

An Essential Guide to the Information Technology Strand for Key Stages 1-3

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Foreword from the Sponsors

Here at Plum Innovations, we have always been proud to be a company that is dedicated to helping teachers succeed in their professional fields with efficient and solid IT platforms by providing a stress-free IT experience. So having an opportunity to sponsor the Naace Essential Guides trilogy: Programming, Digital Literacy and Information Technology was very exciting for us.

As a Naace sponsor partner and British Computer Society organisational member, the chance to really help spread correct understanding of computing felt extremely important to us in regards to helping ensure teachers are able to teach Computing with confidence and ultimately help to boost children's future career prospects. These Essential Guides explain the boundaries and relationships between the three strands of the Computing Programme of Study. The authors of these guides stress the necessity of maintaining a broad, balanced computing curriculum with various technologies available to children, especially with the current emphasis on coding.

We hope after reading these guides, you will find the answers that you are looking for.

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Summary

Information Technology is one of the three strands of the Computing Programme of Study. Of the strands, which are Computer Science, Information Technology and Digital Literacy, it is probably the least familiar to teachers, while at the same time being the least clearly defined within the Programme of Study. There are only two fundamental aspects. The first is that the strand is about **how digital technology works in general**. The second is **how to use digital technology** to achieve meaningful outcomes within Digital Literacy. It follows that knowledge, understanding and competence in this strand is essential if we want our pupils to achieve the aspiration of the Computing Programme of Study, 'to understand and change the world'. To do this, we need to empower our children to solve problems and make things, using digital technology. And for them to do that, they need to know how it all works. Up to a point. This eGuide covers only what children and teachers need to know about Information Technology at key stages 1 to 3. It will not make them technicians.

Introduction

The statements to do with Information Technology in the Programme of Study are

From the purpose of study:

...pupils are equipped to use information technology to create programs, systems and a range of content.

From the aims:

can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems.

From Key Stage 1:

- *use technology purposefully to create, organise, store, manipulate and retrieve digital content*
- *recognise common uses of information technology beyond school*

From Key Stage 2:

- *understand computer networks including the internet; how they can provide multiple services, such as the world wide web; and the opportunities they offer for communication and collaboration*
- *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...*

From Key Stage 3:

- *understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers [for example, binary addition, and conversion between binary and decimal]*

- *understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems*
- *understand how instructions are stored and executed within a computer system; understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits*

These give rise to the two aspects described in the summary.

The first aspect of Information Technology, that it is about how digital technology works in general, is approached by understanding just two big ideas.

Digital devices are basically nothing but vast collections of switches, joined up so that we can control how they are switched on and off, together with ways for us to do that. These switches can be on or off, and grouped together in sets. If we think of a switch which is off as represented by a 0, and one that is on as represented by a 1, then groups of these switches can be used to represent binary numbers. It follows that digital devices work with numbers. More importantly, they don't work with anything else! **The first big idea is that if something is not a number, a digital device cannot work with it.** At the same time, we, as users of digital devices use keyboards, touch screens and mice. We see screens with images, still and moving, and hear sounds. We have lots of other interactions with digital devices. So there is a huge gap between our experience of using digital devices, and how they work. How digital devices work and interact with us, and with each other, when they only use numbers, is a key object of study within Information Technology. The process of converting information into numbers is called **digitisation**.

To introduce the second big idea, you will be very familiar with the fact that the world is full of things, which 'know' you are there, such as automatic doors and traffic lights. **The second big idea is that anything which can be represented by an electrical signal can be detected and used by digital technology, and anything which can be achieved using electricity can be achieved by digital technology.**

The second aspect of Information Technology is that, to get the most out of digital devices, you have **to be able to use them to do useful things**. The big idea here is how that works. Think about other making occupations. A joiner uses tools to make useful things out of wood. A blacksmith uses tools to make useful things out of metal. To be a good joiner or blacksmith, you have to learn how to use the tools appropriate to the materials. And you need a workshop. It is the same with digital devices. The material you work with is information, of all kinds. The tools you use are things which shape information: word processors for documents, spreadsheets for financial models, and so on. And your workshop, the place where the tools and the material are brought together, is the operating system on your computer or tablet – likely to be a version of Windows OS, Android or iOS. To make good quality products out of information, you need to know how the tools work in your workshop. So for this aspect, you need to **understand and deploy operating systems, and know how to use the applications and apps** which reside in them.

Key Concepts

The concepts throughout this strand are often complex and abstract, and yet many of them can be introduced to pupils in simple and fun ways. Learning Linked has a professional development programme entitled 'Fear to Fun' which shows teachers how to do this. It will be indicated with a concept where there is a F2F activity which applies.

Software, hardware and operating systems

The place where tools and information come together in digital devices is the **operating system**. Think of this as like a workbench, where materials are worked on with tools to make useful things. An operating system does much more than this. It is not just a place, but is a management framework, for both the software tools and the information. It does other things, too, such as allowing you to set the time. The operating system, tools and information are the **software** in a digital device. Software is held in **memory**, which is a key part of the **hardware**. This provides the means for us to interact with our devices, through keyboards, mice, touch screens, microphones and speakers, and connect other devices, such as printers, cameras, phones, and so on. These are classified as **input** or **output**, depending on which way the information flows, so keyboards and mice are inputs, screens and printers are outputs. These tools, often called **peripherals**, are connected to hardware by **ports** (sockets), often specific to the type of peripheral.

Perhaps the most common operating systems are **Windows** for PCs, **MacOS** for Apple Macintosh computers, **iOS** for iPads and iPhones, **Android** for other phones and tablets, and Unix. You may also have come across a version of Unix called **Linux**, which is used on the Raspberry Pi.

Nearly all operating systems are graphical, using a mouse or a touch screen to interact with on screen images in windows. These are called **Graphical User Interfaces (GUI)**. The Raspberry Pi is an example of the earlier way of interacting with an operating system, where you had to type everything in. This is called a **Command Line Interface (CLI)**. When you have successfully logged in to a typical Raspberry Pi setup, you get

```
pi@raspberrypi ~ $
```

To start a program, you need to enter its name. This is how you start the Rasperry Pi desktop.

```
pi@raspberrypi ~ $ startx
```

This is about the only time you will ever come across a CLI today!

Tools for working on information are called **applications** in Windows, MacOS and linux, and **apps** everywhere else. Applications and apps are specific to the operating system they run on, so although you can use Microsoft Word, for example, on just about anything, and it looks the same, if you want to use Word you generally have to **install** the correct version for the operating system. Installing apps on phones and tablets is always done by **downloading** them from the internet first. This is now also true for applications.

Applications and apps are all sorts of tools: **web browsers**, like Safari, Explorer or Chrome; **productivity** tools, including **word processors**, **spreadsheets**, **databases**, **presentation** and **drawing** tools; and image, sound and video editing tools are very common. **Programming languages** were

originally applications which allowed you to make your own applications! These include **Python** and lots of different versions of **Basic**. Now there are programming languages which do not make applications but allow pupils to learn how to program. These include **Scratch** and **Logo**.

The general terms for the things we make with digital tools are **digital artefacts**, or **content**. You will be very familiar with the very wide range of things that count as content.

The operating systems mentioned so far fall into two sets, based upon the very different ways they approach the relationship between tools and information. The earlier operating systems, MacOS, Windows and Linux, have a clear separation between applications and storage. There is a single place where information is organised and kept together, and all applications have their information in the same place. These operating systems will be discussed first. iOS and Android use apps, and here the information is integrated with the app, not in a single place.

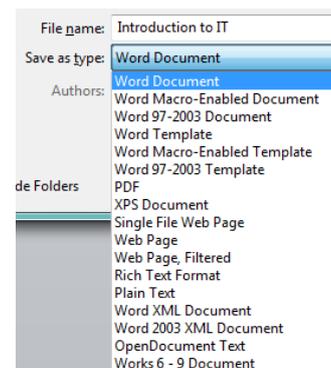
So for Windows and MacOS, applications are the tools which you use to shape information, and when you have made, for example, a spreadsheet, you need to **save** it, not least because when you switch the device off, applications do not retain a copy, unlike apps. The generic name for any piece of saved information produced by using an application is a **file**. So where do you save files? All operating systems provide means for the **storage** of files, and most for the grouping of files together in **folders**. These operating systems also allow you to create folders within folders. When you save a file you have to give it a unique **name**. The combination of files, folders, names and storage is called a **file system**. File systems are finally structured in **drives**, which are physical devices within the hardware. iOS and Android do not use a file system in this way; instead information in an app can be **shared** in ways such as emailing.

For the earlier operating systems, it is really important to understand what is stored in a file. Remember that digital devices can only work with numbers. And that is what is in a file. **A file can only be a sequence of numbers, and nothing more (F2F)**. So, when an operating system encounters a file, how does it know what information the file represents? A file needs to be stored with additional information, which tells the operating system what the numbers in the file represent. This is done by adding an **extension** to the filename. The first time a file is saved, the application adds an extension to the filename, which describes what sort of file it is, so that whenever that file is presented to an application to be loaded, the application knows what to do with it – how to **decode** the numbers in the file. The extension is an agreed abbreviation of the **filetype**. For example,

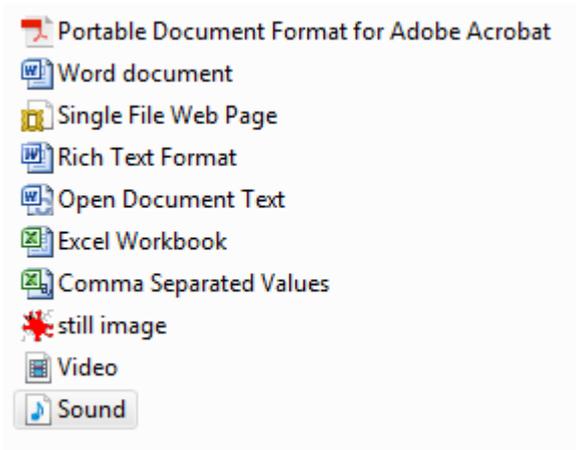
report.doc

is a file created with the application Microsoft Word. The name is “report”, and the extension, “.doc”, tells you that this is a Word 97-2003 file. You need to be familiar with all sorts of different extensions, because most applications will give you choices for the sort of filetype you want to create. Here you can see the choices of filetype available when you save a file in Word 2010.

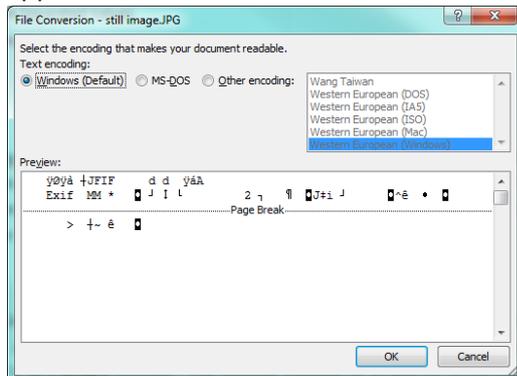
All of these different file types have different properties, and uses. We will look at some of these later.



In practice, you do not often get to see the file extension, when you look at a filename in a folder. Instead, you will see a small image called an **icon** preceding the filename, produced by the operating system. Here is a sample of the contents of a folder, where the filename tells you what sort of file the icon represents.



So the filetype, as represented by the icon, tells you how a file has been encoded. So that many applications can read different sorts of files, these



encodings must be **public (F2F)**. Occasionally, things can go wrong, when the file encoding does not match its type. You can demonstrate this to pupils in Word by right clicking on the filename of a file which is not known to Word, choosing 'open with' and choosing Word as the default application. Here the application does it best to decode the file but 'knows' something is wrong.

Returning to the list of icons, notice that more than one of them can be opened by Word. Both the rich text format and the open document text filetype have icons which show that this version of Word can read them, and allow you to edit them too. This is called **association**. There are two sorts of filetypes. Some of these have been specifically made for a particular application, such as .docx, which is for Microsoft Word, where the association is obvious. There is also a large collection of generic file extensions, which are not automatically associated with a particular application. Here are some of the older ones.

Still bitmapped image	.jpg, .bmp, .gif, .png
Sound	.wav, .mp3
Moving image	.avi, .mov, .wmv, .mpeg, .mp4
Text file	.txt, .csv
Still vector image	.svg, .wmf
Multimedia file	.rtf

It is possible to associate generic filetypes with applications. This association is chosen by the user, becomes the default application for that filetype, determines the icon shown in the file system and as a result, when you double click on a filename, loads the file into the application and **launches** the application.

None of this applies directly to operating systems driving apps, since they do not use a filesystem in this way. Instead, **the work stays with the app.** (September 2017: This has been put right in iOS 10, which now has a files folder!) This means that the things made with apps are not lost when the device is switched off, or a different app is used. The advantages of this approach are offset by the difficulties encountered in creating a single collection of pupil work, and allowing more than one

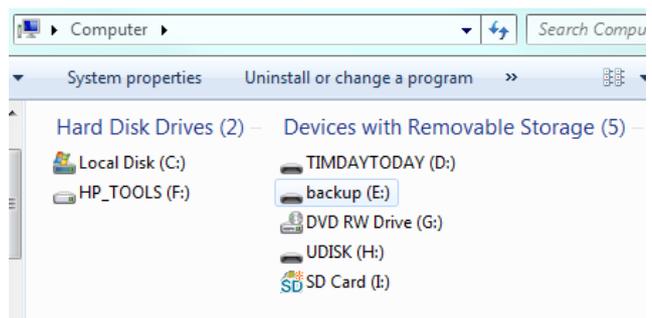
person to use a device. To make iOS and Android operating systems work in school settings, ways have to be found to address these issues, so that the Key Stage 1 Programme of Study requirement to

use technology purposefully to create, organise, store, manipulate and retrieve digital content

can be met. Furthermore, it is essential that children are fluent with both types of operating system, since neither of them is going out of fashion any time soon, and each of the operating systems has strengths and is better for some jobs than the others. Also, functionality in one type of operating system is often embedded in the other. For example, you can plug your iPhone or iPad into the USB port of a PC, and after some chuntering, it will often appear in the PC operating system as a drive which contains folders. There are digital devices too, which do not have an operating system at all. An important example is digital cameras, which undoubtedly take far better images than the cameras in tablets and PCs, and yet we want to use the images we have captured with cameras in the rest of our digital content. We need ways of moving the digital content we have made between all of them.

Very early means for achieving this were floppy disks, CDs, and then DVDs. Each of these, called **media**, were inserted into a drive built into a PC. Later, **external** or **removable drives** replaced media. Remember that drives are the storage units for files and folders. Today, this is very common as a **memory stick**, or USB stick. USB stands for **Universal Serial Bus**, and is a general purpose port, which allows you to connect a whole range of peripherals. When a memory stick is inserted into the port, a new drive becomes available. So files stored on a memory stick can be edited on any compatible device. Here is an example of a Windows filesystem.

Note that drives are given both names and a single letter. Here "C:" is the drive within the computer. The rest are removable. "D:" and "E:" are USB sticks. "G:" is a drive used to make DVDs, and "H:" is a scanner, showing the general purpose use of a USB port. "I:" is an **SD Card** port. SD Cards work like memory sticks but are small enough to



fit into cameras, and provide a way of getting photos from the camera to the computer, by removing the card from the camera and putting it into the port on the PC.

Networks, the Internet and the World Wide Web

This topic is mentioned specifically in the Key Stage 2 Programme of Study.

- ***understand computer networks including the internet; how they can provide multiple services, such as the world wide web; and the opportunities they offer for communication and collaboration***

and so gets a more detailed treatment. Networks connect digital devices together to share services, such as printing, and access to the internet. The connection can be hard wired, or wireless, or a mixture. Devices can have more than one way of connecting to a network, and **wireless connectivity** is becoming commonplace. The availability of the internet combined with wireless connectivity means that today the devices on networks can be almost anywhere. The services on networks are provided by devices called **servers**, so there are email servers, print servers, and so on. The way a print server works, for example, is that only the print server is physically connected to the printer. All the other devices on the network, when they print, send the print information to the print server via the connections between the devices.

Servers are a key feature of how the internet works. Messages on the internet are passed between the servers on different networks. Messages are broken up into **packets**, which are special files with the same structure. To get from one server to another, they need to know where they are going, and all devices on the internet have their own address called the **IP (internet protocol) address**. This address is actually a number in a standard format. An example might be 255.255.148.37. Every single device in the world must have its own **unique** IP address (why?), and there are now so many networkable devices that we are in danger of running out of addresses! So a packet contains the address of the server it is going to. Another fundamental idea is that packets can take different routes through many servers to their destination, so packets might arrive out of order, and they are numbered so that the message can be rebuilt in the right order when it gets to its destination. Finally, all packets must be the same length. A very simple simulation of packets traversing the Web is at https://youtu.be/qAK15O_WlgY. **F2F** contains a set of kinaesthetic activities where pupils role play being servers, and handle packets. This has been extensively used in primary schools, with great success and enjoyment.

The internet is not the same as the **World Wide Web**. It is one way the internet is made user friendly. Firstly, some internet servers are **web servers**. This means that they have on them a **web site**, which is a set of linked pages of information. The web site is given a **domain name**. This is linked to the IP address of the server, so that you can use something understandable to refer to it. You will be very familiar with these. google.com is one; bbc.co.uk is another. The parts of the domain name tell you something about the owner of the web site using this domain name, so .com indicates the owner is a US company and .co.uk indicates the owner is a company in the United Kingdom. To turn the domain name into a web address you simply put www. in front to get, for example. www.google.com or www.bbc.co.uk . The proper name for a web address is a **URL (Uniform Resource Locator)**, because the main purpose of the World Wide Web was for people to be able to share digital resources easily.

So how do you get at a resource using a URL? You need an application called a **web browser**. You will be familiar with Microsoft Internet Explorer, Google Chrome, and Apple Safari, and there are many others. If you know the URL of the site you are looking for, you write it into the address bar of the browser, which translates the domain name into the IP address of the webserver, and downloads the page contents from the server so that you can see it in the browser. When the URL is simply the domain name, the browser downloads the **index or home page** of the website. There are two ways you can see further pages. One is by following links from the home page. The other is to know the complete URL of the page within the website, so, for example www.bbc.co.uk/sport will take you straight to the sport pages of the BBC website. As always, what is downloaded is a file, and

this file is written in a special code called **Hypertext Markup Language (HTML)**. The code contains tags which tell the browser how to redraw the page, including all text, graphics, links and sounds. It is fun to make web style pages using HTML, and counts towards a child's programming experiences, as well as promoting understanding in the Information Technology strand.

The Cloud

The original function of web pages, to link to resources to share online, has been hugely expanded by the idea of **putting sequences of instructions into web pages**, and developing the browser so that it can run these instructions. This allows browsers to perform the same sort of tasks in a web page as an application running in a window on a PC. This is genuinely transformational in terms of what the World Wide Web can be used for, with lots of other advantages. All of the following depend on this.

- Social media such as Facebook and Twitter
- Buying and selling online, such as eBay and Amazon
- Communications tools such as Skype
- A free personal presence online through drag and drop websites, blogs and wikis
- Complete operating systems and applications suites such as Google Apps for Education and Microsoft Office 365, both of which integrate this with email, personal storage and an online presence for an organisation.

Students should encounter all of these to meet the Key Stage 2 requirement that they

- *understand computer networks including the internet; **how they can provide multiple services, such as the world wide web; and the opportunities they offer for communication and collaboration***

You will be familiar with most if not all of these. It is collectively known as **The Cloud**, and shifts processing (executing a sequence of instructions) from the local device to online, as long as you have device with a browser, which can connect to the World Wide Web, and a good internet connection. Currently it is the biggest change affecting the way schools deploy their hardware; there is no need for local servers, and there is no longer a need to employ someone to do the complex tasks to ensure that the local server works, is up to date, and can meet storage demands.

Digitisation

This is the means by which information can be represented as numbers, so that it becomes possible to work on it with digital devices. The first step is to understand how a digital device made only of switches can represent numbers. This topic is mentioned specifically in Key Stage 3 -

- *understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers [for example, binary addition, and conversion between binary and decimal]*

but is fundamental to understanding and should be addressed simply in Key Stage 2. It is not so important to understand the detail, so this will be kept brief. A collection of eight switches, called a **byte**, is often used to represent one number, by thinking of it as a **binary** number. The number

consists of 1s and 0s, to correspond to a switch being on or off, so a binary number might look like this: 10110100. Then we use place value, as with decimal numbers, but to base 2. Use this idea to find the value of our binary number in decimal.

	128s	64s	32s	16s	8s	4s	2s	1s
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary	1	0	1	1	0	1	0	0
Decimal	128	0	32	16	0	4	0	0

So our binary number 10110100 = 128+32+16+4 = 180 in decimal (**F2F**).

Storage

By extending this idea you can see how a digital device **can represent and store any number**, and also can **change the number**, by turning the switches on and off. A vast collection of bytes makes up the hardware memory or **storage** of a digital device.

To meet this requirement

- *understand how instructions are stored and executed within a computer system; **understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits***

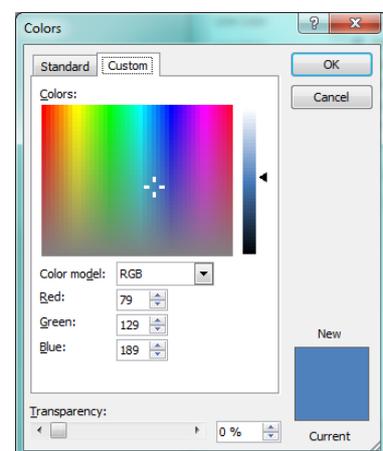
we need to understand something of how numbers are used to represent all the things we want to express as information. We will look at each of the three basic **media types**; text, graphics, and sound, because singly or together they make up any sort of information which can be handled using digital devices.

Text (F2F)

In the digital context, **text** is not just letters. It is also the characters which represent numbers, punctuation, and other symbols. The collective word for these characters is **alphanumerics**. Each of these must have their own number, so that they can be represented within digital devices. This is done by having an agreed **public encoding**, which all digital devices understand, and when these devices are presented with numbers and also told that the numbers represent alphanumerics, the devices 'know' how to decode the numbers. The basic encoding for alphanumerics is called **ASCII**, and it has a long history, because the earliest things digital devices needed to represent were alphanumerics. The filetype for a file which contains nothing but alphanumerics is .txt.

Graphics (F2F)

Digital devices use numbers to represent graphics in two ways. By far the most familiar way is as a **bitmap**, where an image is made out of a very large collection of very small dots called **pixels**, arranged in a rectangular array. A very common way to digitise bitmaps is to use numbers to store information about the bitmap itself, such as its length, width and resolution (the number of dots per inch), and then for each pixel to use three numbers



representing the proportion of red, green and blue to mix together to make the colour of the pixel. So every component of the image can be represented as a number, and thus images become accessible to digital technology. To make shapes which are not rectangular, some image encoding is extended to make a number count as a transparent pixel. To make an image which is realistic, i.e. looks like the real thing, 256 shades of each of red, green and blue are required. Here is the colour picker tool from Microsoft Powerpoint, showing this in action.

This is the RGB colour model. There are other models, different ways of making all colours from a small set of basics.

Further information about the use of graphics can be found in the Naace Essential Guide to Graphics for Primary Teachers.

Because of the number of dots in a high quality image, the files of images can become large, much larger than text files. For example, an image which is six inches by four, with a resolution of 120 dots per inch, in full colour, will require a **minimum** of $6 \times 120 \times 4 \times 120 \times 3 = 1,036,800$ numbers. This is in effect its **filesize**. Filesizes are reported in bytes, which you will remember is the unit of hardware storage, and abbreviations are used, **kilobytes** or Kb for thousands of bytes, **megabytes** or Mb for millions of bytes and so on. This size of image at just over 1 Mb is not actually very big.

Moving images can be thought of as a sequence of still images. Realistic movement is obtained by displaying 25 images, or **frames**, per second.

The other way images are digitised is by breaking them down into lines and curves, which can be open, closed, filled, in various colours, and vary in size and rotation. Each of these are called **objects**, and the image is drawn by drawing all of the objects, which make it up. Each of these objects can be numerically encoded too and thus a file of this sort of image can be created and used to redraw the image. These sorts of images are called **vector** images. You can get a feel for how this works through the use of the programming language Logo. Imagine drawing an image using logo commands.

Sound

The digitisation of sounds is very different from that of text and images, because sounds last over a period of time. Put simply, think of a sound as having just volume and pitch. Sounds are digitised by measuring the volume and pitch a certain number of times a second, and keeping a record of these values. The sound can be played back by recreating the volume and pitch from the measurements. This process is called **sampling**. You have to sample frequently to get good quality sound reproduction. Digitised sound which is indistinguishable from the real thing requires sampling 44,000 times a second, and so, like good quality images, file sizes for good quality sound can be very large. A one minute piece of music in stereo will be a minimum of $60 \times 44,000 \times 2 = 5,280,000$, numbers, or a filesize of over 5Mb.

Compression (F2F)

Imagine that you have to digitise a full screen movie, and bear in mind that today you can watch these on your phone. Suppose that the screen has a resolution of 1024 x 768 pixels, with a stereo soundtrack. This means that in theory **every second** a minimum of $1024 \times 768 \times 2 = 1,572,960$, or

approximately 1Mb of data has to be moved, and a half hour movie would require a filesize of 1800 Mb. These are big numbers. In practice, it cannot be done like that. Instead, techniques are used to get the same end result by sending fewer numbers. This is called **compression**. A very simple way this might work for a sequence of images is as follows. Draw the first image, but after that, instead of sending a whole new image, send the **changes** to the first image to draw the second image. You can see that this would work very well with movies that don't move too much! This general principle also works with sound.

Files which do not last over time, such as still images, can also be compressed, with methods beyond the scope of this eguide. **Zip files** are collections of files which have been compressed into a single folder. Within the list of generic filetypes above, the following are always compressed; jpg, mp3, and all the moving filetypes except avi.

Data vs Instructions

So you have seen how media can be encoded as sequences of numbers. The fundamental idea, which makes general purpose digital devices possible, is that a byte can either be used to represent information, when it is known as **data**, or it can be an **instruction** to turn switches on and off. So by copying bytes from one place to another, data can be moved about, and by combining the individual switches in bytes, numbers can be added, or subtracted. It is almost unbelievable, but these three operations are practically all that is required. Instructions in bytes are called **machine code**. What makes digital devices possible, bearing in mind the simple techniques they use, is that they turn switches on and off unbelievably fast. The rate at which they switch on and off is controlled by an internal **clock** (not a clock that tells the time, but a device which switches the switches) and ordinary digital clocks commonly run at 500 million switches a second, or **500 MHz**.

Generalised Input and Output (F2F)

You will recall that sounds are digitised by sampling. This general principle, of measuring some aspect of the world and by this means representing it as a number, is called **sensing or sampling**. All sensors take some aspect of the world, such as light, heat, position, and convert them into an electrical signal. This signal can then be sent to digital technology. Similarly, digital technology can produce electrical signals, and so can make sounds, light lights, and control motors, and anything which can be done with motors can therefore be done by digital devices. A very simple example is a burglar alarm. Here, unexpected movement can be detected by changes in light or sound, and a signal sent to the local police station.

This idea, that digital devices can sense the world and act on what they find, has profoundly changed the nature of employment in particular, and continues to do so, as many tasks which were formerly undertaken by humans can now be undertaken by digital devices which sense the world and **control** aspects of it. This is often called **automation**.

Key Outcomes

The Information Technology strand covers what you need to be digitally literate, and to understand the profound changes which the continued deployment and development of digital devices are having on individuals and society. A good way to do the first is to develop the use of a set of detailed competences, to be prefaced with 'I can', a version of which specifically for the Information Technology strand follows.

switch computers on and off safely
log in and out
keep my password to myself
load my work
choose a good name for my work when saving
tell what a file is by its icon
use "save as" to show how I have improved my work by saving it more than once
make folders
save work in folders
delete files and folders
rename files and folders
check how my work appears before I print it
print my work
choose how to print my work
change my passwords
choose where to save my work
use "save as" to save work as a different type of document
save documents in generic formats, inc .txt, .pdf, .rtf
save my work to the Cloud as well as on a computer
move my work out of an app
grab parts of the screen to show what I have done
find out the size of files
identify very big sound, still images and movies
tell the applications for documents
install and remove applications
use both local and online applications
identify a device's system
modify settings
encrypt documents
install virus protection
conduct virus detection and removal
describe how the internet works; how packets are sent via servers
describe what a URL is

identify what the parts of a URL tell you
describe an IP address is and how it relates to a URL
make simple pages in HTML
use more than one web browser
protect myself against malware (viruses, Trojans, spyware)
manage my identity online

have my own email address
have more than one email address
use a web-based email
reply to emails
send an email to more than one address
attach documents to an email
save an attachment from an email
set up and use contacts
set up and use favourites or bookmarks
use the browsing history
avoid downloading an attachment from people I do not know
be polite in emails
identify when get emails from people I do not know
deal with spam
deal with phishing, by recognising attempts to acquire personal information such as passwords
sign up to online services with a username and password
choose to receive further information
tell when an online service identifies my preferences by the choices I make online

safely use texting
safely use messaging
safely use chats
comment politely
(for older students) safely manage my Facebook presence
(for older students) safely manage my Twitter presence

Tracking the acquisition of these competences in detail can often be left to the children themselves. They should decide when they have acquired a competence, and then track it very simply as a tick list with a date. Note that the acquisition of competences does not necessarily need to be age related.

Bury Primary Computing Solution EOY Outcomes for IT (Y1-6)

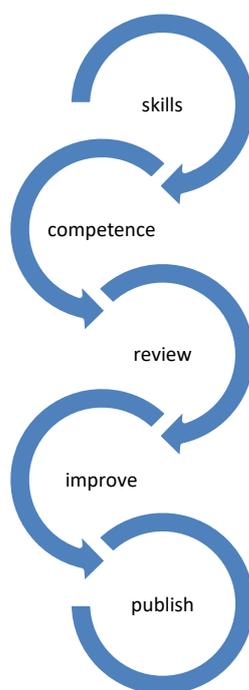
Year	EOY Outcome
1	<ul style="list-style-type: none"> • Explore simulations of real and virtual environments in other curriculum areas • Make informed choices when exploring what happens in a simulation • Develop classification skills by carrying out sorting activities both practically and using technology • Use and explore appropriate buttons, arrows, menus and hyperlinks to navigate teacher selected sources of stored information • Begin to evaluate websites by giving opinions about preferred or most useful sites • Know what to do and who to tell if they see something inappropriate on a website • Develop an awareness of datalogging through the use of various peripheral devices, e.g. thermometers, microscopes and microphones • Keep personal information private; identify where to go for help and support about the internet or other online technologies
2	<ul style="list-style-type: none"> • Independently enter, save, print, retrieve and amend work • Explore the effects of changing simple variables in models and simulations, asking 'what if?' questions • Talk about rules found in simulations and how these affect choices • Sort and classify groups of items by asking simple yes/no questions • Use a branching database program, where appropriate, to sort and identify items • Use basic search tools in a prepared database to answer simple questions • Locate specific, teacher defined, age appropriate websites through a favourites menu and/or by typing a web address (URL) into the address bar in a web browser • Using key words search a specific resource for information, under the guidance and supervision of an adult • Computers require instructions from users (via keyboard, mouse, touch screen etc) in order to perform actions • Upload images and movies to a computer with support if needed • Be aware that data can be captured through independent use of various peripheral devices, e.g. thermometers, microscopes and microphones. • Use technology purposefully • Recognise common uses of information technology beyond school • Send an email, using a subject heading, to a known member of the school community • Open and reply to an email from a known person • Contribute to a blog, journal or forum on the school's VLE or Learning Platform • Develop an awareness of appropriate language to use in email and other forms of digital communication • Use technology safely and respectfully; know where to go for help and support when they have concerns about content or contact on the internet or other online technologies
3	<ul style="list-style-type: none"> • Create and use a branching database to organise and analyse information to answer questions • Use a range of child friendly search engines to locate different media • Develop questions and key words to search for specific information to answer a problem • Use appropriate tools to save and retrieve accessed information e.g. favourites, bookmarks • Use search technologies effectively • Shows an increasing awareness of keeping safe when accessing materials through online sources • Locate, acquire, store and retrieve images from cameras, scanners and the internet for a specific purpose • Begin to understand about copyright and intellectual property of downloaded images

	<ul style="list-style-type: none"> • Be aware that dataloggers can be used when connected to a computer and also remotely • Log on to an email account, open emails, create and send appropriate replies • Forward an email • Select an email recipient from an address book • Recognise acceptable/unacceptable behaviour
4	<ul style="list-style-type: none"> • Independently select process and import images, video and sounds from a variety of sources to enhance presentations • Change the contents of cells in pre-prepared spreadsheets and explore the consequences • Search data according to more than one criterion. • Raise questions and translate them into search criteria that can be used to find answers to specific questions • Use search technologies effectively, being discerning in evaluating digital content e.g. cross-checking with different websites and books • Choose the most appropriate search engine for a task e.g. image search, search within a specific site or searching the wider internet • Identify whether a file has copyright restrictions and can be legally downloaded from the internet and then used in their own work • Save an email in draft format and then return and edit prior to sending • Attach different files to emails e.g. text, audio, image • Open and save attachments to an appropriate place • Use a range of digital tools to communicate, making purposeful contributions to respond to another pupil's question or comment • Able to encode/decode text messages to ASCII • Use technology safely and respectfully • Select, collect, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of content that accomplish given goals
5	<ul style="list-style-type: none"> • Enter formulae such as 'SUM' into a pre-prepared spreadsheet model to explore the effects of changing variables • Consider the effectiveness of key questions on search results and refine where necessary • Design questions and perform complex searches using key words to search a large pre-prepared database looking for relationships and patterns • Understand computer networks, including the internet; how they can provide multiple services, such as the World Wide Web, and the opportunities they offer for communication and collaboration • Use search technologies effectively, appreciating how results are selected and ranked, and be discerning in evaluating digital content • Independently use a datalogger both connected to an computer and also running remotely • Use different styles of language, layout and format of different electronic communications depending on the audience • Publish their work to a wider audience e.g. 'News', 'Blogs' or 'Discussions' within the school VLE or Learning Platform • Able to encode/decode bitmapped images • Evaluate the effectiveness of a variety of digital communication tools • Add email addresses group or distribution lists of contacts to an address book • Recognises and talks about different file types • Identify a range of ways to report concerns about content and contact • Select, collect, analyse, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of content that accomplish given goals

6	<ul style="list-style-type: none"> • Using knowledge and understanding of spreadsheet modelling, develop simple spreadsheet models to investigate problems • Identify and enter the correct formulae into cells; make predictions of the outcome of changing the variable • Solve complex enquiries involving selecting, processing, and presenting data; drawing conclusions from the work • Use appropriate strategies for finding, critically evaluating, validating and verifying information • Distinguish between fact and opinion, developing skills to question where online content might originate from, using their knowledge for example of domain names and common website extensions • Plan and develop structured solutions to tasks which use a combination of ICT tools and techniques • Develop and use criteria to critically evaluate the quality of solutions, identifying improvements and refining their work • Design investigations which require the use of dataloggers recognising what measurements will be needed and the most appropriate means of recording the data • Independently, and with regard for safety, select and use appropriate communication tools to solve problems by collaborating with others within and beyond school • Learn how to use the cc and bcc facilities and discuss when these should be used • Send 'group' emails and be aware of the risks and benefits of 'replying to all' • Extend online publishing to a more global audience • Understands the impact of file size on digital communication • Use technology responsibly • Plan an develop structured solutions to tasks which use a combination of ICT tools and techniques • Develop and use criteria to critically evaluate the quality of solutions, identifying improvements and refining their work • select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of content that accomplish given goals, including collecting, analysing, evaluating and presenting information
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Key Methodologies

The place of the Information Technology strand is at the beginning of the creative process shown, which is the Naace summary of the response to the challenge within the Computing Programme of Study to 'to understand and change the world'.



However, prospective chefs are not expected to learn their craft only by listening to lectures and reading recipe books. Similarly, students need to do more than passively watch demonstrations of competences. They need to know how to sharpen their knives.

So how should they learn?

Clearly, there needs to be some direct teaching, and Naace believes this is best done within the context of solving a problem or making a digital artefact, so that the relevance of the knowledge and competences required within the Information Technology strand is apparent.

From the planning point of view, any scheme of work should ensure that there are sufficient activities to cover all the competences required, and that that children have the opportunities to develop their competences in a range of problem solving and making activities.

Resources

A list of ASCII codes can be found at <http://www.asciitable.com/>

About the World Wide Web from BBC Bitesize: <http://www.bbc.co.uk/guides/z2nbgk7#zsrwmm>

The vibrancy and potential danger of the Internet can be seen in real time at <http://map.norsecorp.com/#/>

Bury Primary Computing Solution <http://tcsc.primaryblogger.co.uk/2014/12/12/bury-primary-computing-solution/>

Computing at School (CAS, <https://www.computingschool.org.uk/>) is a community devoted to the teaching and learning of Computer Science. It is free to join and is packed with all sorts of good things.

j2code www.j2e/j2code is a collection of three free programming environments, including a logo-like environment.

To find out more about Fear to Fun Professional development, email tim@learninglinked.co.uk



Naace has produced this series of Essential Guides, or “eGuides” in response to an identified gap in teachers’ CPD. That is, how to understand and teach the Information Technology strand of the Computing Programme of Study.

Furthermore, Naace believes that technology has a major role to play in raising standards in learning across the curriculum, provided teachers know how to adapt their pedagogies in order to maximise the potential gains offered by learning technologies.

Sponsored by Plum Innovations

For further information please contact
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Cover artwork by Gaia Technologies

Having read this “eGuide”, you may wish to register with The Naace Open Badge Academy for Open Badge CPD accreditation

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