Developing an approach to teaching and learning in Computing

A high-quality computing education equips pupils to use computational thinking and creativity to understand and change the world. Computing has deep links with mathematics, science, and design and technology, and provides insights into both natural and artificial systems. The core of computing is computer science, in which pupils are taught the principles of information and computation, how digital systems work, and how to put this knowledge to use through programming. Building on this knowledge and understanding, pupils are equipped to use information technology to create programs, systems and a range of content. 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.

DfE 2013

Aims

The national curriculum for computing aims to ensure that all pupils:

- can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation
- can analyse problems in computational terms, and have repeated practical experience of writing computer programs in order to solve such problems can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems
- are responsible, competent, confident and creative users of information and communication technology.

By the end of each key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the relevant programme of study. Children are assessed against school criteria at the end of the unit project. They make progress over time as they deepen understanding.

The Teach Computing Curriculum

The Teach Computing Curriculum was created by the Raspberry Pi Foundation on behalf of the National Centre for Computing Education (NCCE). The school have decided to adopt this curriculum because the aims of the Teach Computing Curriculum are as follows:

- ➢ Reduce teacher workload
- ➢ Show the breadth and depth of the computing curriculum, particularly beyond programming
- ➢ Demonstrate how computing can be taught well, based on research
- ➢ Highlight areas for subject knowledge and pedagogy enhancement through training

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Implementation

Coherence and flexibility

The Teach Computing Curriculum is structured in units. For these units to be coherent, the lessons within a unit must be taught in order. However, across a year group, the units themselves do not need to be taught in order, with the exception of 'Programming' units, where concepts and skills rely on prior learning and experiences.

Knowledge organisation

The Teach Computing Curriculum uses the National Centre for Computing Education's computing taxonomy to ensure comprehensive coverage of the subject. This has been developed through a thorough review of the KS1-4 computing programme of study (and the GCSE and A level computer science specifications). All learning outcomes can be described through a high-level taxonomy of ten strands, ordered alphabetically as follows:

- Algorithms —Be able to comprehend, design, create and evaluate algorithms
- Computer networks —Understand how networks can be used to retrieve and share information, and how they come with associated risks

- Computer systems — Understand what a computer is, and how its constituent parts function together as a whole
- Creating media — Select and create a range of media including text, images, sounds and video
- Data and information —Understand how data is stored, organised, and used to represent realworld artefacts and scenarios
- Design and development —Understand the activities involved in planning, creating, and evaluating computing artefacts
- Effective use of tools —Use software tools to support computing work
- Impact of technology —Understand how individuals, systems, and society as a whole interact with computer systems
- Programming —Create software to allow computers to solve problems
- Safety and security —Understand risks when using technology, and how to protect individuals and systems

The taxonomy provides categories and an organised view of content to encapsulate the discipline of computing. Whilst all strands are present at all phases, they are not always taught explicitly.

Spiral curriculum

The units for key stages 1 and 2 are based on a spiral curriculum.This means that each of the themes is revisited regularly (at least once in each year group), and pupils revisit each theme through a new unit that consolidates and builds on prior learning within that theme. This style of curriculum design reduces the amount of knowledge lost through forgetting, as topics are revisited yearly. It also ensures that connections are made even if different teachers are teaching the units within a theme in consecutive years.

Core principles:

Inclusive and ambitious

The Teach Computing Curriculum has been written to support all pupils. Each lesson is sequenced so that it builds on the learning from the previous lesson, and where appropriate, activities are scaffolded so that all pupils can succeed and thrive. Scaffolded activities provide pupils with extra resources, such as visual prompts, to reach the same learning goals as the rest of the class. Exploratory tasks foster a deeper understanding of a concept, encouraging pupils to apply their learning in different contexts and make connections with other learning experiences. As well as scaffolded activities, embedded within the lessons are a range of pedagogical strategies (defined in the 'Pedagogy' section of this document), which support making computing topics more accessible.

Research-informed

The subject of computing is much younger than many other subjects, and there is still a lot more to learn about how to teach it effectively. The Teach Computing Curriculum builds on a set of pedagogical principles which are underpinned by the latest computing research to demonstrate effective pedagogical strategies throughout. To remain up-to date as research continues to develop, every aspect of the Teach Computing Curriculum is reviewed each year and changes are made as necessary.

Formative assessment

Every lesson includes formative assessment opportunities for teachers to use. These opportunities are listed in the lesson plan and are included to ensure that misconceptions are recognised and addressed if they occur. They vary from teacher observation or questioning, to marked activities.

These assessments are vital to ensure that teachers are adapting their teaching to suit the needs of the pupils that they are working with, and you are encouraged to change parts of the lesson, such as how much time you spend on a specific activity, in response to these assessments.

The learning objectives and success criteria are introduced in the slides at the beginning of every lesson. At the end of every lesson, pupils are invited to assess how well they feel they have met the learning objectives using thumbs up, thumbs down, or thumbs sideways. This gives pupils a a reminder of the content that has been covered, as well as a

chance to reflect. It is also a chance for teachers to see how confident the class is feeling so that they can make changes to subsequent lessons accordingly.

Summative assessment

Every unit includes an optional summative assessment framework in the form of either a multiple choice quiz (MCQ) or a rubric. Pedagogically, when we assess, we want to ensure that we are assessing a pupil's understanding of computing concepts and skills, as opposed to their reading and writing skills. Therefore, the assessments in key stage one are mostly rubric-based, though MCQs are introduced in year 2. A rubric is a tool to help teachers assess learning and highlights whether the pupil is approaching (emerging), achieving (expected), or exceeding the expectations for computing in their age group.

Our expectation

- Teachers follow the Teach Computing scheme and overview for learning, ensuring that all topics are covered
- Teachers plan appropriately by being familiar with the subject knowledge, lessons and resources outlined in the prepared plans.(KS1 and KS2 objectives matched to NC)
- Children experience a range of computing programs and devices as suggested in the unit overviews
- Online Safety is taught explicitly through enrichment days, Safer Internet Day, PSHE, assemblies and within the units. The unit overviews for each unit show the links between the content of the lessons and the national curriculum and Education for a Connected World framework (ncce.io/ efacw). These references have been provided to show where aspects relating to online safety, or digital citizenship, are covered within the Teach Computing curriculum.
- Teachers use effective feedback and assessment to support learning and understanding
- Where possible, children use Google Classroom and the Google Suite to capture their learning, especially for UKS2.
- KS1 and LKS2 teachers will use a range of methods to capture learning, including Google Classroom and Computing Class Logs.

There is no set time that Computing should be taught, however the children must have suitable time to practise and apply the objectives of the Whole School Overview. Computing may be taught in weekly lessons or blocked to give sustained time with the equipment. See KS1 and KS2 Teaching Guides for clear guidance and progression.

Special Educational Needs or Disability

Children who have SEND should be provided with adaptations to the curriculum that will enable them to achieve the unit outcomes. Many lesson plans include *scaffolding opportunities* which are suggestions for adjustments to the curriculum for learners who might find it difficult to access the lesson. In some activities, pupils with SEN and/or disabilities will be able to take part in the same way as their peers. In others, some modifications or adjustments will need to be made to include everyone. For some activities, you may need to provide a 'parallel' activity for pupils with SEN and/or disabilities, so that they can work towards the same lesson objectives as their peers, but in a different way − eg using specialist software or equipment to communicate through signs or symbols. Occasionally, pupils with SEN and/or disabilities will have to work on different activities, or towards different objectives, from their peers.

Computing overview of learning

Teachers follow the *Teach Computing* scheme, designed by the National Centre for Computing Education (NCCE), to meet the statutory curriculum requirements and develop a curiosity of new technologies. The content has been created by subject experts, based on the latest pedagogical research and teacher feedback. It also provides an innovative progression framework where computing content (concepts, knowledge, skills, and objectives) has been organised into interconnected networks called learning graphs. The scheme includes computer science, information technology, digital literacy, and the safe and appropriate use of technology.

Computer Science

The scheme has a dual emphasis. It is designed to support children in becoming safe, competent and creative users of technology, building essential skills and understanding through using a range of applications on varied devices. At the same time it inspires them to become productive creators and designers of technology, by introducing the essential

aspects of computer science in a way which blends with the ethos and learning approaches of the primary phase. There is a particular emphasis on unplugged approaches, which enable learners to understand how technology and systems work and are controlled, before using any computer-based applications. The ***computer systems & networks***, ***data*** *and* ***coding*** strands particularly include aspects related to computer science, but there are many elements embedded into other themes, so that this learning can be explored in varied contexts.

The strands

Internet safety and appropriate use	**This aspect is an essential element of the scheme and is embedded across all strands and is taught explicitly during theme days or weeks.** Become safe, effective and respectful users of technology and online systems, recognising both acceptable and unacceptable behaviour and knowing how to respond when they have concerns. Respect copyright and ownership, asking permission before using materials and crediting sources. Understand the need to keep their personal information secure and recognise the need to respect the rights of others to personal privacy. *The children will*: experience general safe use of the computer; explore what to do if children find something that makes them feel uncomfortable; identify a range of ways to report concerns about content and contact from others; understand dangers of sharing personal information and importance of privacy; explore avatars and pseudonyms to protect identity; strangers online; understand the dangers of talking to strangers online through email, text, social media and gaming; consider how they know people are who they say they are? understand how to be safe when web browsing and not to always trust the information you see on websites (phishing, spam, scams, virus', pop ups; recognise acceptable and unacceptable behaviour online; understand the different forms of Cyber bullying including being a bystander; defaced images; identify rules of social media e.g. legal age; understand how to use social media safely respectfully; explore possible dangers that could arise when using social media. Trusted resources: Connected in a Digital World & ThinkYouKnow
Computer systems and networks	This unit develops the children's understanding of technology and how it can help them. They explore how information technology (IT) is being used for good in our lives. Children will develop their understanding of digital devices, networks and computer systems and how information is transferred between systems and devices. They will apply their knowledge and understanding of networks recognising the internet as a network of networks which need to be kept secure. They will learn about the World Wide Web as a communication tool, learning the importance of responsible use of technology, and how to make smart choices when using it. By the end of KS2 they will evaluate online content to decide how honest, accurate, or reliable it is, and understand the consequences of false information.
Creating media	Children begin by exploring the world of digital art through painting programs. Learners will familiarise themselves with typing on a keyboard and begin using tools to change the look of their writing. The children will learn to recognise that different devices can be used to capture photographs and will gain experience capturing, editing, and improving photos. They will explore digital music and how to create it. Learners will use a range of techniques to create a stop frame animation using tablets. The children will explore digital publishing becoming familiar with the terms 'text' and 'images' and understand that they can be used to communicate messages. They will also evaluate how and why desktop publishing is used in the real world. They will examine devices capable of recording digital audio, which will include identifying the input device (microphone) and output devices (speaker or headphones). Learners will develop their understanding of how digital images can be changed and edited and have an opportunity to learn how to create short videos in groups. By the end of KS2 learners will create a website, find

	out that vector images are made up of shape and develop their knowledge and understanding of using a computer to produce 3D models.
Coding	The children are introduced to programming and algorithms through robots and ScratchJr. Pupils develop their understanding of instructions in sequences and the use of logical reasoning to predict outcomes. They will be introduced to a selection of motion, sound, and event blocks which they will use to create their own programs that explore the links between events and actions. The children will look at repetition and loops within programming and use Logo, a text-based programming language. Learners will use physical computing to explore the concept of selection in programming through the use of the Crumble programming environment. Learners will be introduced to a microcontroller (Crumble controller) and learn how to connect and program components (including output devices- LEDs and motors). By the end of KS2 they will learn how the If… Then… Else structure can be used to select different outcomes depending on whether a condition is true or false.
Data	Pupils are introduced to the terms data and information. They are introduced to the idea of assigning data (images) with different labels in order to demonstrate how computers are able to group and present data. Learners will use the data presented as pictograms to answer questions. The children will develop their understanding of what a branching database is, how to create one and how to evaluate effectiveness. Pupils will consider how and why data is collected over time focussing on data logging. The children move on to look at how a flat-file database can be used to organise data in records. They create graphs and charts from their data to help solve problems. By the end of KS2 earners use spreadsheets, create graphs and charts then evaluate their results in comparison to questions asked.

Vocabulary

There are vocabulary lists for KS1 and KS2 which should be taught.

Computing Units

	Computing Systems and Networks	**Creating Media**	**Coding**	**Data**
Y1	Technology Around Us	Digital Painting	Moving a Robot	Grouping Label
Y2	Information Technology All Around Us	Digital Photography	Robot Algorithms	Pictograms
Y3	Connecting Computers	Stop Frame Animation	Sequence in Music	Branching database
Y4	The Internet	Audio Editing	Repetition in Shapes	Data Logging
Y5	Sharing Information	Video Editing	Selection in Physical Computing	Flat File Databases
Y6	Communication	Web Page Creation	Variables in Games	Spreadsheets

Impact

Each year, impact is monitored using formative assessment on Arbor, work scrutiny, teacher voice and pupil voice. Adaptations are made and priorities for improvement identified on the subject action plan.