The Royal Academy of Engineering

bcs The Chartered Institute for IT Academy of Computing

next gen. SKILLS

Get coding!

Resources to support the learning of Computing: a guide for schools

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Acknowledgements and thanks

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Welcome!

The teaching of Computing in schools has moved centre stage over the past few months.

On 13th January 2012, the Royal Society published the *Shut Down or Restart?* report[1], continuing a discussion on computing in schools begun in the earlier Livingstone Hope *Next Gen* report[2]. Chaired by Professor Steve Furber, a fellow of both the Royal Academy of Engineering and the Royal Society, *Shut Down or Restart?* makes it clear that the current ICT curriculum in the English National Curriculum can encourage a pedestrian approach that overemphasizes mundane learning about tools such as word processors and does not do enough to promote the acquisition of the broader computing knowledge and rigorous engineering skills that would keep Britain at the forefront of a global digital economy.

In the same week, the Secretary of State for Education, Michael Gove, announced far-reaching changes to the ICT national curriculum including a proposal to withdraw the programme of study for ICT from the National Curriculum in England.

The Royal Academy of Engineering believes that every young person should have the opportunity to experience and learn real Computing from ages 5 to 19 in the same way that they experience Mathematics or Science. Computing is that important. We don't underestimate the scale of this challenge. We have to get the right curricula, the right qualifications and we must attract and train many more teachers in order to make this happen but the criticality of the next 10 years for Britain's economy means we have to start making a difference now.

This guide, produced by the Royal Academy of Engineering in association with the BCS Academy of Computing, the Computing at School working group (CAS) and Next Gen Skills is a first step. In these pages you will find links to more than 50 resources that can help young people start learning **real Computing** in schools **now**. More resources are out there for you to discover for yourself – but these help you get started.

The resources naturally cluster into themes:

- Animation
- Clubs
- Competitions
- Computing curricula
- Curriculum enrichment schemes
- Events & courses
- Robotics
- Online teaching resources
- Physical computing resources & kits
- Software development resources

Get coding!

Dr David Grant FREng
Chair
Standing Committee for Education and Training
The Royal Academy of Engineering

1 *Shut Down or Restart?* report, http://royalsociety.org/education/policy/computing-in-schools/report/

2 *Next Gen* report, http://www.nesta.org.uk/home1/assets/features/next_gen

Resources list

Animation

Animation (School of Computer Science, University of Manchester)

A computer animation competition open to UK schoolchildren. It challenges children to create their own animations, as part of a drive to inspire the next generation of computer scientists.

www.cs.manchester.ac.uk/Animation10

Alice

3D animation environment for education.
www.alice.org

Processing

Free open source programming environment for graphics programming.

http://processing.org/

Scratch

A programming language that facilitates 2D animations.

http://scratch.mit.edu/

Clubs

CC4G (Computer clubs for girls)

On line after-school clubs used fun IT-based activities to show 10–14 year olds how computing can help in their lives and careers.

http://www.e-skills.com/education/teachers/online-club-cc4g/

Imagineering Clubs

Imagineering Clubs are aimed at encouraging children of 9–12 years to become the next generation of engineers and scientists. In these clubs, children use simple tools to make working models from a series of kits.

www.imagineeringweb.co.uk

Technocamp /Technoclubs

The Technocamps project – led by Swansea University in partnership with the Universities of Aberystwyth, Bangor and Glamorgan – has been created to develop those skills which will have a positive impact on a pupil's ability to better understand a wide range of topics within STEM. Workshops provide an opportunity for pupils to gain a real insight into computational thinking, applied in a practical and fun way. Technocamps will also show how these skills are used in the real world, by letting pupils know and understand potential career opportunities that are available to them with this skills base.

http://test.technocamps.com/wp-content/uploads/2011/09/Technocamps_Fact-Sheet_english.pdf

STEM Clubs network

STEMNET network of STEM clubs in schools.

http://www.stemclubs.net/

Young Engineers Club Network

Schools and youth groups taking part in any engineering-related enrichment activity are eligible to join the Young Engineers Club Network.

www.youngeng.org/index.asp?page=55

Competitions

Cyber security Challenge UK (Qinetiq and others)

Cyber Security Challenge runs national online competitions and raises awareness of cyber learning opportunities and careers. It is designed to excite, inspire and help talented people, of any age, to follow a career in cyber security.

https://cybersecuritychallenge.org.uk/

University of Southampton National Cipher Challenge

The National Cipher Challenge is an online code-breaking competition for UK schools,run by the mathematics department at the University of Southampton. The competition is run annually throughout the autumn term with graded challenges published periodically over a period of three months. The messages to be broken are the episodes in an adventure story, enriched with ideas from science, history and engineering. Solutions are published throughout so that those who are struggling can still follow.

cipher@soton.ac.uk

Young Engineer for Britain

A national engineering and technology competition that celebrates creative projects from UK students aged 12–19. It provides both a regional and national showcase for student's projects where they can demonstrate their ingenuity either as individuals or in teams.

www.youngeng.org/index.asp?page=55

Computing curricula

Behind the screen

A Computing curriculum initiative from the e-skills UK sector skills council.

http://www.e-skills.com/education/behind-the-screen/

Computing at School

A Computer Science curriculum written specifically for schools and endorsed by Microsoft, Google, BCS and Intellect.

http://www.computingatschool.org.uk/index.php?id=cacfs

NAACE

A draft Key Stage 3 ICT curriculum written for NAACE, the ICT association.

http://www.naace.co.uk/ks3ictcurriculum

Computing at School and NAACE are the subject associations for Computer Science and ICT respectively. Both offer online teacher support groups.

Curriculum enrichment schemes

Engineering Education Scheme (Engineering Development Trust)

Teams of 6th Formers take on industrial projects with engineers acting as mentors.

http://www.engineering-education.org.uk

Go4SET (Engineering Development Trust)

A 10 week STEM enrichment programme for 13/14 year olds.

http://www.go4set.org.uk/

Smallpeice Trust courses

One day STEM courses delivered in schools and 3 day residential courses.

http://www.smallpeicetrust.org.uk/

Events & courses

Apps for Good

Apps for Good is a course where young people learn to create imaginative mobile apps that change their world. Our students create apps that make a difference and solve real life issues that matter to them and their community, giving them a launchpad in social enterprise and the exciting world of technology, design and innovation.

http://appsforgood.org

Computer Based Maths

A movement to create a new mathematics curriculum for schools based around computation. Includes projects, learning resources and an annual summit.

http://computerbasedmath.org/

Games Britannia

An annual videogames festival with workshops.

http://www.gamesbritannia.com/2012/

Hack to the Future

Hack days and computing 'unconferences' for kids.

http://teachcomputing.wordpress.com/2012/02/25/hack-to-the-future-11-02-12/

Think Computer Science

Annual event showcasing the work of computer science researchers, to educate and enthuse students about the field of computer science.

http://research.microsoft.com/en-us/um/cambridge/events/thinkcomputerscience/

Young re-wired state

Young Rewired State is a network of developers aged 18 and under. Its primary focus is to find and foster the young children and teenagers who are driven to teaching themselves how to code, how to program the world around them. YRS works to seek out these people and mentor them primarily through a week long hack event in the Summer. A challenge is set to build digital products: mobile and web, using at least one piece of open data.

www.youngrewiredstate.org

Robotics

First Lego League

Programmable devices using Lego Mindstorms platform.

http://www.firstlegoleague.org/

Also Lego Mindstorms.

http://mindstorms.lego.com/en-us/default.aspx

Robotics

This robotics program will introduce students to the Lego mindstorm robot. An example of the capabilities of mindstorm will be shown to students and they will get to experiment with some of these capabilities.

www.stemcentreni.com

Robotics Activities (Exscitec)

The Robotics Programme includes a range of hand-on courses including topics such as gearing and forces, robotic platform and parts assembly, programming, remote control devices, and autonomous programming with sensors.

www.exscitec.com

Robo Challenge

Robo Challenge is an educational event for schools. The Challenge Crew teaches units of the school curriculum as they guide students from year 5 upwards through building their robot kits. Once assembled and the knowledge gained each member of the team gets to battle it out in the steel arena in a bid to be crowned Robo Challenge Champions.

www.robochallenge.co.uk

RoboCupJunior UK (RoboFesta-UK)

RoboCupJunior is one of the activities offered as part of RoboFesta-UK. Teams of pupils design and build robots to perform specific tasks such as dancing, rescuing, and playing soccer.

www.robofesta-uk.org

RoboFesta-UK (Open University)

RoboFesta-UK is an educational robotics network open to individuals and organisations involved with hands-on robotics activities. These events may take place anywhere. the network was established to help co-ordinate robotics-related events and competitions, and provide resources and support to everyone involved with hands-on robotics activities.

www.robofesta-uk.org

Sentinus Secondary Robotics Roadshow

A one day robotics programme which gives pupils the opportunity to engage in programming and control of autonomous vehicles within the context of space exploration.

www.sentinus.co.uk

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Online teaching/learning resources

Adobe Education Exchange

Online community for Primary/ Secondary and Higher Education teachers.

http://edexchange.adobe.com/pages/home

Big Ambition

e-Skills IT careers website.

http://www.e-skills.com/careers/young-people/bigambition/

Computing Science Inside (University of Glasgow)

A range of lesson-length workshops for use by teachers in classrooms. The aim is to highlight the computer science that underpins the technology revolution all around us, thereby demonstrating the difference between computer use (ICT training) and computer science/software engineering.

quintin@dcs.gla.ac.uk

Cs4fn Computer Science for Fun (Queen Mary, University of London)

Explore how computer science is also about people, solving puzzles, creativity, changing the future and, most of all, having fun. Free printed magazine and website.

www.sodarace.net
http://www.cs4fn.org/

Girl develop it

Online learning environment for novice coders – aimed at women and girls.

http://girldevelopit.com/materials

ICT magic

A well-populated wiki for ICT resources.

http://ictmagic.wikispaces.com/

IET Curriculum for Excellence

Electronics resources for the Curriculum for Excellence in Scotland.

http://www.lightingupthecfe.com/

Interactive opportunities

Learning support materials from the video games industry and training in creative digital technologies for schools.

http://www.io.uk.com/

Primary BLOODHOUND SSC

Primary BLOODHOUND SSC is a whole-class activity that could be adapted for a club or activity day. The project is to use stored energy to propel a vehicle that the children have designed and made. 120 pages of editable interactive whiteboard resources support the delivery of the project.

www.primaryengineer.com

Primary Engineer

Hands on primary technology activities and teacher professional development.

www.primaryengineer.com

Times Educational Supplement (TES) resources bank

One of the most widely used resources sites for teachers.

http://www.tes.co.uk/teaching-resources/

Sodarace (Queen Mary, University of London)

Sodarace is a free online education resource for scientific learning, design and play where humans and machine-intelligences compete and collaborate to create racers and racetracks in an online Olympics.

www.sodarace.net

Vimeo

Video resources that help complete novices to understand the principles of 3D graphics.

http://vimeo.com/user904568

Physical computing resources & kits

Arduino

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software intended for anyone interested in creating interactive objects or environments.

http://www.arduino.cc/

Data Harvest

Popular data loggers, sensor etc. commonly used in schools.

http://www.dataharvest.co.uk/

Genie

Microcontroller kits provided by *Rapid*.

http://www.rapidonline.com

PICAXE

Originally designed as an educational system for schools, the PICAXE microcontroller system is now widely adopted by 'hobbyists' due to its ease of use. PICAXE chips are popular because they are very low-cost, and simple to program using free, easy-to-learn software.

http://www.picaxe.com/

Virtual System Modelling (VSM) is an animated software circuit simulator.

http://www.picaxevsm.com/

Raspberry Pi

A low cost ARM-based computer developed by a Cambridge-based charity.

http://www.raspberrypi.org/

STAMPS in class programme

Stamps in Class is a hands-on entryway to electronics and programming using real-world electronic components. It explores subjects such as robotics, inventing, sensors, process control, physics, analog and digital signals.

http://www.parallax.com/Default.aspx?tabid=362

Software development resources

Code Academy

Interactive online learning environment for coding – US based.

www.codecademy.com

Codea

A low-cost code editor to create games, simulations and other visual output on the iPad.

http://twolivesleft.com/Codea/

Coding for kids

This group was created by a community of people brought together on the 12th October 2011 at the Guardian, York Way, London – made up of young people, teachers, ex-teachers, developers, parents and industry with the purpose of finding ways to support education of programming and computational thinking for the current and next generations in the UK.

http://codingforkids.org

Game Maker

Environment for developing computer games.

http://www.yoyogames.com/

Google Code University

Provides sample course content and tutorials for Computer Science (CS) students.

http://code.google.com/edu/

Kodu

A visual programming language made specifically for creating games. It is designed to be accessible for children and enjoyable for anyone. The programming environment runs on the Xbox, allowing rapid design iteration using only a game controller for input.

http://research.microsoft.com/en-us/projects/kodu/

MIT OpenCourseWare

Online course aimed at students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems. It also aims to help students, regardless of their major, to feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python programming language.

http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00sc-introduction-to-computer-science-and-programming-spring-2011/

Python

Online learning environment.

http://learncodethehardway.org/

The Royal Academy of Engineering

As the UK's national academy for engineering, we bring together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering. We provide analysis and policy support to promote the UK's role as a great place from which to do business. We take a lead on engineering education and we invest in the UK's world class research base to underpin innovation. We work to improve public awareness and understanding of engineering. We are a national academy with a global outlook and use our international partnerships to ensure that the UK benefits from international networks, expertise and investment.

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Drive faster and more balanced economic growth

The strategic challenge is to improve the capacity of UK entrepreneurs and enterprises to create innovative products and services, increase wealth and employment and rebalance the economy in favour of productive industry.

Lead the profession

The strategic challenge is to harness the collective expertise, energy and capacity of the engineering profession to enhance the UK's economic and social development .

Foster better education and skills

The strategic challenge is to create a system of engineering education and training that satisfies the aspirations of young people while delivering the high calibre engineers and technicians that businesses need.

Promote engineering at the heart of society

The strategic challenge is to improve public understanding of engineering, increase awareness of how engineering impacts on lives and increase public recognition for our most talented engineers.

The Royal Academy of Engineering promotes excellence in the science, art and practice of engineering.

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