Report

Digital Literacy Within the Computing Curriculum

January 2021

Raspberry Pi

Contents

Teach Computing

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1. Introduction

Young people need the skills, knowledge, and confidence to understand the digital world in which we live. In both their school and personal life, they will use technology to develop solutions to problems. An understanding of the technical, societal, and ethical aspects of technology will help them critically evaluate emerging applications and technologies.

There are a range of terms to describe this body of skills and knowledge. In line with the national curriculum for England, we use the term **digital literacy**, which we define as:

The skills and knowledge required to be an effective, safe, and discerning user of a range of computer systems.
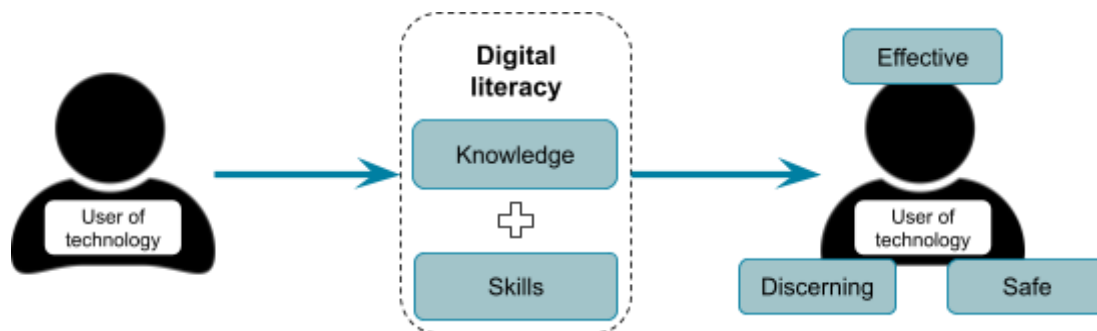

Figure 1: An illustration of the NCCE's definition of digital literacy

In England, the school curriculum includes computing as a mandatory subject from key stage 1 to 4 (ages 5–16). It covers a range of topics, from programming, to how the computer works, to digital literacy. The curriculum programme of study states that "Computing also ensures that pupils become digitally literate – able to use, and express themselves and develop their ideas through, information and communication technology – at a level suitable for the future workplace and as active participants in a digital world." [1]

An important aspect of the computing curriculum is digital literacy. Some skills learnt early on in school have a physical component, such as learning to use a device. As they move through school, learners should use different pieces of software and be confident to use those they haven't yet encountered. Before they leave school, a young person who has been taught the computing curriculum should be able to critically evaluate their choice of software tools; the digital products they create, and the suitability of their products for the intended aims and audience; and the impact of different tools and technologies on society.

The National Centre for Computing Education (NCCE) was launched in 2018 to work with schools across England to support the teaching of computing. In the first two years, we have engaged with 29,500 teachers, of which 7,500 teachers have participated in professional

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[1] Department for Education. (2013) *National curriculum in England: computing programmes of study.* Available from:
https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study/national-curriculum-in-england-computing-programmes-of-study [Accessed 13 January 2021].

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development. The NCCE includes 34 regional Computing Hubs that take a leadership role in their localities and support schools to deliver a high-quality computing education.

This report about digital literacy in the computing curriculum is the first in a series of NCCE reports, each exploring a different aspect of the curriculum.

When the curriculum changed from ICT to computing, there was an assumption that computer science was to be the focus of the subject — media reports concentrated on the term "coding" at the time.[2] However, computing covers digital literacy as well as the foundations of computer science. The NCCE's role has been to support the entire curriculum. A central part of this role has been the development of the Teach Computing Curriculum, which offers teaching resources for each stage of the curriculum. This groundbreaking, and freely available, curriculum supports teachers and learners alike on a journey from key stage 1 to 4 and builds upon the latest research, as well as years of expert teaching experience.

This learning journey is illustrated here in this report (see Figure 2), which is also available to download as a classroom poster from the Teach Computing website.[3] Here teachers can also find curriculum map documents for each key stage.

COVID-19 has emphasised the importance of digital literacy

The move to online learning caused by the COVID-19 pandemic has disrupted schools, teachers, and learners. It has shown the importance of digital skills, while also drawing attention to the digital divide in the UK. Young people who are already educationally disadvantaged may lack a device or internet access to take part in online learning.[4] There are schemes to support access to technology from home, but there are many factors that contribute to this digital divide. A report from the Children's Commissioner for England also shows that for young people to be able to learn from home, they must have access to a device, the internet, and high-quality support from teachers.

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[2] Dredge, S. (2014) *Coding at school: a parent's guide to England's new computing curriculum.* The Guardian. Available from:
https://www.theguardian.com/technology/2014/sep/04/coding-school-computing-children-programming
[Accessed 26 January 2021].
[3] The National Centre for Computing Education. (2020) *Teach Computing Curriculum Journey*. Available from:
https://ncce.io/curriculum [Accessed 14 January 2021].
[4] Children's Commissioner for England. (2020) *Tackling the disadvantage gap during the COVID-19 crisis.*
Available from:
https://www.childrenscommissioner.gov.uk/wp-content/uploads/2020/04/cco-tackling-the-disadvantage-gap-during-the-covid-19-crisis.pdf [Accessed 13 January 2021].
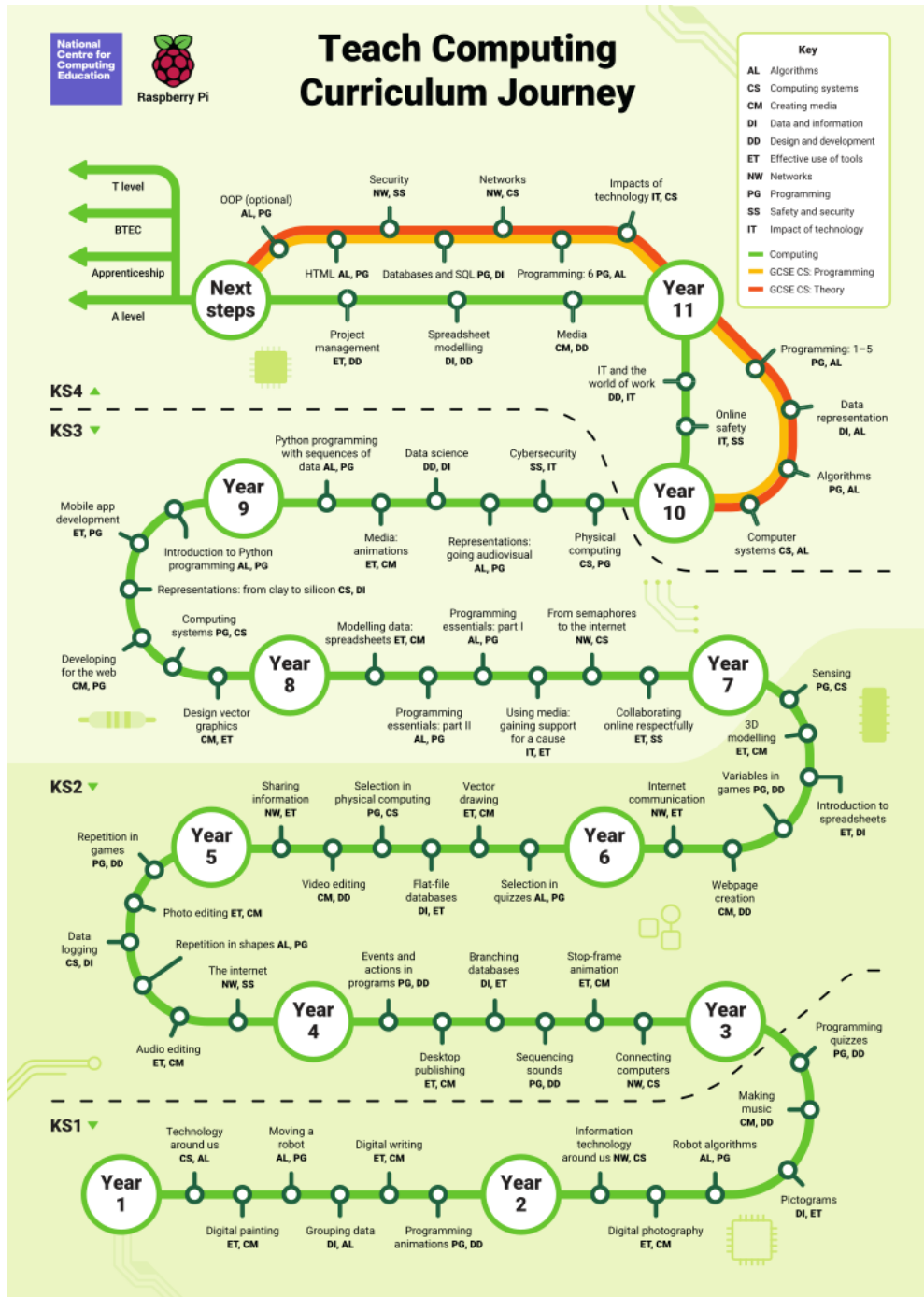
Figure 2: The Teach Computing Curriculum journey

The purpose of this report is to outline the ways in which the NCCE can support you with all aspects of the teaching and learning of digital literacy. It has been written in relation to the curriculum in England, although you may also find it interesting if you're reading this from another context. The intended audience is all serving teachers, prospective teachers, and educators involved in teaching computing; as well as those leading on remote education for their school.

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2. Digital literacy in the national curriculum

Digital literacy is an important element of computing in the national curriculum for England. It goes beyond the practical skills needed to be an effective user of technology, for which we might use the term digital skills. Digital literacy encompasses more critical aspects around the responsible application of technology.

Looking across the aims and key stage specifications of the computing curriculum, it is possible to identify digital literacy themes and how a learner can progress in their capabilities in these areas[5].
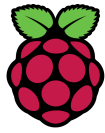
The first theme is the **use of devices, tools, and applications**. The aims of the national curriculum specify that learners should be "competent, confident and creative users of information and communication technology", which should comprise a variety of tools and devices. In key stage 1, learners can do this as they "recognise common uses of information technology beyond school". In key stage 3, learners are asked to "undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices", demonstrating progression

The second theme is **handling and storing information**. There is clear progression from "using technology purposefully to create, organise, store, manipulate and retrieve digital content" in key stage 1, to collecting and analysing data in key stage 3 and beyond.

The next theme that emerges relates to the **design, creation, and editing of content**. For key stage 2, this means "select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals". In key stage 3 this is expressed as "undertaking creative projects that involve selecting, using, and combining multiple applications [...] to achieve challenging goals".

Another crucial element of digital literacy is **communication**, which threads through all of the key stages. In key stage 1 the focus is primarily on the safety issues associated with "content or contact on the internet or other online technologies". Learners quickly progress to "understanding networks" and "the opportunities they offer for communication and collaboration" in key stage 2. This development continues throughout their secondary education, with the expectation that by the end of key stage 4, learners should have the skills and understanding to pursue "higher levels of study or a professional career". In today's world, this includes the need to be able to communicate and collaborate effectively using digital tools.

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[5] Department for Education. (2013) *National curriculum in England: computing programmes of study*. Available from:
https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study/national-curriculum-in-england-computing-programmes-of-study [Accessed 25 January 2021].
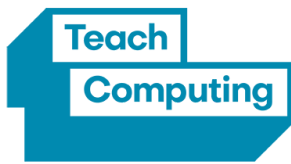
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A fifth theme in our digital literacy framework is **safety**, particularly online. Again, this is emphasised at all stages of the curriculum, from key stage 1 learners being able to "use technology safely and respectfully" through to key stage 4 learners (not just those studying for a post-14 qualification) being able to "understand how changes in technology affect safety". This theme is even more important with the emerging changes in cybersecurity, artificial intelligence, and Big Data, which will affect young people's lives in ways that we cannot yet foresee.

The final theme is around **moral and ethical behaviour**, and its impact on oneself and society. The word "responsible" occurs frequently in the programme of study. For example, in key stage 3 learners should "use technology safely, respectfully, responsibly and to recognise inappropriate content, contact and conduct". We want our young people to be able to use a moral and ethical lens when evaluating the uses of technology. Related to this is the requirement for learners to be able to apply their digital literacy skills to "new or unfamiliar technologies". Examples of these "new" technologies may be those relying on artificial intelligence or data analytics, such as the increased use of facial recognition in law enforcement. Such systems rely on data, and biased data (even unintentionally) can lead to biased systems. Therefore, it's essential that learners leave school able to evaluate the impact of those technologies, and have a basic understanding of digital ethics.

Across all themes and key stages, the ability to evaluate (content, solutions, technology) is repeatedly referenced. We have not identified evaluation as a separate digital literacy theme, as it applies to many contexts. However, we will refer to it in our discussion of the NCCE curriculum materials.

These are the six themes for digital literacy across the national curriculum:

- Use of devices and applications
- Handling and storing data and information
- Design, creation, and editing of content
- Communication using technology
- Online safety
- Moral and ethical behaviour relating to technology

In this report we look at each of the key stages for computing to consider how teachers can ensure that digital literacy is addressed at each stage of a learner's education. In the next section is an overview of the Teach Computing Curriculum and its structure, which also identifies the specific elements of digital literacy at each key stage.

3. Digital literacy and the Teach Computing Curriculum

3.1 NCCE curriculum structure

As already mentioned, the NCCE exists to help teachers deliver the entire computing curriculum. Some interpretations divide computing into three sections: computer science, information technology, and digital literacy. These labels help categorise knowledge and skills, and identify gaps in curricular or teacher development. However, they can also be interpreted as mutually exclusive areas of the curriculum, obscuring the rich, interconnected nature of computing. In reality, any single computing lesson, at any phase, should span these three elements. For example, when learners explore how computer networks function, they think about:

- The needs of the user
- The data they need to transmit and its purpose
- The mechanics of how that data is transmitted across a network
- The need for security and privacy, and how users can protect themselves

With this in mind, the Teach Computing Curriculum, as well as other content from the NCCE, is built upon a 'taxonomy' system used to classify and catagorise content. This categorisation consists of ten strands that span the current national curriculum for computing. Each strand has a combination of skills and knowledge which feature throughout the curriculum. Strands that are rich in knowledge form the basis of the units within the curriculum. Other strands focus on skills across all units. Below in Table 1 is a summary table of the ten strands.
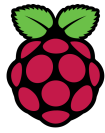
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Table 1: A summary of the ten strands in the NCCE content taxonomy

Strand	Description
Algorithms	Comprehend, design, create, and evaluate algorithms
Creating media	Select and create a range of media including text, images, sounds, and video
Computing systems	What a computer is and how its constituent parts function together
Design and development	The activities involved in planning, creating, and evaluating computing artefacts
Data and information	How data is stored, organised, and used to represent real-world artefacts and scenarios
Effective use of tools	Use hardware and software tools to support computing work
Impact of technology	How individuals, systems, and society as a whole interact with computer systems
Networks	How networks can be used to retrieve and share information and come with associated risks
Programming	Create software to allow computers to solve problems
Safety and security	Understand risks when using technology and how to protect individuals and systems

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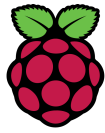
Every objective from the Teach Computing Curriculum's 500+ lessons is mapped against one or more of these strands. When put together, this mapping shows the breadth of knowledge and skills in each unit of work. For example, the Year 8 unit 'Developing for the web', focuses on the 'Programming', 'Networks', and 'Creating media' strands, but it also covers all but one of the other strands.
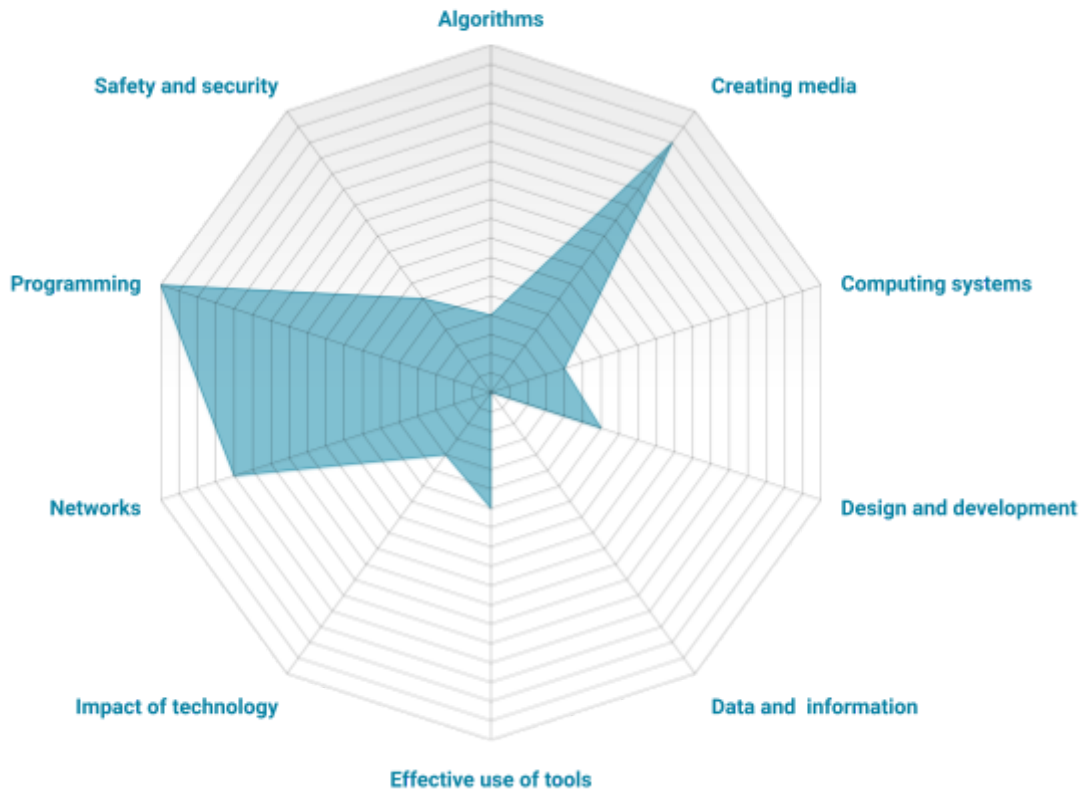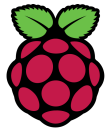

**Figure 3:** Example unit objectives mapped to NCCE taxonomy strands

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We compared the digital literacy themes from Section 2 to the NCCE taxonomy strands. It helped us identify five specific strands to support learners in developing their digital literacy (Table 2).

Table 2: Digital literacy themes mapped to relevant NCCE taxonomy strands

NCCE taxonomy strand

Digital literacy theme	Creating media	Data and information	Effective use of tools	Safety and security	Impact of technology
Use of devices and applications			✔	✔	
Handling and storing data and information		✔	✔		
Design, creation, and editing of content	✔		✔		
Communication			✔	✔	
Safety				✔	✔
Moral and ethical behaviour		✔			✔

Through this mapping, we can look at corresponding objectives from the Teach Computing Curriculum and develop a progression of digital literacy through the lessons. Focusing on key stages provides a narrative of the progression of digital literacy, as illustrated in the next section.
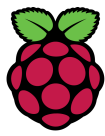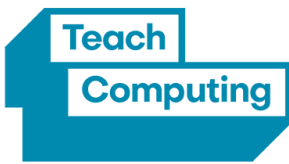
3.2 Progression of digital literacy

There are over 900 learning objectives across key stage 1 to 4. To identify the digital literacy elements addressed by the Teach Computing Curriculum, we evaluated all of these learning objectives, and chose those that fell solely under the five strands identified in Section 3.1.

We then coded and matched each objective to the six digital literacy themes to emphasise individual elements. Below is a description of the digital literacy elements of the Teacher Computing Curriculum, according to each key stage.

As discussed in Section 2, evaluation is an important skill within computing. Evaluation is not limited to digital literacy, but it plays an important role for learners as they develop their digital skills. In each table, the second column indicates which elements of digital literacy involve evaluation.

Key stage 1

In key stage 1, learners begin with a wide range of experiences due to the disparities in access to technology referenced in Section 1. Varying levels of parental engagement can have an impact, as well as differing digital experiences during the EYFS phase. Some learners will have developed digital skills and confidence at home, using it for entertainment, communicating, socialising, etc. However, learners' experiences may centre on portable devices: mobile phones, tablets, games devices. Learners who have used general purpose devices — PCs and laptops — may have had only limited access to a shared device. It is important to invest time in helping all learners achieve a common set of skills to equip them for digital learning in computing. This is especially important for the use of general purpose computing devices.

At this stage there is a clear focus on using devices, such as keyboards and mice. This may be unfamiliar to learners as it requires fine motor skills. Much like learning to use a pen or a pencil, the use of these input devices are fundamental to acquiring digital skills.
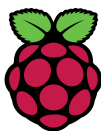
Learners also develop their understanding of what digital technology is and how we use it, identifying examples from home, school, and their wider experience. They gain practical experience in recognising and using both controllable and programmable devices.

Learners create and edit simple media (e.g. text and images), which they will learn to save and retrieve at a later date. Their experience in digital creation allows them to make comparisons with other creation techniques, e.g. drawing and writing by hand.
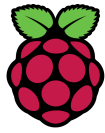
Throughout the key stage (see Table 3), learners should develop this essential foundation of skills and knowledge.

Table 3: Digital literacy skills and knowledge at key stage 1

Digital literacy	Digital literacy theme (* includes evaluation)	Curriculum units
Basic keyboard skills: typing letters, numbers, symbols, backspace, Enter key	Use of devices and applications	- Y1 Technology around us - Y1 Digital writing
Additional keyboard skills: Shift key for upper-case letters or symbols, arrow keys, Del key	Use of devices and applications	- Y1 Technology around us - Y1 Digital writing
Basic mouse skills: move, left-click, drag	Use of devices and applications	- Y1 Technology around us - Y1 Digital painting
Additional mouse skills: scroll, right-click, double-click	Use of devices and applications	Y1 Digital writing
Use digital cameras	Use of devices and applications	Y2 Digital photography
Recognise and control programmable toys	Use of devices and applications	- Y1 Moving a robot - Y2 Robot algorithms
Use equipment safely	Safety	- Y1 Technology around us - Y2 Information technology around us
Create and edit (text and images)	Design, creation, and editing of content	- Y1 Technology around us - Y1 Digital writing - Y1 Digital painting - Y2 Digital photography
Access computing devices: power, login, etc.	Use of devices and applications	Y1 Technology around us

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Save and open files	Design, creation, and editing of content	- Y1 Digital writing - Y1 Digital painting - Y2 Digital photography
Compare technology at home and school	Use of devices and applications*	- Y1 Technology around us - Y2 Information technology around us
Contrasting digital/manual creation activities	Design, creation, and editing of content*	- Y1 Digital writing - Y1 Digital painting - Y2 Pictograms
Collect, count, group, and compare simple data	Handling and storing data and information	- Y1 Grouping data - Y2 Pictograms
Use technology safely and respectfully	Online safety	- Y1 Technology around us - Y2 Information technology around us
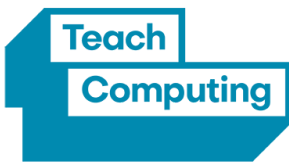
Key stage 2

As learners progress into key stage 2 (see Table 4), they bring with them a secure foundation of digital literacy. They are able to make use of computing devices, including a keyboard and mouse, to create text and graphics. They also have some experience in using technology to organise and categorise simple data.

Learners expand their use of technology to include input and output devices, as well as a broad range of general purpose software. Skills previously learnt in isolation begin to be applied, combined, and further developed. Learners work with a greater sense of purpose to create a selection of media, including sound, video, webpages, and more.
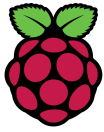
Learners are able to find, select, organise, and present data and information for a purpose. They also learn how technology can be used to safety communicate information around the world.

As learners' digital literacy develops, they should become confident in using common tools and techniques, and applying them in multiple contexts. Skills such as formatting, layout and layering, searching, and copy and pasting will become part of their everyday use of technology.

Table 4: Digital literacy skills and knowledge at key stage 2

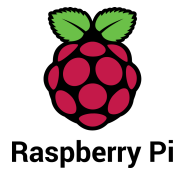| Digital literacy	Digital literacy theme (* includes evaluation)	Curriculum units
Capture digital content using devices including sound recorders, video cameras, sensors, and controllers (Includes embedded devices, e.g. an integrated tablet camera)	Use of devices and applications	- Y4 Audio editing - Y4 Data logging - Y5 Video editing - Y5 Selection in physical computing - Y6 Sensing
Make use of cut, copy, paste, as well as formatting tools	Design, creation, and editing of content	- Y3 Desktop publishing - Y5 Vector drawing - Y6 3D modelling
Organise and present data	Handling and storing data and information	- Y3 Branching databases - Y4 Data logging - Y5 Flat file databases - Y6 Introduction to spreadsheets
Create multimedia (text, sounds, images, video, and 3D objects)	Design, creation, and editing of content	- Y3 Stop frame animation - Y3 Desktop publishing - Y4 Audio editing - Y4 Photo editing - Y5 Video editing - Y5 Vector drawing - Y6 Webpage creation - Y6 3D modelling

Find suitable information online	Handling and storing data and information*	- Y5 Sharing information - Y6 Internet communication - Y6 Webpage creation
Select appropriate communication tools	Communication*	- Y5 Sharing information - Y6 Internet communication
Use collaboration tools (e.g. shared documents)	Communication	Y5 Sharing information
Select appropriate content (purpose, accuracy)	Handling and storing data and information*	- Y3 Desktop publishing - Y4 Audio editing - Y4 Photo editing - Y5 Video editing - Y6 Webpage creation
Select appropriate content (ownership, copyright)	Moral and ethical behaviour*	- Y3 Desktop publishing - Y4 Audio editing - Y4 Photo editing - Y5 Video editing - Y6 Webpage creation
Use equipment safety	Safety	- Y4 Audio editing - Y4 Data logging - Y5 Video editing - Y5 Selection in physical computing - Y6 Sensing
Apply common skills in new contexts	Use of devices and applications	Y3 Stop frame animation

		● Y3 Desktop publishing ● Y4 Audio editing ● Y4 Photo editing ● Y5 Video editing ● Y5 Vector drawing ● Y6 Webpage creation ● Y6 3D modelling

Key stage 3

By the time learners reach secondary education, they will have experienced a range of hardware and software. They should be confident in using technology to create artefacts and present information and ideas. During key stage 3 (see Table 5), they learn to combine their skills and knowledge to solve problems and meet the needs of specific audiences.

Learners apply their past experience to learn to use new hardware and software, identifying common tools and features. This experience also helps them recognise appropriate software for a given task and to make their own selection about what tool(s) to use.
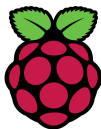
Digital communication is an area that has an increased focus at this phase. Whilst learners may have some experience from home, particularly social media, many will be learning to use technology to effectively communicate for the first time. During this key stage, they make use of email for communication and routinely work using online collaboration tools.

Learners' ability to use and manipulate data will also expand as they become more deliberate in how they plan, collect, and analyse data to answer specific questions or validate hypotheses.

Learners are expected to become more independent in their use of digital tools, managing various credentials for websites, tools, and their school network. They should identify common risks associated with using technology and take sensible steps to protect themselves

Table 5: Digital literacy skills and knowledge at key stage 3

Digital literacy	Digital literacy theme (* includes evaluation)	Curriculum units
Combine software tools to create digital products for different purposes and audiences	Design, creation, and editing of content*	- Y7 Collaborating online respectfully - Y7 Gaining support for a cause - Y9 Data science - KS4 IT project management - KS4 Media
Familiarity with a range of online communication and collaboration tools	Communication	- Y7 Collaborating online respectfully - Y7 Gaining support for a cause - Y8 Mobile app development - Y9 Data science - KS4 IT and the world of work - KS4 IT project management - KS4 Media
Awareness of risks and mitigations associated with online services	Safety	- Y7 Collaborating online respectfully - Y9 Cybersecurity - KS4 Online safety - KS4 Security
Critically reflect on the impact of various technologies in terms of ethics, benefits, risks, etc.	Moral and ethical behaviour*	- Y9 Cybersecurity - KS4 Security - KS4 Networks - KS4 Impacts of technology

Act as a responsible digital user considering copyright, crediting, and online relationships	Moral and ethical behaviour	- Y7 Collaborating online respectfully - Y7 Gaining support for a cause - KS4 Impacts of technology
Define, collect, and clean data to answer a specific question	Handling and storing data and information	- Y7 Spreadsheets - Y9 Cybersecurity
Identify patterns in data as part of analysis	Handling and storing data and information	- Y7 Spreadsheets - Y9 Cybersecurity
Access a computer network using secure credentials	Use of devices and applications	Y7 Collaborating online respectfully
Apply past experience of hardware and software to new devices and programs	Use of devices and applications	- Y7 Collaborating online respectfully - Y7 Gaining support for a cause - Y8 Vector graphics - Y9 Animations
Select appropriate tools	Design, creation, and editing of content*	- Y7 Collaborating online respectfully - Y7 Gaining support for a cause - Y7 Spreadsheets - Y8 Vector graphics - Y9 Animations - KS4 IT project management - KS4 Spreadsheets
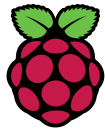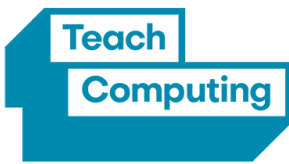
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Key stage 4

By key stage 4 (see Table 6) learners should be competent users of technology, tackling creative and data-focus tasks. During Years 10 and 11, learners focus their digital literacy development on using technology safely, effectively, and productively, particularly in the world of work.

They learn how to use digital technology to manage projects from beginning to end, as they work to a client brief and deadline. As well as using technology to create digital products, they collaborate with their peers and consider the accessibility of the tools and practices they employ.

Learners expand their understanding of the impact of technology on society, with emphasis on the collection and use of Big Data and the value of data as a commodity. They also explore, discuss, and debate contentious issues related to the use of technology.

Table 6: Digital literacy skills and knowledge at key stage 4

Digital literacy	Digital literacy theme (* includes evaluation)	Curriculum units
Awareness of how data is collected, stored, and processed, and for what purpose	Handling and storing data and information	● KS4 Spreadsheets ● KS4 Databases and SQL ● KS4 Programming part 6: dictionaries and data files
Understand the key stakeholders of Big Data and data as a commodity	Handling and storing data and information	● KS4 Impacts of technology
Use technology tools in collaborative projects, enabling accessibility and inclusive work practices	Communication*	● KS4 IT and the world of work ● KS4 IT project management
Use technology to improve flexibility and productivity of work	Use of devices and applications*	● KS4 IT and the world of work ● KS4 IT project management
Create and evaluate digital media artefacts to meet a client brief	Design, creation, and editing of content*	● KS4 Programming part 6: dictionaries and data files ● KS4 IT project management
Present the moral and ethical issues associated with different applications of digital technology	Moral and ethical behaviour*	● KS4 Impacts of technology ● KS4 Online safety

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4. Case studies

To explore the important role that digital literacy plays in computing education, we spoke to two classroom teachers. We asked each of them about their school, their experiences teaching computing, and the importance of digital literacy and digital skills for their learners.

Our first teacher, Rohini Shah, works as a secondary computing educator at Queen's Park Community School in London, where she has taught for the last 17 years.

"Queen's Park Community School is a large inner-city school and has a very diverse group of pupils, from ethnic mixes, to educational needs, to language needs. Historically we've offered GCSE ICT and regularly entered 100+ students per year. This began to change in 2010 as the school joined the pilot program for what was then GCSE computing and eventually became GCSE computer science. We've offered the GCSE since then and over the last 2–3 years entered between 70 and 80 students.

"I'm really passionate about the subject and particularly in bridging the gender divide which is something we've worked hard at in school. I've come to teaching from the IT industry, I used to work for large organisations so I have a decent background in computing. When I think about digital skills, I am talking about having young people ready to tap into any kind of technology and for young people to have the confidence to use all the software that is out there without feeling stressed or as if they don't have the skills.

"When I think of our students, they come to school with many digital skills, but they are usually more social media and entertainment-based skills. I often have parents saying, "oh, they're always on their computer", but what are they likely doing? Perhaps playing games or using Instagram, Snapchat, or something similar. That experience is fine and they are picking up some useful skills, but what about the more serious skills that will prepare them for their future? We need our students to be able to present data using spreadsheets, organise their files, and create presentations and other media that is fit for an audience or purpose. These skills are as equally important as an individual's literacy and numeracy skills to be an effective employee in any business sector. We also need all our students to grasp new technologies like machine learning, artificial intelligence, and Big Data so that they understand the likely impact and ethics. Topics like these aren't currently part of the curriculum, but pupils being aware of these kinds of things feels like an important digital skill. We've moved towards the more technical parts of the subject and have lost our focus on these skills that we used to teach through ICT. However, we have started reconsidering the introduction of a more general-purpose digital qualification.

"As teachers, we've rightly focused on increasing our students' knowledge and skills in computer science and programming, but perhaps taken our eye off the ball when it comes to digital skills. We've maybe assumed those skills will be developed across the curriculum or

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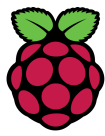
develop naturally with increased experience. I think that we need to be more explicit in how we teach digital skills in computing and reinforce them across the curriculum.
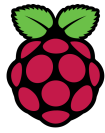
"I think our computing teachers here are well prepared for teaching digital skills as they have those skills themselves, even if they've come to computing as non-specialists. If we want to see digital skills happening across the curriculum, we need to support our non-specialist teachers, who may have gaps in their understanding or experience of using and teaching digital skills. I think these skills gaps could be addressed quite simply through short bite-size skills videos, covering a range of areas from spreadsheet filtering, to calendar management, and email. But sometimes teachers need individual support that should be available to them for their growth and skills development."

Isabelle Young works as a Year 4 class teacher as well as computing lead for Jubilee L.E.A.D. Academy in Nottingham.

"Our school is a single-form entry primary in a deprived area of Nottingham, where pupils' access to technology at home is often limited to a shared phone or tablet. During the last two years we've been really pushing computing as one of our focus subjects, as we didn't have much in place previously. Our initial effort was around addressing online safety with our pupils, and understanding their digital footprint and its impact. More recently we have begun to focus on creative computing as well as more coding-based activities. We've had our pupils using Lego WeDo to get hands on with programming rather than always relying on Scratch. As a school we're getting our computer room redone, our pupils are really comfortable with our iPads but using a laptop is a slightly alien experience for them. We've been spending more time focusing on some of the basics like using a keyboard, logging in, and using common software. We've actually found that the pupils are enjoying the subject more and realising that it's not just going on an iPad and Googling something, that there's a lot more to it.

"To me, digital literacy includes a whole range of things, such as being able to use devices correctly including iPads, computers, and laptops; but also things like cameras and other digital devices. We already do a lot about online safety and there are elements of this that I would include as essential digital literacy. From their experience at home they can use a phone, they can chat to their friends, but they may not have access to a computer or laptop that they can use for learning. I do think one of the big challenges is kind of getting them ready for the outside world. Skills like using email, word processing, creating and editing images, even being able to save and organise their work. I think that's one of the big issues at the moment, is they lack a lot of skills for their everyday life, for learning and their future career prospects. And actually, if they don't have that basic digital literacy in place, then they can't kind of do the more advanced things.

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"Reflecting on our experience, we work hard on developing basic (physical) skills in Year 1, enough for them to access the curriculum, but these skills perhaps aren't developed as pupils progress through to Year 6. For example, we ensure they're able to use a keyboard in Year 1, but don't explicitly revisit in later years, reinforcing the basics and adding new skills like keyboard shortcuts etc. I think that some parts of the computing curriculum are much better than they were, particularly the addition of programming, the pupils need this. But then it's almost like the basic elements have dropped off a bit and think they've missed that. We can see with our current cohorts, the groups that explicitly tackled some of that digital literacy early on are now much more confident.

"Developing digital literacy is wider than the computing curriculum though, they need to be reinforced and supported in all areas. This is something I'm working on right now, finding opportunities to apply pupils' digital literacy across the curriculum, moving their experience beyond "researching with Google" to make effective use of their skills. This means we have to support staff whose experiences and confidence can be very varied. I'm quite confident myself in either having the skills needed or being able to figure things out through experimentation. I've recently been offering small CPD activities for all our staff, particularly in response to the pandemic, each focusing on essential skills related to a software package or activity. Sessions have included a focus on effective use of email, introducing new tools like Scratch, or advanced features of PowerPoint. I've found that many staff members already know a lot more than they think and for many it has been about giving them the confidence they need."

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5. Professional development for computing teachers

A core part of the NCCE's role is to help teachers with their digital literacy through continued professional development (CPD).There are a number of routes for teachers to participate in CPD to support their digital literacy.
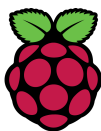
Table 7 (below) shows the courses that are available within the NCCE to support teachers' development of digital literacy. Teachers can explore and enrol on all of the NCCE's courses at teachcomputing.org/courses.

Beyond accessing formal courses, there are many opportunities for computing teachers to learn through networks such as Computing at Schools (CAS). These local communities continue to meet regularly and share best practices and skills and are therefore a great source of inspiration and development for teachers. As well as local support and meetups, CAS and the BCS have produced a series of webinars as part of **CAS Inspire 2020**.[6] Many of these sessions address the digital literacy that teachers need.
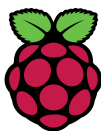
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[6] Computing at School. (2020) *CAS Inspire Primary & Secondary Webinar*s. Available from: https://www.gotostage.com/channel/casinspire20 [Accessed 25 January 2021].

Table 7: Courses to support teachers' development of digital literacy

| Course	Format	Primary / secondary	Description	Digital literacy themes
Get Started Teaching Computing in Primary Schools	Online	Primary	This course examines the breadth of computing using activities from the NCCE Teach Computing Curriculum (TCC), develops subject knowledge, and teaching practices.	• Use of devices and applications • Handling and storing data and information • Design, creation, and editing of content • Communication using technology • Online safety
Introduction to Cybersecurity	Online	Secondary	Teaching cybersecurity in schools is an important way to help learners stay safe while using technology. On this course, teachers will be introduced to the core ideas of cybersecurity that should be taught in the classroom.	• Communication • Safety • Moral and ethical behaviour
Introduction to Encryption	Online	Secondary	This course covers encryption, its history, current use, as well as future applications. Participants will learn about a range of encryption techniques and schemes.	• Communication • Safety
Understanding Computer Systems	Online	Secondary	Understanding how a computer works is crucial to working with technology effectively. This course explores what	• Use of devices and applications

			happens inside the machine and how computers turn inputs into outputs.	
Embedded Systems	Online	Secondary	This course explores how embedded systems are used in the world around us. It covers what makes an embedded system different from a general purpose system, and how embedded systems are specialised for a particular use.	● Use of devices and applications
Impact of Technology	Online	Primary / secondary	In this course, teachers explore the ethical, legal, cultural, and environmental concerns surrounding Computing. Participants practise the skills needed to hold relevant, open, and exciting discussions in the classroom.	● Moral and ethical behaviour
Databases and SQL	Online	Secondary	This course addresses what databases are and why we use them. It explores how SQL is used to search and manipulate the data.	● Handling and storing data and information
Introduction to Primary Computing	Remote	Primary	This course helps teachers to understand the nature of computing in the curriculum; the breadth and depth of the subject. It provides hands-on experience of teaching different aspects of the computing curriculum.	● Safety (online)

Teaching and Leading KS1 Computing	Face-to-face and remote	Primary	This course aims to give you confidence in teaching the whole of the key stage 1 computing curriculum. It unpicks the curriculum providing a clear vision of the expectations for this key stage.	● Handling and storing data and information ● Design, creation, and editing of content ● Safety (online) ● Use of devices and applications
Teaching and Leading KS2 Computing	Face-to-face and remote	Primary	This course addresses the key stage 2 computing curriculum. It explores how to support learners in becoming skilled and critical users of technology, and how to choose tools to help them achieve their goals while developing safe and acceptable online behaviours.	● Use of devices and applications ● Safety (online) ● Moral and ethical behaviour relating to technology ● Design, creation, and editing of content ● Handling and storing data and information ● Communication using technology
Key Stage 3 Computing for the Non-specialist Teacher	Remote	Secondary	This course is designed to develop subject knowledge around key topics such as algorithms, data representation, hardware, and programming. It also explores useful and engaging strategies for delivering this content in the classroom.	● Handling and storing data and information
KS4 Computing for All	Face-to-face	Secondary	This course explores the options available to teachers in different school contexts to provide a high-quality computing education in KS4 for all learners.	● Use of devices and applications ● Handling and storing data and information

				• Design, creation, and editing of content • Safety (online)
Introduction to Computer Systems, Networks, and Security	Face-to-face and remote	Secondary	During this course, teachers establish a foundational knowledge of concepts, terminology, and classroom practice related to the components of computer systems and how these can then be connected together to form a network.	• Safety (online)
The Internet and Cybersecurity	Face-to-face and remote	Secondary	Participants explore how the internet works and how its expansion has led to the rapidly growing cybersecurity industry. The course covers the inner working of local networks to global systems and develops knowledge of computer security issues and practices.	• Safety (online)
Python Programming — Working With Data	Face-to-face and remote	Secondary	During the course participants learn about data types, and how data structures are manipulated in Python programs. Creating and editing files that can store data for later use is covered in the context of developing more complex software applications.	• Handling and storing data and information
Introduction to Programming,	Face-to-face and remote	Secondary	This course addresses some early steps in teaching GCSE computer science. It helps establish a foundational knowledge and	• Handling and storing data and information
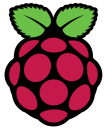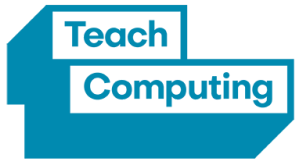
Algorithms, and Data			covers algorithms, programs, as well as how computers use binary numbers to represent data.	

6. Digital literacy across the curriculum

Digital literacy can be developed through the delivery of the Teach Computing Curriculum, and reinforced when applied across the curriculum. Learners need to be able to use their digital literacy to research topics and present their work in every subject in the curriculum. For example, skills in data handling in geography, photo editing and graphic tools in art, and giving learners the opportunity to discuss the ethics of advancing technology in a range of subjects, from science to physical education.

Similarly, all teachers, whatever they are teaching, should have the confidence that they can model the use of technology in their subject, and support their learners. However, teachers may not have had training in digital literacy, and it is no longer a requirement in the Teacher Standards[7]. A Rand Europe report from 2017 found that teachers were in need of professional development in digital literacy[8]. This aligns to research into adult digital skills. In 2019, the Department for Education reported that 21% of adults did not have the full set of digital skills, reported as essential in the digital skills framework, which fall into the following categories[9]:

- Communicating
- Handling information and content
- Transacting
- Problem-solving
- Being safe and legal online

Whilst the NCCE's courses are targeted towards current or aspiring teachers of computing, many of the resources described here may be valuable to colleagues wanting to develop their own digital literacy as a teaching professional. The NCCE suite of professional development is open to all teachers, regardless of their subject discipline.
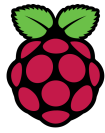
We have learnt from the case studies that teachers of the wider curriculum often rely on computing teachers in their school for digital literacy support. This additional teacher-to-teacher support may include training sessions, video content, mentoring, and more. Recent demand has increased due to the wide-scale adoption of remote teaching. We acknowledge the additional demand on computing teachers who may have had to develop resources, training, and policies to support their colleagues.

Another source of support is Computing at School (CAS) communities and events, which are highlighted in Section 5. This support is a great resource that **all teachers** can access to help them develop their digital literacy.

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[7] Department for Education. (2011) *Guidance: Teachers' Standards*. Available from:
https://www.gov.uk/government/publications/teachers-standards [Accessed 25 January 2021].
[8] Grand-Clement, S., Devaux, A., Belanger, J. & Manville, C. (2017) *Digital Learning: Education and Skills in the Digital Age.* RAND Corporation and Corsham Institute. Available from:
https://www.rand.org/pubs/conf_proceedings/CF369.html [Accessed 25 January 2021].
[9] Department for Education. (2019) *Guidance: Essential Digital Skills Framework.* Available from:
https://www.gov.uk/government/publications/essential-digital-skills-framework/essential-digital-skills-framework#digital-foundation-skills [Accessed 27 January 2021].

7. Conclusion

In this report, we've highlighted how digital literacy can be developed over the duration of a learner's school life, supported by lessons that are freely available as part of the Teach Computing Curriculum. We hope that this mapping helps primary and secondary teachers identify any gaps and opportunities within their current teaching and ensure that this important part of the computing curriculum is comprehensively covered.

There are some elements of the debate around digital literacy that were beyond the scope of this report. The various definitions of what is covered within digital skills, digital literacy, and digital competencies make for some confusion, not just within the UK, but globally. In this report we have built our definition of digital literacy from the English national curriculum.

We have presented representative case studies of the experiences of computing teachers, their perceptions of digital literacy, as well as how they promote the development of these skills in learners. These examples also highlight the challenges that teachers face, ranging from their own varied skills and confidence, to the impact of the digital divide on their learners' experiences.

We recommend that teachers continue to develop their own digital literacy alongside their ability to support learners' digital literacy through their teaching. To this end, we have suggested a range of development activities from small scale teacher-to-teacher support, to wider community-led interventions, to formal computing courses that also address the teaching of digital literacy.

We welcome feedback on this report, and we plan to publish more reports on other topic areas within the computing curriculum.