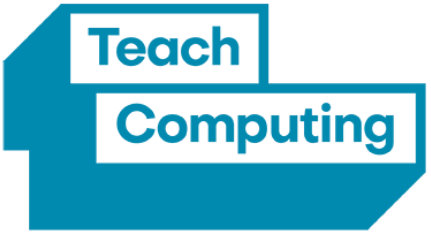
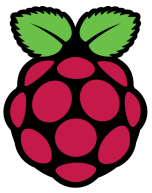
Report

Digital Literacy Within the Computing Curriculum

January 2021





Raspberry Pi

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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.

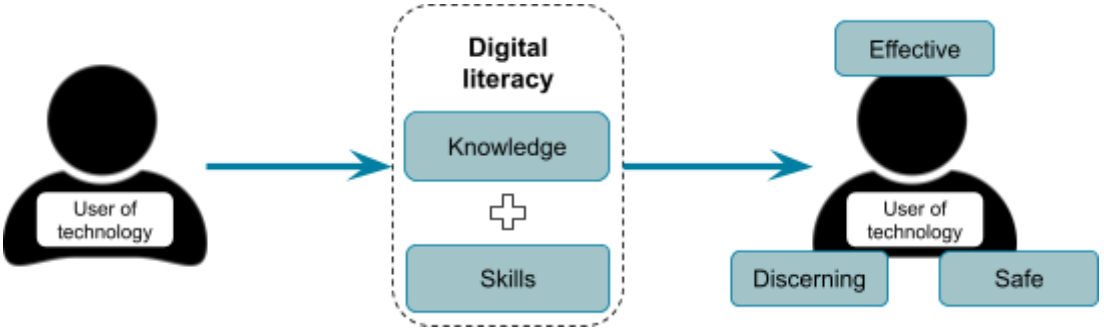

Figure 1: An illustration of the NCCE's definition of digital literacy

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

[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].

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.

[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].

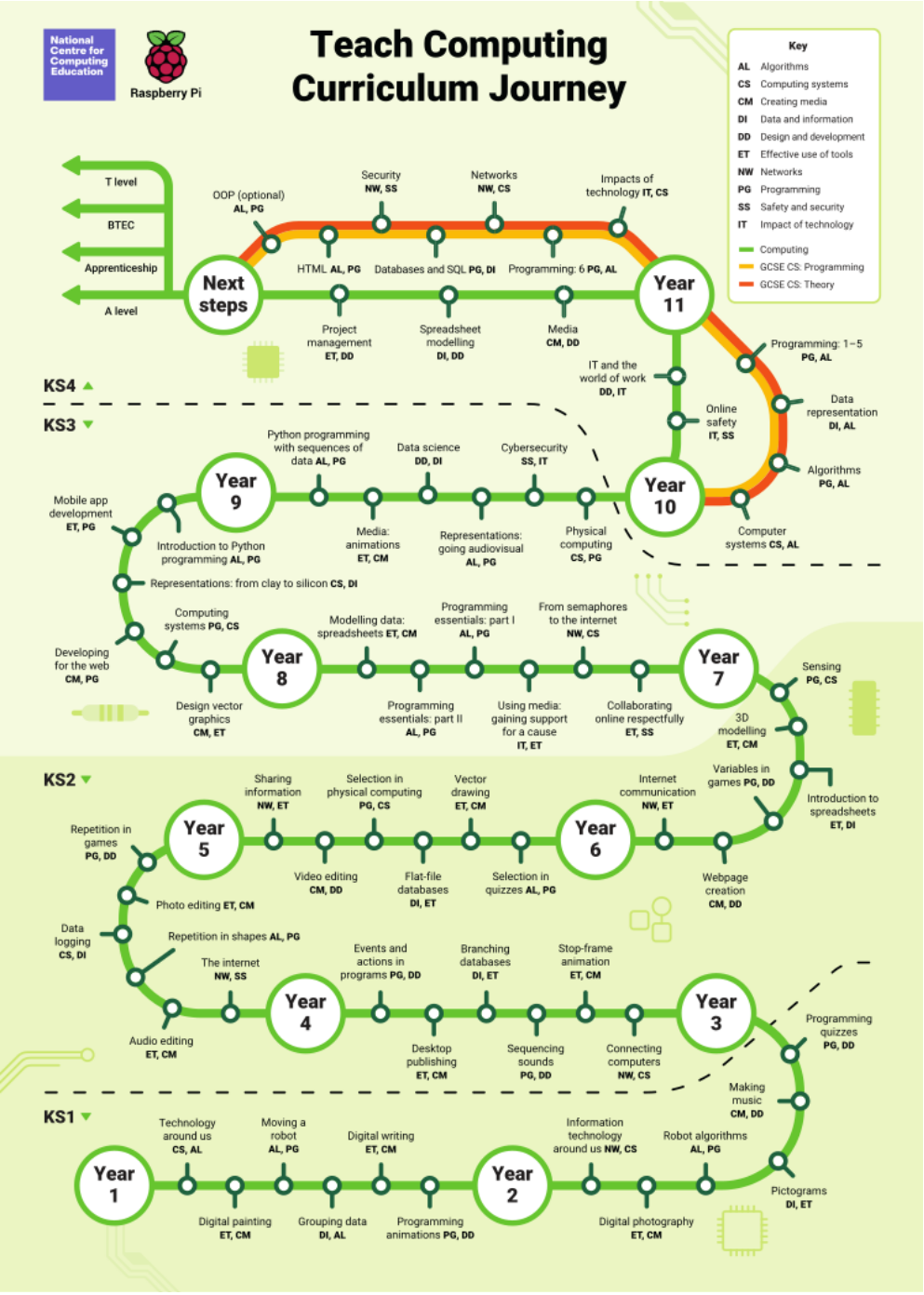

Figure 2: The Teach Computing Curriculum journey

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.

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.

[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].

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.

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

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.

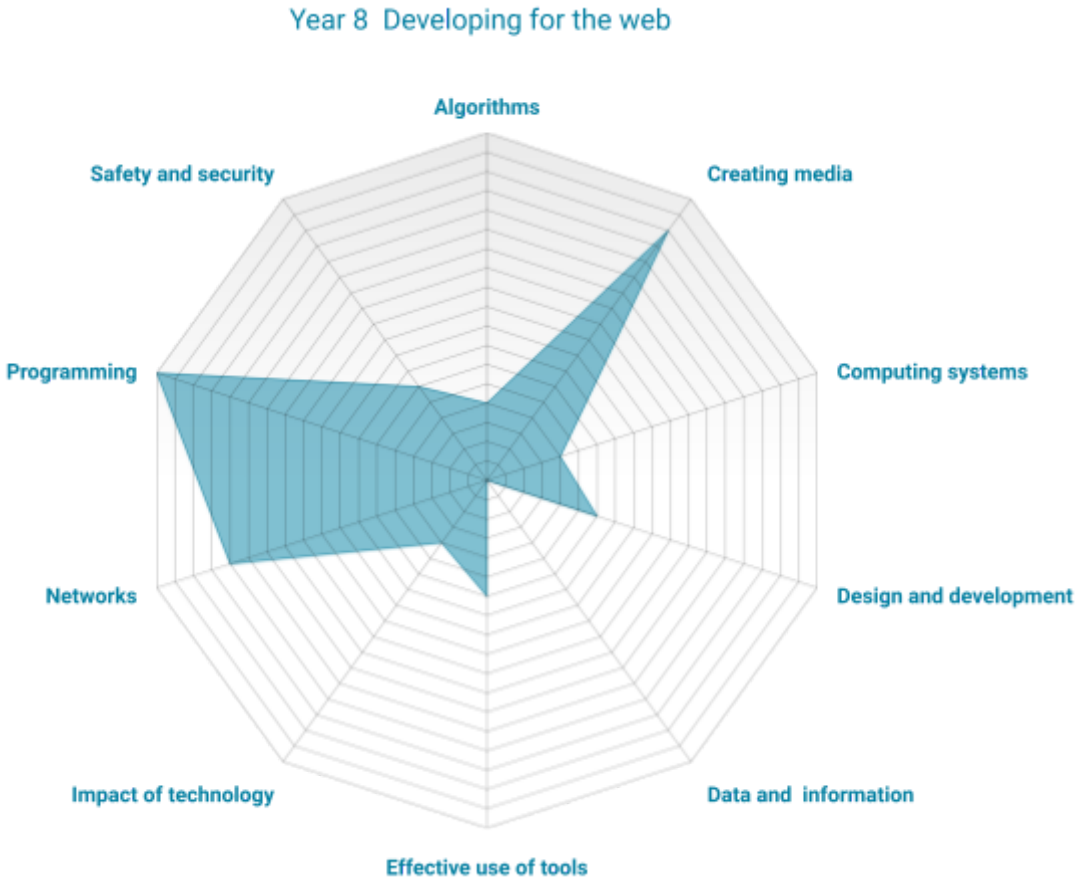

Figure 3: Example unit objectives mapped to NCCE taxonomy strands

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

Digital literacy theme	NCCE taxonomy strand: 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

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