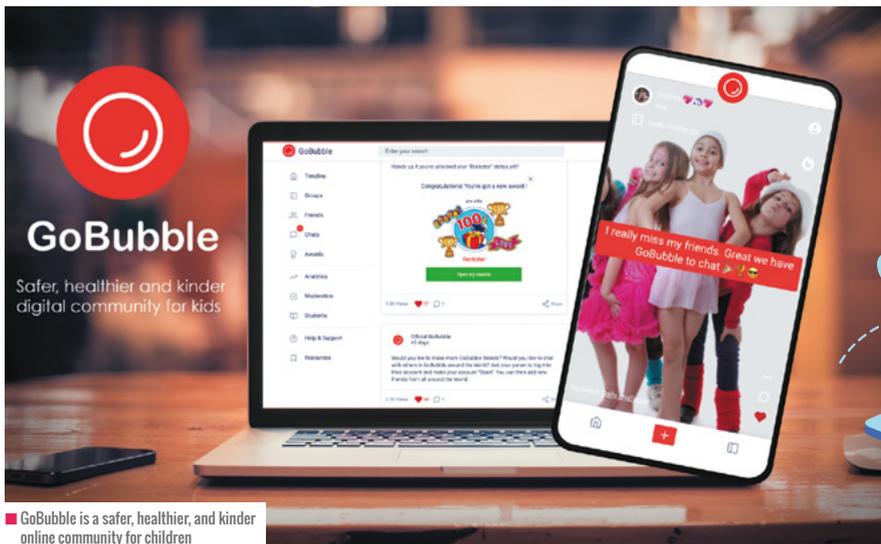
## Introducing GoBubble

I'd come across the social platform GoBubble before, having seen it

promoted through the eCadets' online safety programme. Created by ex-police sergeant Henry Platten, web-based GoBubble promotes itself as a "safer, healthier, and kinder digital community for teachers, kids, and parents to connect and communicate with colleagues, friends, and classmates". Currently, children under the age of 13 are welcome to join, but there are plans later in the year for students in Years 7–12 (ages 11–18) to be allowed access to the platform. A mobile app is in development too. GoBubble is free for schools, but there are also paid upgrade options available.

Students sign up with a unique school code after a school account is made,

meaning they can see and contribute to school groups and chat directly with each other. Within the groups, they can make bubbles (posts) to share their thoughts, ideas, and opinions, and they can reply to and like others' bubbles. Parents — who are required to verify their children — are able to see their children's interactions, as are school staff, who are also able to moderate comments. There are various other positive bubbles for students to view, including jokes and messages of hope that are posted by GoBubble users and staff. The positive nature of the community for students is uplifting; there's a real focus on mental health and positive online experiences.



“ THE POSITIVE NATURE OF THE COMMUNITY FOR STUDENTS IS UPLIFTING; THERE’S A REAL FOCUS ON MENTAL HEALTH

### How did GoBubble support our transition?

We wanted a way for our students to connect with each other safely before they started school — we found that GoBubble was ideal for this. After signing up, we notified all parents of the site and gave them our unique code. I was stunned by how many students signed up within hours; we now have the majority of our new cohort using the platform. I posted some bubbles asking them questions about what they were looking forward to about starting secondary school, and the interactions began. I then noticed that they were messaging each other about their hobbies, which school house they were in, and what they were looking forward to or worried about. It was great to see the interaction, and some of them have made friends with each other before starting school. Over the summer, I’m planning to check in regularly to answer any questions — I expect there’ll be an influx a few days before term starts!

For our students, GoBubble has proven to be invaluable — it has already supported the wider work we have done regarding transition and has helped students feel part of the community before they’ve even started.

### Continuing to use GoBubble

It is highly likely that we will continue to use this platform into the next academic year. GoBubble is such a well-moderated and positive place for students to be that I’d rather see them continue to use this than explore other social networks, which may not be as well moderated. In terms of wider reach, it’s possible for students to connect with other students via the app, making GoBubble an ideal platform for cross-school sharing and project collaboration. When they do start to sign up to other sites, the skills they’ve learnt through using GoBubble should benefit them and help keep them safe. (HW)

 Matt Lovegrove  
+2 days

It's the summer holidays! What are you hoping to do over summer?



### WHAT MAKES GOBUBBLE SAFE?

GoBubble has in-built technology that checks content before it goes live. A team of moderators are also on hand to ensure that content posted on the platform is appropriate. Children are only allowed to chat with other children, their parents, or their teacher, thereby reducing the risk of them being approached by an unknown adult. If a safeguarding concern is identified, the team makes contact with parents and schools to resolve the issue.



### MATT LOVEGROVE

Matt Lovegrove is the Head of Computing at Desborough College, Maidenhead. An ex-primary teacher, he leads transition between primary and secondary for his school and is passionate about online safety.



# A FREE US HIGH SCHOOL COMPUTER SCIENCE CURRICULUM

**Wendy Lint** explains why she chose resources from Carnegie Mellon University Computer Science Academy to challenge, encourage, and entice her students to learn

**I**n the rush to bring education online earlier this year, I was inundated with offers of resources from educational organisations, each of them claiming to have a curriculum that was the best choice to take my students through these uncharted waters. I am sure that many of my fellow computer science teachers received similar offers, and that it was overwhelming at times! Many educators will likely have sorted through all these and similar offers to try and find the best way to teach their

students; after all, as educators it is our mission to search for interesting, high-quality content that will ensure a thorough understanding of the subject.

It was great to have most of these resources free of charge, if only for a specified time frame. Teachers could select the curriculum that best fit their individual needs and requirements, without having to worry about getting administration to approve within their department budget. Hallelujah! From a business standpoint, this

was certainly a smart move. If teachers adopt a particular curriculum now, it is likely that they will also want to purchase it for the next academic year.

Even though I was certain that my curriculum was fine for remote learning, I decided to take a look at other curricula and see how they have changed and what has been added since I chose my curriculum three years ago.

In the end, the curriculum I have been using for three years is the one I chose to



# Computer science free for everyone, designed for you.

CMU CS Academy is an online, graphics-based computer science curriculum taught in Python provided by Carnegie Mellon University. We create novel, world-class Computer Science education for your classroom —and it's entirely free.

[Sign up now](#)



## AS EDUCATORS IT IS OUR MISSION TO SEARCH FOR INTERESTING, HIGH-QUALITY CONTENT TO USE WITH OUR STUDENTS

stick with. Carnegie Mellon University has developed a free introductory computer science course (CMU CS Academy), which is taught in Python. The course offers high-quality instruction in the development of programming skills, exercises with engaging graphics that are interesting and fun, an opportunity to focus on individual creativity, and the ability to challenge even the best student.

### Fostering higher-level thinking skills

Of course, not every student who takes an introduction to programming course will want to pursue a future career in software development. Not every student is even going to like programming. So why worry about the quality of your curriculum? Don't we just want to give them a taste of coding so that they can understand the digital world around them a little better? Not in my opinion. That would be a

disservice to all students, in this era of twenty-first-century learning.

We need to prepare our students for success in their future endeavours. High school computer science curricula that just teach a student to use syntax and allow them to randomly code — or even worse, drag and drop code until they get it right — is like teaching a student words without explaining the difference between an adjective and a noun or allowing them to write sentences. If we want our students who are entering third-level computer science programmes to have a competitive advantage in the field of software development, we need to ensure that the quality of their learning is of the highest standard. To go a step further, we need to ensure a high standard if we want enough students to be capable of entering these fields in the first place.

Beyond providing students with a good

foundation in programming, a good-quality curriculum can also reinforce a student's ability to think critically and problem-solve in an ever-changing world. In my experience, I have found the CMU CS Academy's flagship CS1 curriculum to be excellent in terms of fostering higher-level thinking skills and creativity in my students. They have created a curriculum in which problem-solving, critical thinking, and comprehension skills are reinforced, challenged, and honed to the highest of levels. Students can use these skills to progress through differentiated and levelled exercises, and design and create what is uniquely their own work.

### What is essential to a good computer science curriculum?

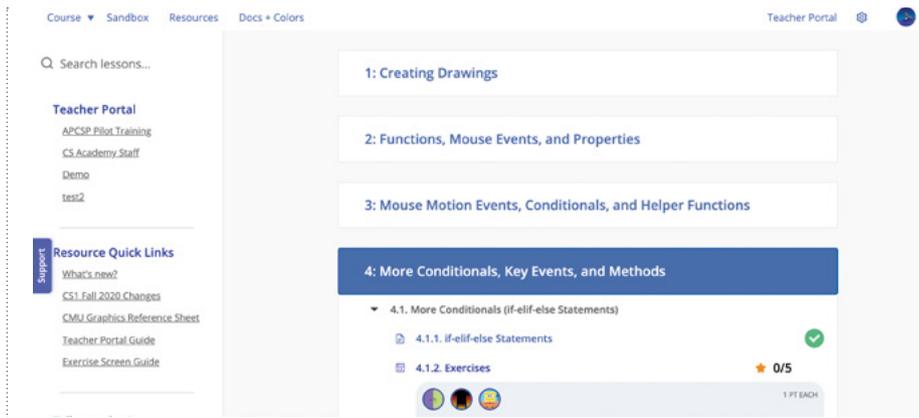
#### Graphics

We need to offer high school students graphics that are interesting, engaging, and challenging, and the CS1 curriculum makes use of good graphics from the very first lesson. As students learn about syntax, they learn to use graphics as tools. From the start, debugging is as much a visual act as it is a check for errors during compilation. It often makes more sense to 'see' the error than to have to search through text for it. I find the exercises visually interesting and believe

▶ that they provide various levels of challenge for students. At the end of each unit, students get to create their own graphical designs and animations, which helps to encourage their own unique creativity.

### Event-driven programming

What drives most high school students to learn about computer science? We all know the answer: games! And what is involved in all the games that students like to play? Great graphics, and interaction with the graphics. When educators introduce events



■ The Teacher Portal offers everything a teacher could possibly want

## WHAT DRIVES MOST HIGH SCHOOL STUDENTS TO LEARN ABOUT COMPUTER SCIENCE? THE ANSWER: GAMES!

to their students early on, they are able to interact with their projects sooner. Starting in unit two, the CS1 curriculum introduces mouse events, allowing students to make their graphics do something. This has helped my students to become even more engaged and has made them want to learn more events. Many curricula do not present event-driven programming at all, and if they

do it is often after most other programming concepts have been taught. By that time, many educators will have lost most of their students to boredom or frustration. Adding events early is a good incentive for students, as it will enable them to do more; they can learn the necessary programming concepts in order to progress through the units and create cool animations and games.



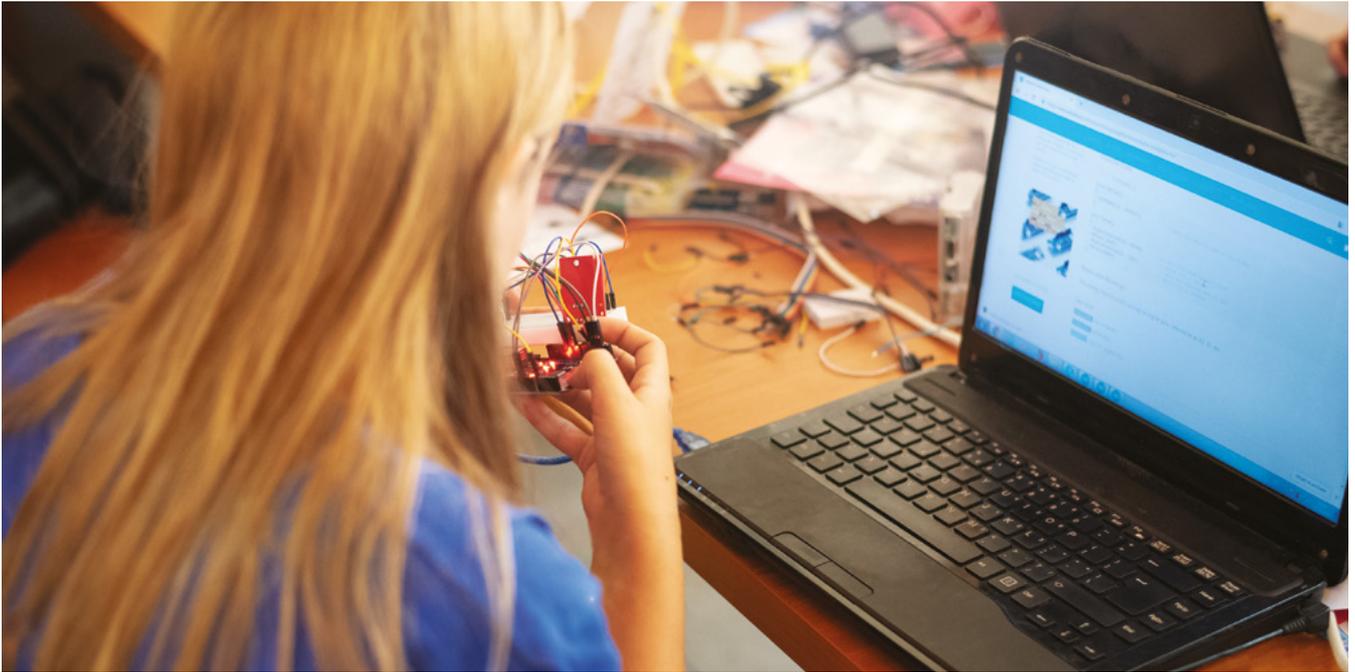
### Critical thinking and problem-solving

Problem-solving and critical thinking refer to the ability to use knowledge, facts, and data to solve problems effectively. For our students, this doesn't mean that they need to have an immediate answer — it means they need to be able to assess problems and find solutions. According to the US Department of Labor, this is one of the critical skills employers are looking for in the present-day workforce. Furthermore, this is a skill that all employees will need, and not just computer science employees.

For my students, I have found that the CS1 curriculum helps with the development and strengthening of these skills. Each exercise contains prewritten code and/or commenting and hints that help to develop and reinforce a student's ability to think critically and solve problems to complete the exercise successfully. It is not enough for a student to simply code an exercise until it produces the solution on its own. They need to use what given information they have, to find and create the solution as they are directed. As logic becomes more and more a part of the exercises, students need to use their critical thinking skills at higher and higher levels to solve the problem that the exercise presents.

### Teacher support

What teacher doesn't want tools that can help to relieve the burden of mundane tasks? Whether teaching remotely or in the classroom, we all want to be more available for the important things: answering students' questions, differentiating learning, and



“ **WHETHER TEACHING REMOTELY OR IN THE CLASSROOM, WE ALL WANT TO BE MORE AVAILABLE FOR THE IMPORTANT THINGS**

providing supportive instruction. The tools provided by CMU CS Academy have allowed me as a teacher to determine classroom pacing, collect individual academic data on each student, access student work, limit the ability of students to share or copy each others' work, and autograde exercises.

The Teacher Portal offers everything a teacher could possibly want, as well as the ability to pick and choose the tools and resources that best suit their teaching style. While teaching my students remotely earlier this year, the hardest thing for me was to know how much effort my students were putting into their work. Then CMU CS Academy added a feature called the Daily Usage Chart, which allowed me to know how long each student had actively used the

site. This allowed me to track those students who were not working on the curriculum as much as they needed to in order to succeed.

### Cost

One major benefit of the CMU CS Academy offering is that it is free. Not only do you receive the curriculum and all teacher support tools, there is no cost for professional development through Carnegie Mellon University, and there is no cost for using their resources for assistance through the year.

### Final thoughts

I have always found programming a fun challenge. When I began teaching, I noticed how little students think — truly think — when they are learning to program. Get those synapses firing! More and more I find that computer science curricula are focusing on the fun of coding and not on the thinking that is necessary for deep and lasting learning. Unlike when I learnt to program (before the internet), students today have the ability to simply change code haphazardly until it works. Skills such as writing flow charts,

hand tracing through code to find logic errors, and testing with all boundary conditions seem to be things of the past. However, the more students do use them, the more these skills help them to find logical errors and create more efficient programs.

While teachers and their students will all have different requirements, the CMU CS Academy has certainly worked well for me. In my experience, it promotes proper learning, and facilitates and hones thinking skills. Although we are teaching twenty-first century learners, our curricula should still be reinforcing the value of thinking in all areas. Our students may be keen on using fun and engaging activities to increase their knowledge base these days, but we should never choose learning that does the thinking for them just because it looks fun. (HW)

## RELEVANT LINKS

- Carnegie Mellon University Computer Science Academy:  
[helloworld.cc/cs-cmu](http://helloworld.cc/cs-cmu)

## WENDY S LINT

Wendy has been a Mathematics and Computer Science teacher at Greater Latrobe Senior High School since 2007. She holds a bachelor's degree in Computer Science and a 7-12 Mathematics certification. Wendy is a CSI Academy Certified Educator for levels 1 and 2 with Carnegie Mellon University and is also an Academy Certified Trainer. She was recently a co-presenter at the CSTA 2020 Virtual Conference.

# AN INTRODUCTION TO THE WORLD OF ESPORTS

Even before lockdown, a large proportion of 12- to 15-year-olds were playing video games regularly. Isn't it time educators started looking at video gaming and esports differently?

**E**sports is organised, competitive, player-to-player video gaming, with people playing against each other online or at live spectator events. Competitors are both amateurs and professionals. It is open to all; anyone with an interest can become involved. Most esports is team-based, and games are always played against another person or team of people. This makes it a social activity — which of course is in contrast to the stereotype of a gamer in their bedroom, playing against a computer. In the UK, esports is classified as games, much like chess and bridge. It is not classified as sports.

Esports can be played on PCs, consoles, and mobiles. Depending on the game, the format can be 1v1, 2v2, 3v3, and so on. There are currently around 35 different video games that are recognised as esports, including multiplayer online battle arena (MOBA) games such as League of Legends and Dota 2; first-person shooters (FPS) such as CS:GO, Call of Duty, and Overwatch; fighting games such as Street Fighter and Super Smash Bros; and sports-based titles including FIFA and Rocket League.

During the last academic year, we saw just under 300 teams from around 80 UK schools and colleges compete in the British

## How will esports benefit young people?

Esports can engage a wide demographic of young people in team-based activities. This may include young people who are not interested in traditional team-based activities such as sport, music, or drama.

When practised in moderation, as part of a balanced lifestyle, esports is also a beneficial alternative to consuming passive media, such as watching television or scrolling social media. It has explicit links to computing education, STEAM subjects, and the development of digital skills. It also promotes character development, in the same way as traditional team-based activities.

## THE ESPORTS INDUSTRY

Global esports revenues reached around \$1.1 billion in 2019, a year-on-year growth of over 26 per cent. Revenues are still on the up, and are expected to reach \$1.8 billion (over £1 billion) by 2022. In the UK, esports is the second fastest-growing entertainment and media sector (21 per cent year on year) and is predicted to be worth £48 million by 2022 ([www.newzoo.com](http://www.newzoo.com), [www.ukie.org.uk/reports](http://www.ukie.org.uk/reports)).

At the professional level, leading global teams and players can earn significant sums in wages and prize money playing in online and live tournaments. For example, the team of five who won last year's Dota 2 'The International' tournament won \$11 million. Many traditional sporting organisations, like Manchester City FC and Barcelona FC also now have their own esports teams.

**“** WHEN PRACTISED IN MODERATION, ESPORTS IS A POSITIVE ALTERNATIVE TO WATCHING TV OR SCROLLING SOCIAL MEDIA

Esports Championships (or 'Champs'). The British Esports Association has also led a groundbreaking esports project in alternative provision schools. Through this, we have collected many case studies about the positive impact esports has had on young people. These impacts range from significant improvements in attendance and behaviour and positive engagement with members of staff, through to helping young people to engage with Higher Education and career pathways linked to esports and wider digital industries. Through harnessing young people's enthusiasm, passion, and commitment to esports, educators can use it as a modern, very relevant vehicle to motivate and engage.

Participating in esports promotes leadership skills and teamwork, boosts social and communication skills, and helps to develop problem-solving, decision-making, and multitasking abilities. It can also help to improve digital skills, develop friendships, improve reaction times, and increase resilience. Of course, it also provides a number of intrinsic emotional rewards, helping to make students happy!

## Careers and transferable skills

As the esports industry continues to grow, more and more jobs and career pathways are being created, creating a demand for people with specific skills. Roles within the industry include professional player,

# BRITISH ESPORTS ASSOCIATION

The British Esports Association is a not-for-profit organisation established in 2016 with government backing, to support and promote esports in the UK. As a national body, their aims are to foster British talent, increase the awareness of esports, and provide expertise and advice. They help to educate the general public - including parents, educators, media, and government - about what esports is and its benefits ([www.britisheports.org](http://www.britisheports.org)).

coach, referee, and production crew, as well as, for example, social media manager or events manager. The knowledge, skills, and experience that young people develop by studying and participating in esports are very much transferable, and will only become more so as our industries become more digital.

## Education pathways

Esports is already popular with many young people, and they can now pursue qualifications in the subject. Our team at the British Esports Association has partnered with Pearson, the global education publisher, to develop the first



■ Farnborough students at the championships

esports qualification of its kind in the world: the BTEC in Esports. The Level 3 BTEC is fully funded by the Education and Skills Funding Agency, and over 65 further education colleges have already registered to deliver the qualification from September, although the course only launched at the end of April. We are now working on an entry level qualification, Level 1, Level 2, and international equivalents. For more information on the BTECs in Esports, please visit [helloworld.cc/pearson-esports](http://helloworld.cc/pearson-esports).

There is also a small but growing number of universities offering academic undergraduate and postgraduate programmes, including Chichester University, and Confetti Institute, which is part of Nottingham Trent. Furthermore, in the USA, there are now over 200 universities offering esports scholarships to their students.



■ Students from Farnborough sixth form focus on their games

## The British Esports Championships

In the Champs, teams play against each other in weekly online fixtures across three different age-appropriate games: League of Legends, Overwatch, and Rocket League.

In the 2019/2020 season, just under 300 teams competed, from over 80 different schools and colleges. As a result of lockdown, our live grand finals were streamed live on Twitch, the Amazon-owned platform, rather than at the Insomnia66 gaming festival as planned. The Rocket League final, between Glasgow Clyde and Sunderland Colleges, was seen by almost 2,000 viewers.

The 2020/2021 championships start at the end of September; schools and colleges can register their interest by visiting [britisheports.org/championships](http://britisheports.org/championships). <sup>(HW)</sup>



■ The Fortes girls team



## TOM DORE

Tom is Head of Education for the British Esports Association, the UK's not-for-profit, national body for esports. Tom is also a part-time teacher, with 15 years' experience across state and independent schools ([@british\\_esports](https://twitter.com/british_esports)).



# A WARM WELCOME TO THE WORLD OF COMPUTERS

**Miriam Tocino** shares the idea behind *Zerus & Ona*, her unique book series designed to get young children interested in technology through the power of books

**I**n 2013, I quit my job as an architect and stayed home for six months, teaching myself how to code through online courses. I then became a software developer, before going on to become a coding teacher. Three years ago, when I had my son, I started thinking about the way in which I'd like to introduce him to the world of computers. How would I go about it?

I started by looking at what we were already doing at home with him, which was reading books. Children start building their reality from books — when they read, their whole life becomes that book. We often use computers to introduce children to the wider world, but I wanted to use books to welcome him to the world of computers — without the need for a screen.

It was during a discussion with my husband, who is a game programmer, that the idea for *Zerus & Ona* first took shape. “What if we read him stories that take place inside a computer? About how computers do maths, or graphics, and how

the internet works? And what if they were told by a zero and a one? They could live in the Binary World!”

That's how *Zerus* and *Ona* were born. They are the two main characters of a picture book series about computer-related topics, with the aim of getting young children excited about technology and helping them expand their vocabulary and their knowledge of computer science.

### Seeking creativity in technology

I haven't always been this passionate about computers. My dad wanted me to go into computer science but, as a child, I always thought computers were grey and boring. I wanted to do something creative and colourful, something that helped other people around me. So instead, I went to college and studied architecture. It took me more than 30 years to find the creative, colourful, human side of technology. I don't want the same thing to happen to today's children. That's why we need to come up with fresh

and innovative ways to introduce young children to the world of computers, and to reach as many of them as we can so they learn how exciting it can be!

We now live in a world where children are introduced to computers at a younger and younger age, but computers are often seen as daunting by both parents and teachers. We need to take those fears away, and to talk to our children about technology so that they become familiar with it and don't suffer from those same fears.

After speaking to parents and teachers, it seems that many girls in particular still see computers as I did. With *Zerus* and *Ona* I want to intervene and save those girls. They're a tool my dad didn't have when he was encouraging me to become interested in computers. Of course, the books aren't just for girls — it's important to reach out to boys too; that's why I chose two main characters, because I want to portray an equal relationship between a boy and girl in dealing with computers, and so that both girls and boys can identify with the characters.



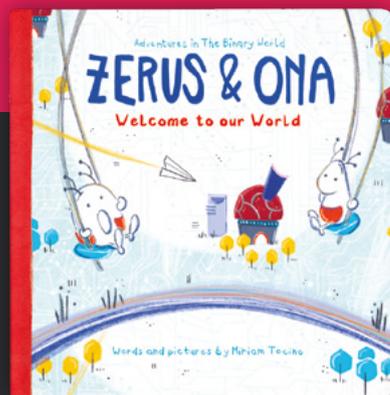
■ Storytelling and illustration are effective vehicles for introducing children to computer science without the need for a screen

## A STORY ABOUT FRIENDSHIP

Zerus and Ona live inside computers with millions of other zeros and ones, in the Binary World!

They're now best friends and like to do everything together. But there was a time when they didn't know each other. How did Zerus and Ona first meet?

*Welcome to Our World* will be published this autumn (Binary World Productions, £17,50), and is available for preorder at [www.zerusandona.com](http://www.zerusandona.com).



### Understanding computers is a superpower

Children need to know that understanding computers and how they work will give them superpowers! This understanding will become part of the toolkit they use to express themselves and create their own world, in whatever way they choose — whether they become a dancer, a scientist spending their time in the lab, or an astronaut who goes into space. Not every child needs to become a computer programmer, but as adults they will undoubtedly need computers in some way — even if they just require a website. And we

start by reading the book with your children, so they get to know Zerus and Ona. You could talk about zeros and ones, and how they live inside computers; then introduce them to the song that accompanies the book. They can learn it by heart, and dance to it for a week.

Once they're reciting the song, you can say, "Oh, did you know they use code to play the music? Let's see how they do that!"

You can then show them some code pieces for running and making sounds. So you've now sparked their curiosity for STEM, and when it's time to learn some coding,

I have a passion for finding unexpected and surprising connections between technology and the world around us. And these are the conversations that I wish to see happening more and more between parents, teachers, and children. Technology is everywhere right now, and it's becoming easier every day to find examples that connect with children's interests.

You can order the books in the Zerus & Ona series, and learn more about them, at [zerusandona.com](http://zerusandona.com). To subscribe to The ABC of Computers newsletter, go to [helloworld.cc/zerusandona-newsletter](http://helloworld.cc/zerusandona-newsletter). (HW)

“ CHILDREN NEED TO KNOW THAT UNDERSTANDING COMPUTERS WILL HELP THEM TO CREATE THEIR OWN WORLD, IN WHATEVER WAY THEY CHOOSE

need to teach this in such a way that they see the computer as a friend, full of possibilities and challenges. Computers are everywhere — they're part of children's culture, and part of their upbringing.

### Sparking children's curiosity

Illustration and storytelling are two of the things I loved the most when I was little. And when learning something new, the vehicle of communication becomes as important as the topic we're trying to teach, and it enables us to reach our children.

Let's take the next title in the Zerus & Ona series as an example. The book is in the form of a poem and a song that children can learn, sing, and dance along to. You can

your children are already interested.

To accompany the Zerus & Ona book series, I created The ABC of Computers, a free series where children can build up their knowledge and learn about computer technology, week by week. A recent chapter introduced children to the computer's central processing unit (CPU). You can explain to your children that the CPU is like the brain inside their computer, and it's in charge of controlling its other parts. A good idea is to take a human example. Tell them that every time they want to move a finger, it all starts in their brain. The brain sends instructions to that part of their body, and tells it to move. The CPU plays a similar role inside their computer.



### MIRIAM TOCINO

Miriam is a coding teacher, programmer, and mum dedicated to making computers more approachable, friendly, and easy to understand. She is the author of *Zerus & Ona*, a book series that teaches young children about the digital world without the need for a screen (@miriamtocino).

# COULD CURRICULUM DESIGN BE AS SIMPLE AS ABC?

It's easy for online lessons to rely heavily on passive activities such as watching videos. A curriculum design process known as ABC, developed by UCL for use in universities, is helping classroom teachers review and plan more balanced online learning activities

**A**rena Blended Connected (ABC) curriculum design is a popular and well-respected process used in universities across the world. Based on Professor Diana Laurillard's research and designed and developed by UCL, the process guides educators to create or adapt sequences of learning modules to include online and blended elements. Rather than focusing on which technology is going to be used, the process centres decisions around the type of learning that will take place.

Earlier this year, the Computing at School (CAS) Research working group ran a series of training sessions to introduce teachers at primary and secondary schools to the

process, as it had potential benefits to support the planning of learning during school closures. Working with the team at UCL, CAS Research developed training sessions that presented the basics of ABC. A group of teachers then set to work trialling and adapting ABC to their schools' needs.

## ABC explained

ABC is based on the idea that there are six learning types (not to be confused with the now-debunked visual, auditory, and kinaesthetic learning styles): acquisition, investigation, discussion, collaboration, practice, and production. Educators review the type of learning that they would like to occur

for a particular learning objective and design an activity to meet the learning type need.

To help educators, the ABC method makes use of cards with suggestions of potential activities for each type. The potential activities are either a face-to-face option or an online option. As the computing teachers who were taking part in the ABC training started using the standard ABC cards, they soon realised that they needed to create their own sets for their own situations. Rather than having just a face-to-face and an online option, the group decided to include three online options. These were low-tech, mid-tech and high-tech: some teachers, and their students in

### Acquisition

Learning through acquisition is about what learners are listening to: hearing a lecture or podcast, reading from books or websites, or watching demos or videos.

### Collaboration

Learning through collaboration embraces mainly discussion, practice, and production. Building on investigations and acquisition, it is about taking part in the process of knowledge building itself.

### Discussion

Discussion requires learners to articulate their ideas and questions, and to challenge and respond to the ideas and questions from the teacher, and/or from their peers.

### Investigation

Investigation encourages learners to take an active and exploratory approach to learning, to search for and evaluate a range of new information and ideas.

### Practice

Practice enables knowledge to be applied in context. The learner modifies actions according to the task, and uses feedback to improve. Feedback may come from self-reflection, peers, the teacher, or from activity outcomes.

### Production

Production is how the teacher motivates learners to consolidate what they have learnt by articulating their current conceptual understanding and reflecting on how they used it in practice.

■ Not to be confused with learning styles, the learning types in ABC are not distinct for a specific activity. Source: UCL

## AN EXAMPLE OF AN ABC CARD

<b>Creator of card:</b> Matthew Wimpenny-Smith	<b>Date created:</b> 19 May 2020	<b>Context (e.g. phase, subject, school):</b> Primary KS2	
<b>Card name:</b> Practice			
<b>Current activity</b>	<b>Alternative activities</b>		
	<b>Low-tech</b>	<b>Mid-tech</b>	<b>High-tech</b>
Worksheet-based task is photocopied and handed out in class	Worksheet is converted to digital format and emailed to learner. Learner prints and completes worksheets then photographs or scans and emails back.	Worksheet converted to editable file and then posted on Google Classroom as one copy per child, or on Seesaw app. Learner completes digitally via keyboard or digital inking.	Worksheet becomes Google form or other web-based activity for the learner to complete, for example interactive Seesaw activity.
	Prep time: quick Feedback time: slow	Prep time: some initially Feedback time: quick and all digital	Prep time: high initially Feedback time: could be very fast through self-marking

some schools, had the skills and experience to use quite complex software, whereas in other situations a more low-tech option was needed. Sets of context-specific cards were created by two primary teachers and two secondary teachers. Since then, a set of cards has also been created for delivering professional development.

### How was ABC used and what were the challenges?

The computing teachers who trialled ABC found the cards were a great way to help them and their colleagues plan for remote teaching. The cards have been used for quick reviews of current planning and to help develop new activities.

ABC has been used both by individual teachers to review their lessons, and by groups of teachers. In one school, the cards have been very popular across the whole school, and in another context, they are being used to support professional development for teachers across many schools. As well as being used for planning computing units of work, some of the teachers have also used the ABC process for reviewing other subjects, including

English and maths. In several primary settings, both specialist and generalist teachers have started to use cards. Teachers have used them not only to work out remote activities, but also to help them flip between remote and in-school delivery.

When developing the cards, teachers audited the content to be delivered and the resources that were usually used. The

Teachers who trialled ABC noted that those schools who had already implemented a standardised approach to remote learning (such as using Google Classroom, Microsoft Teams, Seesaw learning journals, etc.) were at a great advantage. However, ABC can also help schools that are new to remote teaching. Sets of ABC cards have been created for

**“ SOME SCHOOLS USE COMPLEX SOFTWARE; OTHERS NEED A MORE LOW-TECH OPTION ”**

process focused them on thinking about alternative pedagogies. Approaches such as flipped learning were encouraged, moving away from an emphasis on passive learning (acquisition) through watching videos. Some teachers also reported that the process linked nicely with other frameworks for integrating technology in the classroom, such as the SAMR (Substitution and Augmentation, Modification and Redefinition) model and the T-PACK (Technological, Pedagogical, and Content Knowledge) model.

different technology options, and these can be shared, giving less experienced teachers a menu of ideas to select from.

One of the main benefits of the ABC approach is that it allows for the development of remote teaching that isn't just centred around acquisition, production, and the recall of information and facts, but can expand into collaboration, investigation, and discussion. ABC particularly highlights where learning is passive, and also supports teachers to include assessment.

Embedding formative and summative **▶**

assessment is a significant challenge in designing remote education. Often, quite high-tech options are needed to provide timely feedback to pupils. Learning platforms such as Google Classroom can be used for online marking. Rubrics can be set up and shared with pupils, for self-assessment, questions asked in live lessons, and quizzes used for asynchronous learning. Teachers have found that ABC has helped them tackle the assessment challenge by pinpointing potential strategies and opportunities for introducing assessment.

Other challenges to introducing ABC have been not about the process itself, but more about the contexts for learners and schools. One such challenge has been the range of pupils' access to technology, while another involves safeguarding restrictions. Some schools found their pupils had to share devices with either older siblings or



## “ ABC PINPOINTS OPPORTUNITIES WHERE ASSESSMENT CAN BE INTRODUCED

parents who were also working from home. What types of device pupils had access to, and when, could not be guaranteed; for example, some students had access to a phone or tablet device only in the early evenings. The low-tech, mid-tech, and high-tech options on the cards helped teachers to begin to address these technical and timing issues.

However, to know what low-tech, mid-tech, and high-tech would look like, teachers needed to ask families what devices would be made available to pupils, and when. It would therefore be useful, as part of the ABC process, to include a first step of auditing the devices available to your pupils. The audit needs to be done before you start your cards. Similarly, you also need to take into account the devices and platforms available to teachers, and their level of expertise.

Further challenges for the introduction of ABC are those of CPD and time. Teachers need training and time to enable them to develop these cards in preparation for the next period of remote education. In one school, senior management is concerned about how long the process will take, and worried about the additional teacher workload. However, the

teacher trialling the process is looking at how ABC can be integrated into PPA time once training has been delivered.

### Matthew Wimpenny-Smith's account of using ABC

“Up until the recent pandemic, my primary school, as I am sure is the same for many others, had only been dipping their toes into the use of remote learning tools such as using online software for homework. But as we know, this all changed very rapidly, and the use of remote learning was brought sharply into focus. Luckily, the school that I work at had invested in IT and edtech. We had set up Google Classroom, albeit on a small scale, but we hadn't planned for complete remote education. A significant next step for my school is to establish the policies and processes needed for remote education, including considering remote options as part of everyday planning. With this in mind, I have created a set of ABC cards for my school, for computing and other subjects, including English and maths. We will be using these to support our planning this academic year so that we are better prepared for the next remote teaching requirement.”

### Taking it further and training in ABC

You can read about the original ABC process on the UCL website ([blogs.ucl.ac.uk/abc-ld](https://blogs.ucl.ac.uk/abc-ld)); to find out how it has been adapted to our current computing school context, look at the Computing at School website ([helloworld.cc/abc\\_cas](https://helloworld.cc/abc_cas)). There is a resource describing ABC, and sets of example cards, along with templates for teachers to use to create their own sets for their own schools. A set of resources ('CAS in a box') has been designed to share the ABC process with teachers. This CPD will be shared with the community of practice leaders in the autumn 2020 term. We hope that community leaders will cascade this to their local communities over the following terms. Please contact Jane Waite (@janewaite) if you would like more information or if you would like to attend training on ABC for schools. (HW)

JANE WAITE ,  
MATTHEW  
WIMPENNY-SMITH,  
CLAIRE BUCKLER,  
CALVIN ROBINSON  
& NIC HUGHES



**OLIVER QUINLAN** RASPBERRY PI FOUNDATION

# THE HARDEST THING ABOUT TRAINING IS TIME

How can we recreate the dedicated focus of a day of professional development while face-to-face courses are on hold?

**I** have been working on teacher professional development for years, talking to educators about their needs, setting up courses for them to take, and surveying them about the impact of training. Whenever we touch on the challenges of professional development, there is one area that comes up over and over again: time.

Educators are all busy; it's in the nature of the role. When you are responsible for the learning and development of young people, there is always more to do. Yet it's essential to make time for developing skills and knowledge, getting better at the job, and trying out new things for yourself.

When I was a teacher myself, the standard model of professional development was the one-day course: a day spent out of school to focus on a particular area of practice. At the moment, face-to-face courses like this look as if they may be on pause for a while.

I attended some very good courses, and some that were not so good, but I often felt the best thing about them was that with a place to go to and someone else teaching my class (and with it being socially unacceptable to use the time to get through marking), it forced me to focus on professional development for a certain amount of time.

There are many other models available for professional development: online courses, reading books and discussing them with others, or even just reflecting and planning how to get better, can all educate and inspire. These all give value; but what they don't usually give, that

a one-day face-to-face course does give, is a structure that helps you to make time for your own learning.

## **A commitment to professional development**

During the recent lockdowns, we saw a surge in the numbers of people taking our Raspberry Pi Foundation online courses. Many people were facing serious challenges at this time, but some seemed to find they nonetheless had the time to engage more with professional learning, and it's worth thinking about how we can make time to keep engaging with professional learning once we've moved past this current crisis.

Making a commitment to spend some dedicated time on it, as with a face-to-face course, is the start. Try to set aside a good chunk of time, if possible a full day; if you can't manage that, even setting aside a few hours on particular days to commit to focusing on professional learning can work well. It does need to be a commitment, though — something that you don't allow other work such as marking, planning, or other people's priorities to encroach on. See if you can negotiate some time out of classes to focus on your professional development. If you would normally be able to attend a course it's worth finding out if you can at least get the time this would have given you.

A chunk of the value of face-to-face courses is the commitment you make to spend uninterrupted time on them. If you can replicate this, and find some of the many great resources to engage with, you should be on the way to achieving some valuable professional development. **(HW)**

## AGE RANGE

7-10 years

## YEAR GROUP

Years 4-6

## LESSON TYPE

Visual/block-based coding

## REQUIREMENTS

- A computer or tablet capable of running Scratch
- Scratch 3 (either online or offline)

# AN ENVIRONMENTALLY -CONSCIOUS GAME

Save the Shark is a fun new project from the Raspberry Pi Foundation that introduces learners to gaming while also teaching them about the environment

**S**ave the Shark is a digital game in an exciting new Raspberry Pi Foundation series of projects. The series aims to show learners how they can protect the environment using the power of technology, and draws on several of the United Nations' 17 Sustainable Development Goals (SDGs), with Save the Shark engaging with two of the goals in particular: Life Below Water and Responsible Consumption and Production.

In this activity, learners create a game in Scratch in which they have

to save the shark by eating fish and avoiding rubbish. The project explores relevant environmental themes such as sharks' food sources and the negative impact of plastic in the ocean.

Although it has a serious theme, Save the Shark is a fun project that introduces learners to game building while also educating them about the environment. Using step-by-step instructions, learners are introduced to key computing concepts such as selection, variables, and random numbers. **(HW)**

## OBJECTIVES

- ✓ How to use random numbers to change costumes
- ✓ How to generate and delete clones
- ✓ How to use random numbers to alter the behaviour of clones

## ACTIVITY 1: MOVE THE SHARK 15 MINUTES

In this step you will learn how to use code to control the motion of a shark on the screen using the mouse. If you are working online, open the starter project in Scratch ([hello.world.cc/shark-online](https://hello.world/cc/shark-online)). If you are working offline, open the project starter file in the Scratch offline editor.

In the starter project, you should see a shark sprite against an underwater background. When the green flag is clicked, the shark should start at the bottom of the screen.

To make this project mobile-friendly, you're going to use the location of the cursor when the left mouse button is pressed, or when a finger touches the screen, to control the movement of the shark.

Add a **forever** loop to your script so that your program can constantly detect when the left mouse button is clicked, then use an **if... then** block to detect if **mouse down** — see figure 1.

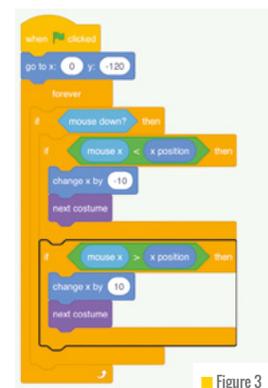
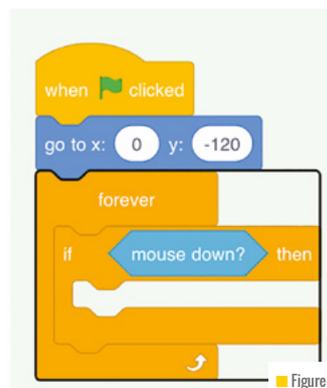
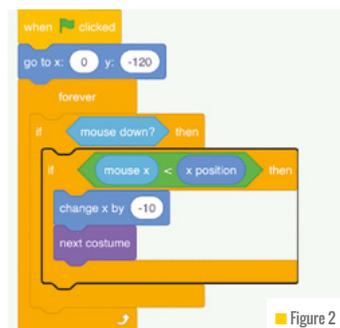
When the mouse is clicked, if the **mouse**

**x position** of the cursor is **less than** the **x position** of the sprite, then the sprite should **change x by -10**, so that it moves left. Add the following blocks, as shown in figure 2.

Click on the green flag to run the program and test that the shark does move to the left. If the **mouse x** position of the cursor is **greater than** the **x position** of the sprite, then the sprite should

**change x by 10**, so that it moves to the right. Add the following blocks, as shown in figure 3.

Click on the green flag to run the program and test that the shark does move to the right.



## ACTIVITY 2: PLASTIC WASTE 15-20 MINUTES

You should see a sprite that looks like a plastic bottle in your sprites pane beneath the stage. This sprite has four costumes: a bottle, a wrapper, a bag, and a can holder.

When the flag is clicked, this sprite needs to move to the top of the screen and then **hide** itself. Add the code as shown in figure 4.

The plastic sprite should now randomly generate clones of itself. See figure 5.

When a clone is created, it should **show** itself, pick a random costume, and then move to a random **x** position. Add the code shown in figure 6 as a new script.

You want the speed at which the plastic moves towards the bottom of the screen to be **random**, so create a new **variable** called **speed**.

Set the **speed** to be a **random** number, and then move the clone down the stage using the **speed** variable. See figure 7.

Run your game, and you should see plastic waste falling from random positions and at random speeds from the top of the screen. The problem is that the waste accumulates at the bottom of the screen, and stays there. Add blocks to detect when the plastic sprite touches the bottom of the screen, and then deletes itself. See figure 8.

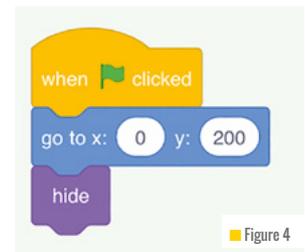


Figure 4

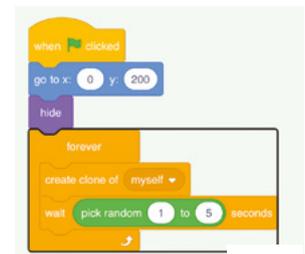


Figure 5



Figure 6

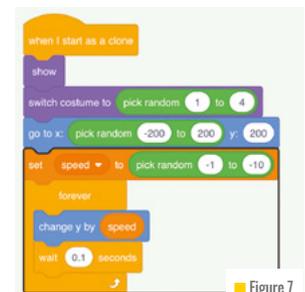


Figure 7

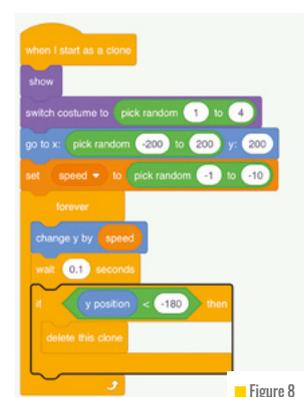


Figure 8

## ACTIVITY 3: SHARK HEALTH 15-20 MINUTES

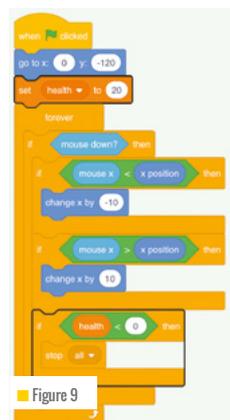


Figure 9

In this step, you are going to include health points using a **variable**. The health of the shark will reduce if it accidentally eats plastic waste.

Create a new **variable** called **health**.

On the shark sprite, when the game starts, the shark's health should be set to **20**, and then when the health gets below **0**, the game should end. See figure 9.

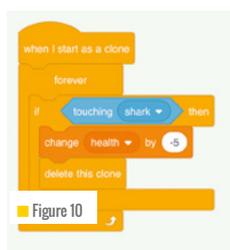
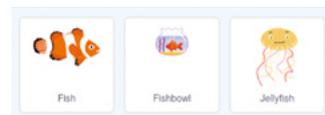


Figure 10

Back on the plastic sprite, add some code to reduce the shark's health if it accidentally eats any of the plastic. See figure 10.

Run the program again to test that the health of the shark reduces if it eats plastic.



## ACTIVITY 4: FEED THE SHARK 15-20 MINUTES

Now, when you play the game, the shark needs to avoid the plastic, or the game will end because the shark's health has decreased. In this step, you'll add fish that the shark can eat in order to increase its health.

Add the **fish** sprite to your project. The code for the **fish** sprite is almost identical to the code for the **plastic** sprite. Drag and drop the three scripts from the **plastic** sprite onto the **fish** sprite in the sprites pane.

Now you can edit the code that reduces the shark's health, so that it increases the health instead. See figure 11.

Run the program again to test that the health of the shark increases if it eats fish.



Figure 11

## DIFFERENTIATION

More advanced coders could add different fish that give the shark increased health, and adjust which plastics hurt the shark the most. Less advanced coders could be provided with a more complete starter project with a few blocks missing.

## RELEVANT LINKS

[helloworld.cc/shark-projects.raspberrypi.org](http://helloworld.cc/shark-projects.raspberrypi.org)

## AGE RANGE

5-6 years  
7-10 years  
11-13 years

## YEAR GROUP

UK Years 3-6

## LESSON TYPE

• Unplugged

## REQUIREMENTS

• The equipment required varies by activity and most materials should be readily available in the natural environment (e.g. leaves, twigs, shells, stones)

# GET OUTDOORS WITH UNPLUGGED ACTIVITIES

Taking your computing lessons outdoors will help your students to explore computing concepts and approaches – without the need for ICT equipment

**O**utdoor learning is nothing new. Since the launch of the Forest School Association in 2012, there have been a growing number of forest schools and beach schools enriching their curriculum with lessons in the great outdoors. And it's no surprise why — outdoor learning boasts several benefits,

including improved health and fitness, concentration, teamwork, independence, and emotional well-being. I've not had a pupil yet who has complained about going outside for a lesson! (That said, I have had a few confused looks when I told them we were going outside to do computing.)

The following activities teach

computational thinking concepts and approaches, as outlined by Barefoot Computing (see Relevant links). Many of them incorporate several concepts and approaches, but I've focused on one or two for each activity so we can look at them in detail. The key to any unplugged computing lesson is relating the offline activity back to its computing equivalent. **(HW)**

## ACTIVITY 1: FOLLOW THE SEQUENCE 20 MINUTES

In this activity, pupils work in pairs, with one (Pupil A) giving instructions while the other (Pupil B) follows those instructions. It could be played in a woodland area or on the beach, using sticks to draw in the soil or sand. This activity demonstrates an algorithm — a computational thinking concept.

Sit the pupils back to back so they cannot see each other's drawings. Ask Pupil A to draw a picture of something simple and then ask them to describe it to Pupil B. Afterwards, both pupils look at what they have drawn. The closer the two images, the more successful the exercise. You don't need to explain just how precise the instructions need to be for this to work — they'll discover this for themselves! The

pupils should then evaluate how they could do it better (evaluation being another computational thinking concept). Relating this to computing, remind them that computers follow algorithms precisely and cannot think or act for themselves. In other words, in this scenario Pupil A is the 'programmer' and Pupil B is the 'computer'.

Repeat the activity with Pupil B giving instructions and Pupil A drawing. Ask them to evaluate the outcome again.

To differentiate this activity, you could provide the students with a premade picture of simple 2D shapes to describe to their partner. This will reduce the cognitive load of coming up with a picture and giving instructions at the same time.



**WILL FRANKLIN**

Will is a Key Stage 2 teacher at Westdene Primary School in Brighton and leader of CAS Brighton Primary Community (@wnfranklin).

## OBJECTIVES

- ✓ An understanding of computational thinking concepts and approaches

## ACTIVITY 2: DEN BUILDING 40 MINUTES

In this activity, pupils work together in groups to build a den to shelter them from the weather. The effectiveness of their shelter is then tested, by pouring water over the roof and seeing how wet it gets inside.

The process of building a den involves many computer science concepts and approaches. First, the children need time to tinker with the design of the shelter using the materials they have collected. During this time, they are applying logical reasoning; they must consider which of their materials could be useful for

the structure, which could be useful for shelter, and so on. It is important to break down the problem into parts, so that the group can work more efficiently to achieve a den within the time they have. Problems will undoubtedly arise, so debugging will be going on throughout. The whole process will fuel collaboration and perseverance, which are key computational thinking skills.

After they have successfully completed a den, the group could follow it up by creating a den building algorithm that another group could try to follow.

## ACTIVITY 3: NATURAL MAZES 40 MINUTES

In this activity, the children create mazes by drawing on the floor of a woodland area or in the sand on the beach. They then design an algorithm to help a classmate navigate through the maze blindfolded.

Designing algorithms will involve decomposing the route, representing the instructions, and debugging, with the group testing their sequence of instructions until they are sure it works. These algorithms can be made out of natural materials as well, such as stick arrows.

When the groups have finished their mazes and algorithms, get a child from a different group to be their Kidbot and ask them to wear a blindfold. Remind the Kidbot that they can only do what they are programmed to do by following the algorithm — in the same way that computers do. Following the activity, get the children to evaluate the success of their algorithms.

To differentiate, ask children who have a good understanding of algorithms to try and shorten the sequence using repetition. For instance, instead of having three arrows pointing forward to represent 'move forward three paces', can they think of a way to represent the same action in a different way?



## ACTIVITY 4: BINARY ON THE BEACH 30 MINUTES

While binary is not explicitly mentioned in the primary computing curriculum, it is a fundamental part of computer science that can be introduced at this stage. For this activity, you need to ensure that there are plenty of materials available for the children to use to create their codes. Use two different types of material to represent 1 and 0. They could be two differently coloured leaves, or differently shaped leaves; they could be stones and shells on the beach.

Put the children into small groups and give each child a binary alphabet sheet. In this activity, the children create coded messages that represent binary code — the coding system used in a digital device. You can find a binary alphabet sheet and a series of starter activities for binary on the Our Family Code website (see Relevant links).

To create binary messages, the groups will represent letters of the alphabet using a 5-bit binary code. To start with, get them to spell out short words and encourage them to decode other groups' words using their binary alphabet sheet. Depending on how many resources are available, you could then move up to short sentences.

For younger children, you can keep binary simple with some leaf threading. Leaves can also be threaded onto string to make ornate binary necklaces spelling out their name.

## RELEVANT LINKS

Barefoot Computing computational thinking concepts and approaches: [helloworld.cc/barefoot-concepts](http://helloworld.cc/barefoot-concepts)

Colour by Numbers from CS Unplugged: [helloworld.cc/cs-unplugged-colour](http://helloworld.cc/cs-unplugged-colour)

Our Family Code: [helloworld.cc/ourfamilycode](http://helloworld.cc/ourfamilycode)

## FINAL THOUGHTS

Why not give outdoor computing a try this term, and spend more time exploring computing concepts in a completely new environment? Please share what you get up to on Twitter using the hashtag #CASInspire20.

AGE RANGE

7-13 years

YEAR GROUP

This activity was run as part of a CoderDojo workshop: attending learners ranged from seven to 12 years.

LESSON TYPE

Physical computing

REQUIREMENTS

- Raspberry Pi Zero W
- Raspberry Pi Camera Module
- 16GB microSD card
- USB A to Micro B cable
- Powerbank
- Heat sink
- Plastic food storage box with lid
- Large plastic drinks bottle
- A computer with Wi-Fi access or a smartphone/tablet

Note: My Naturewatch Camera kits are available to buy from electronics suppliers, but the above components can be assembled relatively inexpensively, using existing items where possible.

# DISCOVERING WILDLIFE WITH MY NATUREWATCH

Using just a few household items and affordable electronics components, anyone can make this motion-sensitive, Raspberry Pi-powered, DIY wildlife camera

**I**n my experience, learners have found this activity to be highly engaging because of the hands-on workshop approach. They get a special sense of achievement out of building a functioning device from scratch and seeing the results of their efforts. This activity gives a real insight into how things work for curious young minds.

The My Naturewatch Camera was designed by the Interaction Research Studio at Goldsmiths, University of London, in collaboration with the Design Products Programme at the Royal College of Art. This was part of a research project funded by the Engineering and Physical Sciences

Research Council. The aim of the project is to collect content about UK wildlife as a way of building new relationships and engagement between people, nature, and technology.

To build one camera, educators need to put together a kit of electronic components and household objects, as shown in the image below. The learners will then follow instructions on how to connect all of these component parts together in order to make a working wildlife camera.

The Royal College of Art hosted several 'train the trainer' workshops for teachers, club volunteers, and local group leaders to demonstrate the build process and give further information about the project. The trainers were then able to go back to their classrooms or clubs and

hold their own workshop events up and down the country.

At Doncaster Central Library CoderDojo, we were extremely fortunate to become involved with the programme and were kindly donated five My Naturewatch Camera build sets to use with our young people.

We held a series of workshops with our CoderDojo club over three weeks. At the first session, each learner — alongside their parent or guardian — built their camera and took it home. At the next session, they returned to show us the images that their camera had captured. Squirrels, birds, mice, and cats featured among the images collected.

Illustrated instructions corresponding to the lesson plan can be found at [mynaturewatch.net/make](http://mynaturewatch.net/make). **(HW)**

## OBJECTIVES

- ✓ Assemble electronic components to create a working device
- ✓ Install a software image onto an SD card
- ✓ Spend time outdoors and connect with local wildlife



## ACTIVITY 1: DOWNLOAD THE SOFTWARE UP TO 60 MINUTES

This software contains the operating system for the Raspberry Pi Zero and an application that controls the camera.

This could take a while, depending on variables such as the speed of your internet and the computer you are using.

- 1 Download the disk image from: [helloworld.cc/disk-image](http://helloworld.cc/disk-image). This is a 4.5GB file.
- 2 Download an application called Etcher (see Relevant Links). This will copy the disk image to the microSD card safely and easily.
- 3 Insert the microSD card into your computer.

4 Using the Etcher software, select the disk image as 'image' and the microSD card as 'drive', then press 'flash'. This step takes around 15 minutes.

It is important to note that after Etcher has flashed the drive, computers with Windows operating systems will sometimes ask if you would like to format the SD card. If this happens, click 'no', otherwise the software will be deleted and you will have to flash it again.

It may be appropriate to download the software once on to a teacher's PC or laptop and then allow each student to flash their SD card directly from there, rather than trying to download a 4.5GB file multiple times.

## ACTIVITY 2: ASSEMBLE THE ELECTRONICS 20-30 MINUTES

Discuss with the students what each component is and what it does. Ascertain whether they can identify parts of the Raspberry Pi Zero board (processor, GPIO, power, USB, HDMI, SD card slot, and so on).

You may wish to pair up learners so that they can assemble the electronics together, or they can assemble independently following the step-by-step instructions.

Some steps can be a little fiddly, due to the fragility of the components — stress that pupils need to take their time and be careful.

- 1 Ensure your USB powerbanks are charged.
- 2 Attach the camera module to the Raspberry Pi Zero (the camera connector is very fragile, so take care with this step!).

3 Attach the heat sink over the large black chip on the Raspberry Pi Zero. This is to dissipate heat from the processor.

4 Using the cardboard mount template (see Relevant Links) mount the Raspberry Pi Zero W to one side of the card with a double-sided sticky pad. Carefully fold the camera ribbon cable at its narrowest point around the top of the card and stick to the other side of the card. A small piece of masking tape can also be used to secure the camera ribbon.

As teacher/mentors, you can supervise and offer further instruction or guidance on how to attach the components as required. Some students will require more help than others.

## ACTIVITY 3: RENAME YOUR CAMERA 5 MINUTES

The My Naturewatch Camera creates its own wireless network, allowing you to control it through a web browser on any smartphone, tablet, or computer connected to it.

You can leave the wireless network name as the default, but if you have a few devices with the same name, it could become problematic when trying to connect to each camera later in the

workshop. Therefore, it is advised that you change the wireless network name to something unique to each device.

- 1 View the contents of the microSD card on your computer by selecting 'boot'.
- 2 In 'boot', open '\_naturewatch-configuration.txt'.
- 3 The name and password of your camera

can be edited — by default they are set to 'MyNaturewatch' and 'badgersandfoxes'. Please note that any new name or password must contain at least eight characters of letters or numbers. Save the file if you make any changes.

## RELEVANT LINKS

You'll find all the resources you need, as well as additional information and a video demonstration, here:

- Download Etcher software from: [helloworld.cc/etcher](http://helloworld.cc/etcher)
- Official My Naturewatch site: [helloworld.cc/mynaturewatch](http://helloworld.cc/mynaturewatch)
- Cardboard mount template: [helloworld.cc/card-template](http://helloworld.cc/card-template)
- Video demonstration by Maddie Moate: [helloworld.cc/maddie](http://helloworld.cc/maddie)

## HEALTH AND SAFETY REQUIREMENTS

A small hole for the camera lens needs to be drilled in the plastic storage box. Depending on the age and competency of your learners, you may wish to drill this hole ahead of time on each box yourself.

Once the top of the bottle has been cut, you could cover the cut edges with some tape to decrease the likelihood of anyone cutting themselves.

Keep the My Naturewatch Camera out of direct sunlight to avoid overheating issues.

## ACTIVITY 4: TEST YOUR CAMERA 5 MINUTES

- 1 Insert the microSD card into the Raspberry Pi Zero.
- 2 Power the unit by connecting the USB powerbank to the Raspberry Pi Zero.
- 3 Allow 60 seconds for the Raspberry Pi Zero to boot up. The green light will flicker to indicate processing. Once the system has started, a red LED on the camera ribbon cable will light. If the red LED does not light, it is likely that the camera ribbon cable is not correctly seated in the Raspberry Pi Zero and will need looking at.
- 4 On a smartphone, tablet, or computer, connect to the camera's wireless network. The Wi-Fi network name will either be 'MyNaturewatch' or the unique name you gave it. The Wi-Fi password will either be 'badgersandfoxes' or the unique password you gave it.
- 5 Once connected with your device, open any internet browser and visit the following webpage to access the camera interface: [helloworld.cc/camera-local](http://helloworld.cc/camera-local); or go to the Naturewatch Camera IP address instead: 192.168.50.10.

## ACTIVITY 5: MAKE THE CAMERA HOUSING 10-15 MINUTES

Once the learners are confident that their components have been set up correctly and have tested them, it is time to build the housing for the camera to be placed into. You will need to power down the Raspberry Pi Zero before the next step.

- 1 Cut down the top section of a drinks bottle — this will be your lens cover to protect the camera.
- 2 Drill a hole in the side of the food storage container at a height that is suitable for the camera lens. Learners can do this by lining up the cardboard mount (that they have attached the components on to) inside the storage box. This should then give a good indication of where the hole needs to be. The hole should be about 10 mm in diameter. Starting with a small drill, work up to the desired size to prevent the container from cracking.
- 3 To make the lens cap detachable, you can also drill an identically sized hole in the drinks bottle cap (always take care when cutting plastic).
- 4 Position the drinks bottle cover over the opening in the food storage box and make a waterproof seal using a hot glue gun.

## DIFFERENTIATION

There are some brilliant instructional videos on YouTube explaining how to set up a My Naturewatch Camera. These videos may be easier for some learners to follow than written instructions. They could build along with the video, pausing when needed.

Depending on the resources available, students could be put into pairs or small groups to build one camera. They could then take turns taking the camera home and sharing their findings as a group or individually.

Educators could run the session as a demonstration, with all of the students completing each step at the same time. If any problems arise, they can be dealt with together. This will also make the educators aware of anyone who may need extra help.



Design Products • Futures, Royal College of Art, London

## ACTIVITY 6: SECURING THE CAMERA INSIDE THE HOUSING

### 5 MINUTES

Tape the cardboard camera mount inside the container, with the lens positioned to look through the hole that you drilled earlier. Attach the battery pack.

Close the lid, and voila, you now have a My Naturewatch Camera!

In order to save power, remember to unplug the battery when you are not using the camera. Another tip would be to include an optional pouch of silica gel, which will help to absorb any moisture that collects in the container.



## ACTIVITY 7: USING YOUR CAMERA

- 1 Position the camera in a good place to spot wildlife.
- 2 Scatter some birdseed or other appropriate wildlife feed, about 0.5–1 metre from the camera for optimal focus. For example, I placed my camera in a tree facing two bird feeders — you could use a bungee cord to secure it in place — and successfully captured some birds. You could use loose seed scattered on the ground, hiding the camera nearby to capture images of other animals, such as squirrels.
- 3 Use the web interface to control the camera and see the images.

Search for the Wi-Fi network name 'MyNaturewatch', or the unique name you set earlier in your configuration file. Once connected with your device, open any internet browser to navigate to: [helloworld.cc/camera-local](http://helloworld.cc/camera-local) or type in the My Naturewatch Camera IP address, 192.168.50.10.

Remember to click on 'start image capture' when you are sure you have placed your camera in a suitable position.

Whether you are using a phone, tablet, or computer, you can disconnect the live view of the camera by closing the web browser window. Keeping the live preview feed open in the browser will drain the battery and put



extra strain on the Raspberry Pi Zero, which could lead to overheating issues.

The My Naturewatch Camera takes photos by looking for changes in what it can see. To adjust the sensitivity, click 'settings' and then 'movement sensitivity'.

Once your camera has been capturing images for a while, you may want to save the photos from the camera. When you are ready, go to the browser page and either select individual photos to download, or select 'download all photos'. This will save everything as a zip file.

Lastly, do remember to share on social media your favourite wildlife photos that you have captured. You can tweet @ **mynaturewatch**, or use the #mynaturewatch hashtag.



### NATALIE SHERSBY

For three years, Natalie has been running Code Clubs in a school and a CoderDojo in a community library. She is a STEM Ambassador and has judged a national Robotics Competition. Natalie's career in IT systems support has spanned 15 years (@gigglingnatalie).

AGE RANGE

7-11 years

YEAR GROUP

Year 6

LESSON TYPE

Visual/block-based coding and physical computing

REQUIREMENTS

- Sphero robot
- Sphero EDU app
- iPad/Mac/PC/Android device
- A sense of adventure

# UNLOCK THE POWER OF DATA WITH SPHERO

**Matt Warne** shares some exciting activities with programmable robots

**H**aving led computing with primary-aged pupils for seven years, there's one thing I've learnt that resonates with every aspect of education: make learning fun and pupils will become risk-takers. Never have I seen this more than when pupils are engaging with robotics in STEM subjects.

This learning pathway was devised to develop and enrich pupils' understanding of data, and how data can be used to evaluate the success of an activity. I have been using Sphero robots in computing for over five years now, and I often meet educators who are unaware of the data that can

be harnessed from them. When pupils can see what's happening to the Sphero during a challenge, they can start to use the extra information to evaluate the success of the activity. The data that can be harnessed with Sphero includes:

- Distance travelled (cm)
- Orientation (pitch, roll, and yaw)
- Acceleration (G-force)
- Velocity (cm/s)

Earlier this year, I delivered this series of progressive challenges at the #EveryoneCanCode Teacher Summit in Johannesburg, which was well-received and very hands-on.

After each activity, I have linked in the project so that readers can copy

it directly into their own Sphero EDU app. You will need to set up a free account so that you can save all your activities and personal projects. The activities mentioned in this article will work with the Sphero Mini, SPRK+, and BOLT. [\(HW\)](#)

## OBJECTIVES

- ✓ Design programs to accomplish specific tasks
- ✓ Use decomposition to design and execute a program
- ✓ Evaluate data and explain findings

## ACTIVITY 1: ENGAGING PUPILS WITH EXAMPLES 60 MINUTES

In this game, get the pupils to toss the Sphero between them and ask them to guess the random animal sound that plays. If their guess is wrong, they're out and will need to act out the correct animal (if they are comfortable doing so, of course!).

This program shows how the accelerometer sensor can trigger an if-then statement, which is a very common concept in programming. Animal Toss uses the accelerometer to detect readings over 3 g, and the if-then statement plays a random animal sound at that sensor threshold. That's an

if-then statement: if this happens, then something else happens.

The PRIMM approach is recommended for this project:

- Predict: Pupils look at the code shared on the board and make predictions about what might happen when the code is run.
- Run: The pupils run the code and discuss what actually happened. Were their predictions correct? What misconceptions did the pupils have?
- Investigate: Pupils build the code on their own devices. This is a great opportunity for some paired programming.

- Modify: What could pupils change about the code they are writing, and how could they put their own creative stamp on it?
- Make: Have pupils gained the skills to make their own version of this project, without the guidance they have been receiving up to this point?

This is an engaging project that can easily be adapted for use in other curriculum areas. It also encourages pupils to implement decomposition while looking at the original code.

## ACTIVITY 2: NAME AND TIMING 60-90 MINUTES

This activity builds on the Animal Toss project, in which the Sphero uses conditional statements to execute code. The project is centred around a piece of code that will run if the Sphero rotates clockwise or anticlockwise, utilising the 'yaw' data that represents rotational speed. This triggers the Sphero to change colour. I find that pupils love watching the data graph as the Sphero is spun clockwise and anticlockwise.

As the code in this activity is a little more complex, I recommend using decomposition with the pupils to break down the activity concepts and to share understanding before attempting paired programming. Once pupils have grasped the concepts, they can work together, taking it in turns to programme and support each other with building the code.

Once the code is ready, pupils need to test it, modify it, and then evaluate their findings. When the sensor data has been gathered,

pupils need to be guided to use the three dots in the top corner of the Sphero EDU app and export the data. Bringing the data into an app like Numbers on the iPad will allow the data to be graphed. Pupils then have the opportunity to embed voice notes at specific points in the graph to demonstrate their understanding and explain what the data is showing.

A walk-through code tutorial can be found here: [helloworld.cc/sphero-tutorial](http://helloworld.cc/sphero-tutorial).



## ASSESSMENT

When running these activities, always make sure that pupils get the chance to demonstrate their knowledge.

I often bring in a diary room task. This is an opportunity for pupils to talk openly to a camera, or with the teacher, about what they felt confident with and what they found challenging. As new language is being introduced, I would always bring in a Kahoot!, Socrative, or Quizlet interactive quiz to support pupils with the understanding of language used in the task.



■ Teachers exploring the Animal Toss game at the #EveryoneCanCode summit, Johannesburg, March 2020

## ACTIVITY 3: HOT POTATO 30 MINUTES

This will let pupils turn their robot into a 'hot potato' that they can play with together. The program uses the toss and expire variables. Every time pupils toss the robot, it increases the toss variable. When the toss variable becomes greater than the random expire variable, their potato is too hot to handle and whoever catches it will be out.

**Tip:** Increase or decrease the number of tosses required for expiration — change the random range bounds.

## RELEVANT LINKS

If you've enjoyed these activities, there are tasks within the Sphero EDU app that are ready to be distributed or adapted for your learners: [helloworld.cc/sphero-edu-app](http://helloworld.cc/sphero-edu-app).

## DIFFERENTIATION

Pairings decisions are always very important. You want to avoid a situation where one person dominates a group; likewise, you want to support the quieter members in pairs, who may watch the action but don't contribute. It can be useful to have a 5-10 minute timer to remind pairs to swap roles from driver (the person coding) to navigator (the person who advises on the code).

These activities lend themselves well to differentiation. The sharing of code within the PRIMM approach enables all learners to

get straight on task exploring what it does, while class discussion, teacher questioning, and decomposition will all enable a better understanding of the code. Pupils working in pairs will naturally feel more confident.

When looking to advance pupils, there is always the chance for them to modify and make their own versions of these activities as part of the PRIMM structure. As computer science is such a creative subject, we all want our learners to add their own personality and creativity to these projects.



### MATT WARNE

Matt Warne is a computing and IT specialist teacher who works at the Royal Grammar School in Worcester. He is a CAS Master Teacher and community leader. Matt was recently named in the EdTech 50 Awards as a leader of change in the UK.



# VIRTUAL VISITS: SCHOOL TRIPS FROM HOME

A virtual visit to an inspiring location can provide a respite from remote lessons.

**Alan O'Donohoe** shares tips for creating happy memories of a shared experience

**W**hen we are thrown an unexpected curveball, whether it be the unexpected absence of a colleague, severe weather conditions, or a global pandemic, it can be tempting for us teachers to put any planned school trips on hold. But our students may not appreciate a curriculum that consists of just the absolute necessities, particularly if they are finding it difficult to cope with events they have little control over and would welcome activities to take them away from it all.

It's likely, in anticipation of the possibility your school may need to close at short notice this term, that you will already have contingency plans in place for blended, online learning activities to be accessed remotely. When planning these activities, it can be difficult to inject fun, excitement, and interest. This is where a virtual visit can be a real game changer, as it offers unique

opportunities to create a different kind of learning experience for students, one which broadens their horizons outside the prescribed curriculum, as well as engaging their interest beyond what happens on the screen.

## What is a virtual visit?

Traditional school trips offer plenty of opportunities for engaging and inspiring learning experiences in a stimulating environment away from the classroom. On a virtual visit, rather than taking students to a physical location, the teacher instead simulates a visit to a destination using images, audio, and video to enhance the experience. A virtual tour is typically hosted using the screen sharing mode of a learning platform that students are already familiar with, such as Microsoft Teams, Google Classroom, or Moodle.



■ A tour guide brings the history of computing to life

If you have not yet experienced a virtual visit for yourself, you might first follow the example of some other computing teachers who have. These teachers have been surprised at how engaging their students found the experience and how much they enjoyed it, too. It's highly likely that your students will thank you for planning a very different learning experience for them.

While some schools have experimented with virtual reality headsets to conduct tours, I have found a conventional screen and headset or speakers is perfectly adequate and far more accessible, especially in a lockdown scenario.

“ A VIRTUAL VISIT CAN BE A GAME CHANGER THAT BROADENS HORIZONS

### Advantages of virtual visits

A virtual visit is not intended to replace a normal school trip, but it can definitely create interest in visiting a destination and offers many advantages of its own:

- There's often no cost or a lower cost to host a virtual visit, which opens up the option of experiencing inspiring locations to more students. Data from Teacher Tapp suggests that families in schools with higher numbers of free school meals are less likely to pay for trips, and that these schools are most likely to cancel a trip if parents can't contribute.
- There is zero travel time, whereas travel time often exceeds the amount of time at the target destination on a school trip. What's more, not a single sick bag needs to be deployed!
- Destination choices are no longer restricted by geographical boundaries – you might choose to visit The National Museum of Computing in Bletchley (UK) or the National Cryptographic Museum in Maryland (USA).
- You'll enjoy substantially lighter stress and workload in terms of contingency planning and risk assessment.
- You have the flexibility to change or cancel plans at the last minute when changes in circumstances demand it.
- There are more access options – virtual visits can be accessed

## OTHER VIRTUAL VISIT FORMATS

There are other formats of virtual visits worth considering, but these are recommended for learners who have already experienced at least one virtual visit and are ready to explore an alternative format.

### Mystery tour

The teacher takes students to a mystery location with a strong connection to an area of the curriculum they have been studying. Collaborating in teams, learners will take part in a through the keyhole game, in which they need to guess the location using the clues offered. Following this, learners watch recorded interviews with various individuals who have an association with the location, and additional games, puzzles, and quizzes can also be included, to combine an element of interactivity and entertainment with the educational aspects of the visit.

### Flipped tour

In this more advanced version of a virtual visit, the roles are flipped so that students become the tour guides, while teachers and other adults form the audience. Teams of students are assigned objects, and are required to present their object in a virtual visit for an invited audience, and create puzzles and activities for the guests. This takes much more planning to ensure that students feel confident taking on the roles required, but provides a much deeper experience and longer-term connections for the students.

remotely at home, together in class, or a combination of both.

- You can split virtual visits into smaller bite-sized chunks, to be accessed over a longer time period. School trips, by their nature, typically pack a lot into a single day, potentially overwhelming and exhausting learners. However, The National Museum of Computing will split their virtual visits into segments to fit your timetable requirements.
- You have the opportunity to extend the visit, and learners can also choose to access parts of the tour on demand afterwards, if they choose to.

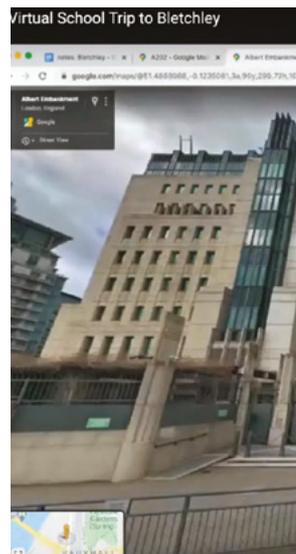
### Drawbacks of virtual visits

- A virtual visit can't replace the same tactile, social experience of a school trip, but it can enhance and stimulate deeper interest in visiting a museum or place of interest.
- Although access to digital devices is required for learners to access a virtual visit, this can be facilitated via Smart TV services and mobile devices, if laptops are not available.
- There's less opportunity for students to socialise in the same way as they might on a coach journey, so build in collaboration to mitigate against this.

### Alan Turing's Manchester

In April, I organised an exa.foundation free virtual computing history tour of the streets of Manchester. A group of teachers, their

☰ **Computing History Tour, Manchester**



## RESOURCES AND FURTHER READING

The **National Museum of Computing** has some of the best options for virtual visits. You have the option of choosing to organise your own DIY tour or arranging a paid-for curated tour led by a museum guide. The images are of a high quality and the guides are extremely knowledgeable and willing to accommodate your needs. Curated tours also include hands-on virtual activities, and the museum is happy to deliver a tour in separate lesson episodes. Contact the education team for more details: [helloworld.cc/tnmocour](http://helloworld.cc/tnmocour).

**Exa.foundation** regularly hosts free, online virtual visits to different locations worldwide depending on your needs and interests, and is also willing to support schools who choose to organise their own visits. Contact [info@exa.foundation](mailto:info@exa.foundation) to make an enquiry, or visit the events calendar at: [exa.foundation/events](http://exa.foundation/events).

At time of writing, the **National Cryptological Museum** in Maryland, USA, is closed to the public, but is hosting free virtual visits each week. The museum guides providing these tours are retired members of National Security Agency staff who are extremely well qualified and willing to answer questions and interact with the audience. Check your time zone: for example, a 10:00 EDT tour can be enjoyed at 15:00 GMT in the UK. When the museum reopens it may stop advertising virtual tours; contact the museum directly to enquire about their tour plans: [helloworld.cc/ncmtours](http://helloworld.cc/ncmtours).

A video recording from a virtual visit to **Bletchley** provides a useful reference for someone who has not yet experienced a virtual visit. It was one of the first virtual visits I hosted: [exa.is/bletchleytour-example](http://exa.is/bletchleytour-example).

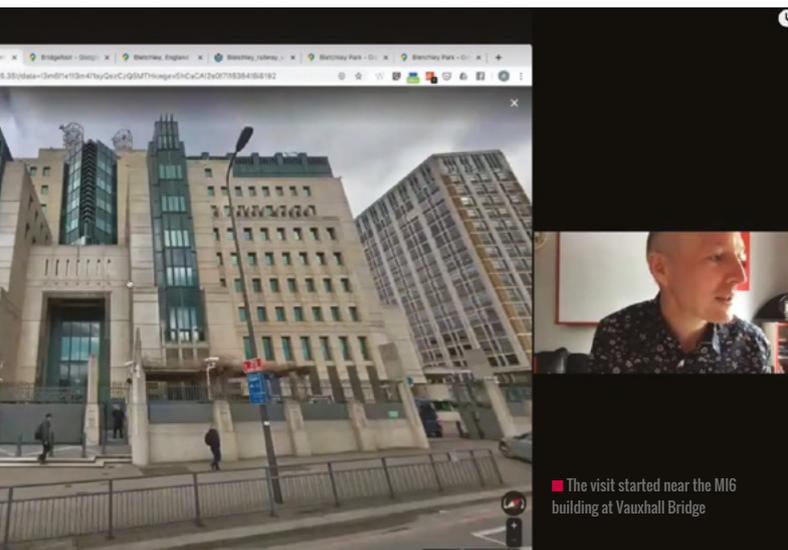
**Planning a virtual school trip:** To get the most from a virtual visit, it's worth considering why you are planning a tour and what you hope to achieve. This guide can help by raising some important questions for you: [helloworld.cc/virtualtripguide](http://helloworld.cc/virtualtripguide).

▶ students, and I visited three locations which paid tribute to the life and work of Alan Turing and his contribution to the development of the modern computer. These tours were planned specifically so that learners could take an independent self-guided tour around Manchester city centre at a later date and visit the locations at their convenience. On some versions of the tour, we deliberately chose locations that could be visited 24/7 by members of the public. On other versions of the tour we visited private buildings and museums to reveal some hidden mysteries. Here are some thoughts from teachers who took their classes on a Manchester visit which I led:

“ VIRTUAL VISITS COST ALMOST ZERO AND THERE ARE NO LIMITS ON LOCATION

Damian Sinnott, a computing teacher in Manchester, said, “The feedback from my students was overwhelmingly positive. After spending weeks completing work remotely it was a nice opportunity to engage with something different. One student reserved judgement, but the rest of the feedback was very positive and they want to do it again. The majority wanted to do it in real life, in fact – students commented they had previously walked past many of the locations and hadn't realised their relevance; it was very revealing. It really was a fantastic success and I look forward to doing more in the future. I had done the online tour before on my own, but still really enjoyed it.”

Calum Woodhead, a computing teacher in Preston, said, “I am glad that we organised a virtual computer history trip, because it provided the students with a unique learning opportunity, encouraged students to interact with each other, and allowed them to visualise places outside of their normal learning environment. The most successful part of the virtual trip was how Alan engaged with the audience and regularly asked students



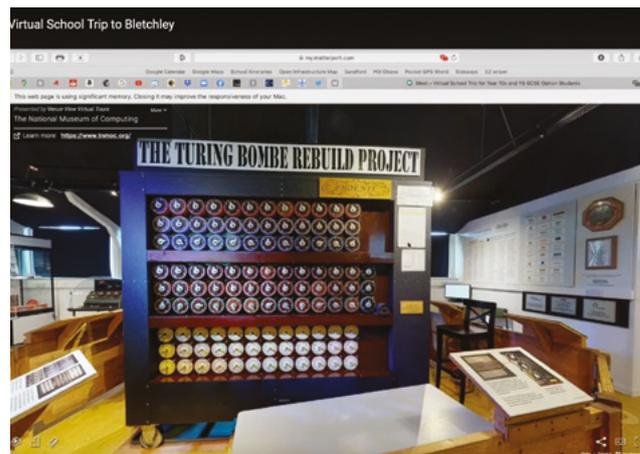
“ A VIRTUAL TRIP PROVIDES STUDENTS WITH A UNIQUE LEARNING OPPORTUNITY

to respond to questions. The students that I spoke to at the end of the session thoroughly enjoyed it and said they would like to do it again. Unfortunately, on the platform we used there was no option for this. They did mention having multiple-choice questions throughout so that everyone can engage – some of the students felt nervous about answering in front of the others. We look forward to more sessions like these.”

**Bletchley Park codebreakers**

Two London schools participated in visits to Bletchley and The National Museum of Computing. In both cases, the visit started near a well-known London landmark, the MI6 building at Vauxhall Bridge, and traced the journey to Bletchley, to help students understand the significance of the location as well as the history of the intelligence services. The trip culminated in a brief tour of historic Bletchley Park Mansion and grounds, and then a volunteer from The National Museum of Computing gave a highly informative tour which featured Enigma, the Bombe, Lorenz, and Colossus. One school extended the visit to a Second World War codebreaking project day during which students collaborated in online breakout rooms to develop and create projects in response to what they had learnt on the visit. At the end of the day, the teams of students presented their projects to an invited audience. In both cases, it was clear how much the students appreciated hearing from a volunteer at The National Museum of Computing and having the opportunity to ask questions.

Stuart Shum, a computing teacher in London who took classes on a Bletchley tour, said, “The virtual trip was a great success. We had 30 students join the tour who were excited to virtually visit somewhere out of London during lockdown. Alan started the trip by



■ A working reconstruction of the Turing-Welchman Bombe



■ An Enigma machine on display at Bletchley Park

showing how to get to Bletchley and then to The National Museum of Computing. Our tour guide Peter (a volunteer from The National Museum of Computing) showed us around, giving us a whistle-stop tour of the museum, during which he showed us a range of interesting computers and devices which were relevant to what my students have been learning in computer science. This sparked the curiosity of the students, which resulted in positive feedback after the event. A few students had even told me they wanted to go and visit sometime in the future. Afterwards, word got round about the trip and many of my colleagues, parents, and a few students asked to watch the recording of the trip. The whole experience was really valuable and I would highly recommend it to anyone.”

Halima Bhayat, a computing teacher at an all-girls' school in London, said, “During the coronavirus situation it has been difficult and at times unsafe to think about having a physical trip, so we organised a virtual visit. Virtual visits cost practically zero, much less than a physical trip, and you are not limited on location. I welcomed the fact that there were far less admin tasks and set-up. It was useful having someone to answer questions and go through the same steps on the tour, giving the impression that everyone is together, compared to a real trip, where you might split up as you cannot stay as one big group.”

“I was impressed by the engagement right from the beginning as we started near our school in London and were led with some ▶



■ Home-baked cryptography

▶ history along the way to Bletchley. As we are in London, the girls were able to start with familiar landmarks.”

“During the group work part of the day, we should have planned more time for the girls to think about their project and kept girls in the same groups to work with each other. It helped having a collaboration area for the groups to work in e.g. we moved to Microsoft Teams and all the girls did this for the project so they could collaborate in an area and produce something.”

### Tips for planning a virtual visit

I've learnt some things from arranging a few virtual visits, which might be helpful if you are considering organising something similar:

- Don't try to reproduce online exactly what you would do on a normal school trip. Consider a virtual visit as a taster, rather than a replacement for real-life activities.
- Try booking onto one of the free virtual visits being hosted by [exa.foundation](https://www.exa.foundation/) or the other organisations listed. This will provide you with an opportunity to experience a virtual visit for yourself and anticipate how your students might engage.
- When planning the tour, limit the time of the tour presentation to 45 minutes, or a little longer if there is more than one presenter.
- Plan a virtual visit to the location yourself beforehand so you know what to expect.
- If a paid-for tour is available, do the maths. This may be much more cost-effective than using your already limited time and resources to try to match the quality of a professional tour guide There may be better resources out there already than you can create yourself.
- Try to ensure levels of interactivity to maintain engagement, so it

is not an entirely passive experience. Boost engagement through games, puzzles, and multiple-choice questions. Anonymous responses tend to encourage higher participation levels.

- Plan the build-up to the visit – consider how you will raise student excitement levels. Could students design special badges or accessories to bring to their online experience? Are there interesting or fun facts you can use to entice interest?
- Assign students to groups and ask them to research objects at the target destination.
- Vary the contents, to avoid it just being a spoken tour – consider including video clips, interviews, and other activities to add more layers to the tour.
- Extend the trip into a project, to avoid the experience being wholly about what they experience on the screen. Students will enjoy opportunities to collaborate, even if managed remotely, on a project closely tied to the visit. (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](https://www.exa.foundation/), delivering professional development to engage digital makers, supporting computing teaching, and promoting the appropriate use of technology (@[teknoteacher](https://twitter.com/teknoteacher)).

# THE BEBRAS PUZZLE PAGE

Chris Roffey shares a computational thinking challenge for your students

## THE CHALLENGE: ANIMATION

Put the images in the correct order

An animation of a face will be made from a sequence of pictures. Only one feature of the face should change from one picture to the next. Unfortunately, the pictures got mixed up. Put the pictures in the correct order.  
*Solution on page 97.*

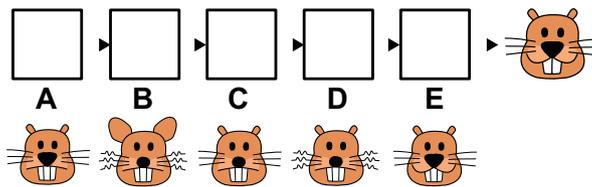
### Further information

In order to find the differences between the pictures, you have to examine the important

attributes of the faces first. The list of attributes and their possible values is:

- **Ears:** small, large
- **Mouth:** plain, smile
- **Nose:** small, large
- **Number of teeth:** 2, 3
- **Whiskers:** curly, straight

Face A can now be described as: ears small; mouth plain; nose large; number of teeth 3; whiskers straight. In computing, it is very common to model things from the real world as objects that have attributes and values.



### DOMAIN

Data, data structures, representations

### SKILLS

Abstraction, decomposition, evaluation, generalisation

### AGE

8-14 years

### DIFFICULTY RATING

Ages 8-10 medium;  
Ages 10-14 easy

### ABOUT BEBRAS

Bebbras 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](http://bebras.uk).



## COMPUTING KEYWORD SPOTLIGHT: DATA

Defining everyday techniques used by problem-solvers

A computer program can often be split into three parts:

- Data input
- Data processing
- Data output

The input data may come from the user via the keyboard or sensors, or be gathered from a data structure such as a database. Data processing is where the program uses an algorithm to manipulate the input data in order to generate the required output data. The output may be as simple as an average temperature, or

as complicated as the pixel values required to produce a movie frame.

At school, students learn about several data types, such as integers, floats, booleans, and strings. Data is stored as values in variables, which have identifiers (names) and are assigned a memory location.

It is often helpful to store collections of data in data structures. These can be huge organisations of data, such as databases, or much less complex structures,

such as sets or arrays. Many problems can be solved more easily by considering the best data structures to use before choosing the algorithm to manipulate them.

In the animation problem shown above, it is possible to write a program to follow the same algorithm described in the explanation. To do so, the images have to be modelled by organising the face attributes as data values in a data type such as a tuple, a dictionary or an object.

# COMPUTER SCIENCE IN K-12: AN A-TO-Z HANDBOOK ON TEACHING PROGRAMMING

A new book from a group of 40 researchers and teachers is likely to prove an invaluable resource for both novice and experienced computing teachers

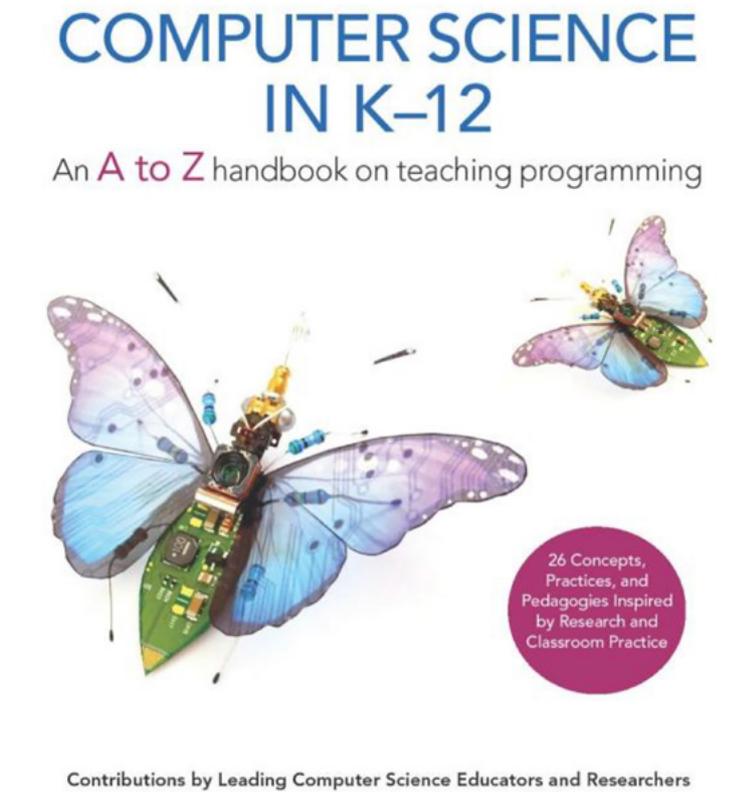
**INFO** BY Shuchi Grover (ed.)  
**PUBLISHER** Edfinity  
**PRICE** £24.99  
**ISBN** 978-1734662702  
**URL** [helloworld.cc/CSK12AZ](http://helloworld.cc/CSK12AZ)

**W**orldwide, we are literally inventing computing education in schools as we go along," Mark Guzdial writes in the foreword to this new book. Compared to most other subjects taught at school, computer science is new, and, unlike other subjects, few school-based computer science teachers have any formal training in the subject they are teaching.

In this book, Shuchi Grover and her co-authors — a group of 40 leading teachers and researchers in computer science education — succeed in the ambitious aim of answering two fundamental questions: which aspects of programming should be taught in schools? And how should they be taught?

While the ideas in the book are drawn from research, the chapters are not written in the style of research articles, which could be alienating for teachers with numerous demands on their time and attention, but rather in a clear tone that reflects the book's handbook ethos.

Grover is based in the US, but the book's group of authors are drawn from across the globe. The focus of the content, on the foundational ideas of learning to program, rather than broader questions around teacher professional development or country-



Edited by **SHUCHI GROVER**

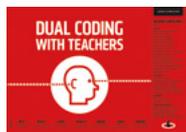
specific contexts, means that the book will be relevant to teachers in numerous countries.

The question of what to teach is covered in chapters on concepts (such as algorithms, data structures, and physical computing) and practice (the strategies students must learn to create programs, such as planning and debugging). How to teach is addressed in 12 chapters focused on pedagogy, covering a range of

approaches and concepts such as pair programming, worked examples, and universal design for learning. Each of the book's 26 short chapters is written clearly, with headings, diagrams, and examples. Practical advice for the classroom is foregrounded at the start of each chapter, with brief reading lists at the end. It is likely that the book will be a useful companion guide for teachers both experienced and new. **HWD**

# DUAL CODING WITH TEACHERS

Katharine Childs shares a fantastic reference for creating great classroom visuals to support learners' understanding



**INFO** BY Oliver Caviglioli | PUBLISHER John Catt | PRICE £16.00  
 ISBN 978-1912906253 | URL [helloworld.cc/dualcoding](http://helloworld.cc/dualcoding)

**W**henever I want to create some explainer content, I reach for this book. It's packed full of great ideas about how to structure documents, slides, and diagrams in the clearest way possible.

Caviglioli draws on a cognitive science theory called dual coding, which suggests that learners best acquire new knowledge when it is presented in two different ways — both written and visual. This theory is then combined with graphic design principles. The result is an informative guide to combining

words and visuals in teaching resources in a way that will prevent information overload.

Computing teachers will find lots of inspiration in this book, whether you're creating a diagram to explain the steps in reviewing code, doing a live drawing to explain a key concept, or making a classroom display on computing pioneers. The practical tips on layout and style are easy to apply and will help learners understand and retain subject knowledge at all levels in the curriculum. **(HW)**

# THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION

This classic text on statistical graphics, tables, and charts is of enduring relevance at a time when we are bombarded with data daily



**INFO** BY Edward R Tufte | PUBLISHER Graphics Press LLC | PRICE £26.81  
 ISBN 978-0961392147 | URL [helloworld.cc/tufte](http://helloworld.cc/tufte)

**I**n 1854, Dr John Snow plotted the locations of deaths from a cholera outbreak in central London. On a map of Soho, he marked deaths from the disease with dots, and water pumps with crosses. Examining his chart, Snow noticed that cholera was most prevalent among those who drank from one specific pump: the one on Broad Street. He had the handle of the pump removed, ending the neighbourhood epidemic.

In *The Visual Display of Quantitative Information*, Tufte (Professor Emeritus of Political Science, Statistics, and Computer Science at Yale) presents

Snow's work as an example of graphical excellence: complex ideas communicated with clarity, precision, and efficiency. Tufte argues that graphics, when done well, reveal data. We can often understand more about a complex data set from a graph than we can from tables of numbers or statistical summary values.

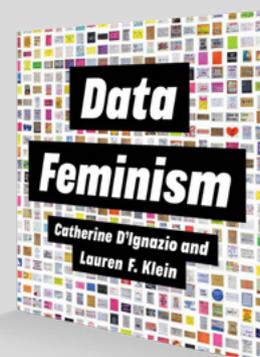
Although the first edition of the book was published in the 1980s, Tufte's guidelines for what makes a good graphic (a lot of data conveyed with minimal ink) and a bad graphic (sizes of effects in graphics not representing sizes of effects in data) are still resoundingly important today. **(HW)**

## ESSENTIAL READING

Three books that examine data and equity

### DATA FEMINISM

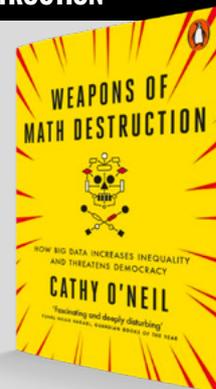
BY Catherine D'Ignazio and Lauren F Klein  
 PUBLISHER MIT Press  
 PRICE £18.49 / free online  
 ISBN 978-0262044004  
 URL [data-feminism.mitpress.mit.edu](http://data-feminism.mitpress.mit.edu)



D'Ignazio and Klein present a new way of thinking about data science and data ethics that is informed by the ideas of intersectional feminism; the book is also available as an open-source download.

### WEAPONS OF MATH DESTRUCTION

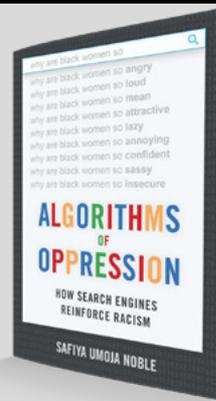
BY Cathy O'Neil  
 PUBLISHER Penguin Random House USA  
 PRICE £7.72  
 ISBN 978-0553418811  
 URL [helloworld.cc/wmd](http://helloworld.cc/wmd)



A former Wall Street quant warns of the unregulated and opaque mathematical models that pervade modern life.

### ALGORITHMS OF OPPRESSION HOW SEARCH ENGINES REINFORCE RACISM

BY Safiya Umoja Noble  
 PUBLISHER NYU Press  
 PRICE £17.26  
 ISBN 978-1479837243  
 URL [helloworld.cc/noble](http://helloworld.cc/noble)



Noble challenges the idea that search engines such as Google offer an equal playing field for all forms of ideas, identities, and activities.

# SURVEY RESULTS

In June we started sending out a short monthly survey to random samples of Hello World subscribers.

This new format of gathering feedback has been really interesting: it helps us to reflect on what we're doing well and how we can improve the magazine on a more regular basis. It will also let us track any changes in reader satisfaction over time.

We have been very pleased to see that, consistently every month, over 90 percent of respondents use the magazine to support their teaching. Answers to the question "What kind of content would you like to see more of in the magazine?" reflect previous annual survey results, with a strong demand for lesson ideas and activities, and features from other educators.

Here, we are sharing some of the comments we have received on these surveys. We read every comment — so if you get an email asking for your views on the magazine, please do take five minutes to let us know what you think. Or if you'd like to get in touch at any time, email [contact@helloworld.cc](mailto:contact@helloworld.cc). We are always interested in reader feedback.

And if you would like to write for the magazine then please do drop us an email too!

Our surveys are managed and analysed by Sophia Donovan-Spalding.

Thank you for the great work from your side. Your magazines have been of magnificent help to me and the kids I have been working with. The challenge of fear of programming is gradually disappearing from my young worriers.

**Brill magazine. Great recommendations for own classroom. Started Bebras, PRIMM teaching, and restructured our schemes etc. all from reading about them in your mag! Keep up the great work. Thanks.**

Love the magazine, please keep it printed (hard copy). I am dyslexic and find reading online magazines a chore — but Hello World always gets my attention! I really like hearing what other educators are getting up to, how they have implemented certain ideas, products, and resources, and would love to read more of these. Keep it up, thanks!

**Hello World helps me to understand and be braver in my work as a teacher. We don't have an IT teacher so everything I do with my primary students I learn myself; Hello World helps me to achieve my goals.**

I think the magazine is amazing and great to support CPD. It would be great if there was a section promoting computing courses teachers can access for CPD as it isn't easy to find them. To have them all in one place with recommendations both for online courses and workshops you attend in person would be incredibly useful.

## CORRECTION

In Blackpool Micro-bit Illuminations: a Cross-Curricular Collaboration on pages 54-56 of issue 13, Shelley Howarth's photography wasn't credited. The digital version of the magazine has been updated and we apologise to Shelley for this mistake.



I really appreciate practical articles dealing with live issues for the teacher, such as how to effectively teach coding, how to encourage problem-solving and resilience amongst students, how to teach models or more advanced subjects at GCSE or A level. These types of articles are the most help to me as a non-specialist teaching computer science.

I teach home-educated kids computer science (and also home-educate my own kids). I know that you primarily aim content at schools, but just thought I'd mention that home educators use your magazine too and I find it useful :)

It always contains something relevant to me as a primary specialist, and in turn it always contains some things that are 'above' my understanding — I like how there is that range in there — not too dumbed down, but still readable. Keep up the great work!

It is just about the only magazine I actually read. Having activities aimed at different levels is really useful. Book reviews probably aren't that helpful to me, but it would be great to have more general resources reviews, which could include books, but could also include online learning resources, perhaps reviewed by computing professionals for technical accuracy as well as teachers for usefulness and how to integrate into teaching? Thank you, and please keep going, you're doing a great job!

I think your work is incredibly informative for both novice and veteran teachers alike. Please continue doing your amazing work!

It's great because it keeps me up to date and gives me real tried and tested activities to try, and which exemplify the ideas.

I would love it if I could get the print edition in the US.

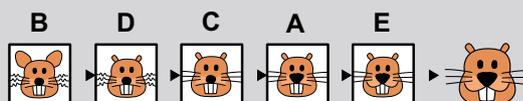
I have found Hello World invaluable for improving the quality and type of computing/coding activities run at the library where I work.

I am more interested in the digital making/general digital aspects in education, especially digital language learning. I'm not your computing reader as such. So any articles that are more general — I zoom into them. I've received Hello World since it began and it is very well formatted and interesting, and when the articles suit me I feel that I'm well informed. The blended learning issue was great and the book reviews were very useful. More blended learning please! *Diolch* ('thanks' in Welsh).

I regularly stick Post-it notes on the pages and update my lesson notes with ideas from the magazine. Keep up the good work!

## BEBRAS PUZZLE SOLUTION (PAGE 93)

It's best to work backwards, starting with the last picture. The picture before it must have only one difference — this is E (number of teeth). Now we can use E as the target and find the picture that only has one difference to it — this is A (mouth). The picture that has only one different attribute to A is C (nose size). D is next because it only differs from C by the whiskers. That leaves B as the first picture (that only differs from D by ear size).



# “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](http://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

Want to talk? You can reach us at:  
**[contact@helloworld.cc](mailto:contact@helloworld.cc)**

---

## FIND US ONLINE

**[www.helloworld.cc](http://www.helloworld.cc)**

 **[@HelloWorld\\_Edu](https://twitter.com>HelloWorld_Edu)**

 **[fb.com/HelloWorldEduMag](https://fb.com/HelloWorldEduMag)**

**SUBSCRIBE  
IN PRINT  
TODAY!**

**PAGES 38–39**



[helloworld.cc](http://helloworld.cc)