Oxford International Curriculum

Primary

Computing Curriculum

OXFORD

LETTER TO EDUCATORS WORLDWIDE

Oxford University Press is a global publisher with a core mission to promote excellence in education. In 2017, Oxford University Press asked us to develop a new curriculum to provide an international framework for the development of skills in computing. This curriculum is now ready for use, and is offered to educators worldwide to enhance and support practice, and to provide a structured educational journey for young learners.

Our world is shaped by technology, and we are shaped by it. Participation in modern society, informed citizenship and economic independence are increasingly linked to the facility and confidence with which we use technology. Education must prepare all students for adult life. That means they must become more than passive consumers of technology. They must be ready to engage actively, critically creatively and skilfully with the technology of the future.

An education that does not support these goals is not completely fit for purpose.

We are all aware that the future is a moving target. Technology has developed immeasurably over the past 20 years, and the future will bring changes that none of us can predict with absolute confidence. It is not enough to train young learners to use the technological tools of today. They must be made ready for anything because – literally – anything could happen in the years and decades to come.

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Our students depend on us to guide and shape their learning

Yet many teachers are left wondering where to start, and worrying that they may not be providing everything that their students need. How do we prioritise? Which skills are essential and which are contingent on the technologies of today, technologies that may soon change out of all recognition? How do we make the most of the time we have in the classroom, to ensure that it provides the richest possible learning environment for our students? What if our skills are out of date?

Our students depend on us to guide and shape their learning. The younger generation are sometimes called ‘digital natives’. But children are not born with digital skills, or the adult wisdom to make the best decisions in the digital world. They rely on us, and trust us, to prepare them for adult life.

This curriculum is structured enough to provide a trustworthy route to equip all learners with the skills they need for full digital participation in the adult world. It is flexible enough to prepare students for the lifelong learning journey that awaits us all, because technology never stands still.

Students will begin this curriculum with simple learning tasks. Every year’s teaching will develop skills further through active and creative engagement with technology. Teachers will be left in no doubt about what students should learn, but they will be able to adapt students’ experience to the technologies and priorities of their own communities.

This curriculum is designed to be within the capability of all young learners, in all countries and from all backgrounds. But it also offers an appropriate challenge for our fastest and most confident students. Learners can join this journey at any point, and start to improve immediately.

We are proud of the work we have done, and excited to offer this framework to educators worldwide so that all students can now set out on this most important learning journey, a journey that will last a lifetime.
January 2020

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PREFACE

The world today faces significant challenges. Technology, if it is well used, can be part of the solution to these problems. The United Nations Conference on Trade and Development (UNCTAD) has recently stated that technology could literally transform the world:

> We live at a time of technological change that is unprecedented in its pace, scope and depth of impact. Harnessing that progress is the surest path for the international community to deliver on the 2030 agenda for people, peace, and prosperity. Frontier technologies hold the promise to revive productivity and make plentiful resources available to end poverty for good, enable more sustainable patterns of growth and mitigate or even reverse decades of environmental degradation.[1]

This is an opportunity and a promise that we cannot afford to ignore. Because technology could also make things much worse:

> If policy-makers are not proactive, technological disruption can entrench inequality, further marginalize the poorest, and fuel reactionary movements against open societies and economies.

The United Nations has challenged educators to work to direct change in a constructive direction:

> Education will become an even more indispensable lever for development and social justice. Since digital technologies are enablers and multipliers of other frontier technologies we should ensure that all...

are given a real chance to build digital capabilities. Most crucially, there is an urgent need for a sustained effort by the international community to ensure that the multiple gaps in technological capabilities that separate developed and developing countries are closed.

And this transformation begins with our school system and our youngest learners.

THE **GLOBAL** CONTEXT

According to a report published by the McKinsey Global Institute[2], about half of all paid activities worldwide could be automated right away, if existing technologies such as robotics and artificial intelligence (AI) were deployed fully. Furthermore, it has been estimated that as many as 65% of young learners in primary education will work in jobs or fields that do not even exist today[3].

Some economists predict that the disruptive effects of technology could lead to economic and social problems as jobs disappear. But the same sources acknowledge that these changes could drive new and unprecedented prosperity globally. In India, for example, it has been estimated that expansion of digital technologies could contribute between $550 billion and $1 trillion of economic impact per year by 2025[4]. According to a recent report by Deloitte, simply expanding levels of internet access in developing countries to those currently seen in Europe and the United States could increase productivity by as much as 25% in those countries. The resulting economic activity could generate $2.2 trillion in additional GDP and more than 140 million new jobs.[5]

So digital technology could bring prosperity, or threaten social collapse. What will make the difference between these two outcomes? Globally, and within each individual nation, education will have a decisive impact. In the International Monetary Fund publication, *Finance and Development*, the type of education that is needed is described as follows:

> Policy makers working with education providers (traditional and non-traditional) could do more to improve basic STEM skills through the school systems, put a new emphasis on creativity as well as critical and systems thinking, and foster adaptive and life-long learning[6].

1 https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=2110
2 https://www.mckinsey.com/featured-insights/employment-and-growth/technology-jobs-and-the-future-of-work
3 https://oecd-development-matters.org/2018/03/01/how-to-build-inclusive-digital-economies/
4 https://www.mckinsey.com/industries/high-tech/our-insights/indias-tech-opportunity-transforming-work-empowering-people
5 https://www2.deloitte.com/ch/en/pages/technology-media-and-telecommunications/articles/value-of-connectivity.html
6 https://www.imf.org/external/pubs/ft/fandd/2018/06/impact-of-digital-technology-on-economic-growth/muhleisen.htm
7 https://www.pewinternet.org/2018/11/28/teens-social-media-habits-and-experiences/
8 https://oecd-development-matters.org/2018/03/01/how-to-build-inclusive-digital-economies/

We are sometimes complacent about the technological confidence and skills of young learners, as if the older generation has no responsibility to guide their learning. But recent research by the Pew institute found that, even in a technologically developed nation such as the United States, a quarter of all teenagers believe that digital technologies are having a negative impact on their lives[7]. Young people adopt technology quickly. But this does not protect them from its dangers or equip them to use it for their own best interests.

And if educators do not rise to this challenge the impact on the life chances of the young could be devastating:

> Technology can be a force for good... but it can widen the digital divide, increasing the gap between those who benefit from technology and those who are excluded and risk falling further behind[8].

THE **CHALLENGE** FOR EDUCATORS

In the words of Klaus Schwab, Founder and Executive Chairman of the World Economic Forum (WEF):

> Without urgent and targeted action today, to manage the near-term transition and build a workforce with future-proof skills, governments will have to cope with ever-growing unemployment and inequality, and businesses with a shrinking consumer base.
> (WEF)

Computer skills will underpin social as well as economic participation. The OECD report, *Students, Computers and Learning*[9], warns that:

> Students unable to navigate through a complex digital landscape will no longer be able to participate fully in the economic social and cultural life around them... (Our) analysis shows that the reality in our schools lags considerably behind the promise of technology.
> (OECD, page 3)

Following a survey of multiple education systems both within and outside the OECD countries, this study concluded that computing education is failing globally to deliver on its early promise. The reason is the lack of a strong conceptual framework to underpin delivery.

[9] OECD (2015), *Students, Computers and Learning: Making the Connection*, PISA, OECD Publishing. http://dx.doi.org/10.1787/9789264239555-en

Such a framework must combine a coherent learning strategy, a realistic route to delivery and support for the required level of expertise in the classroom:

> The impact of technology on education delivery remains sub-optimal because we may overestimate the digital skills of both teachers and students, because of naïve policy design and implementation strategies, because of poor understanding of pedagogy, or because of the generally poor quality of educational software and courseware.
> (OECD, page 4)

WEF, OECD and many other national and international bodies have identified a significant lack of focus and competence in defining education for computing. Schools throughout the world need a coherent route to deliver the education their students demand:

> To harness the potential of ICT, teachers and industry must create and develop new educational resources – software, textbooks, lessons plans etc. They may find encouragement and support to do so in changes in related education policies, including curricula, assessment frameworks... and professional development for teachers"
> (OECD, page 62)

Oxford International Computing has been developed to address this need.

MEETING THE **NEED**

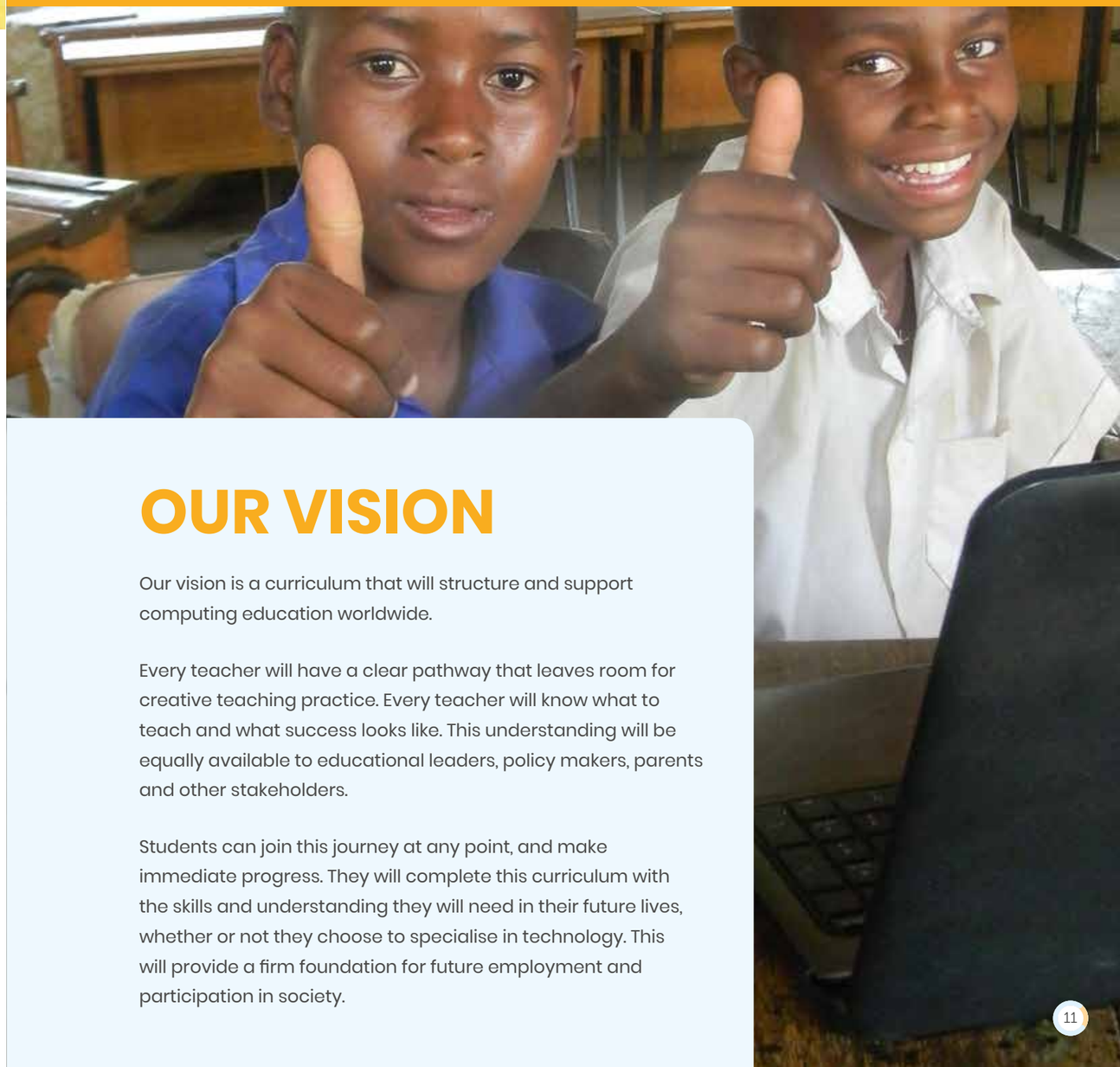
The Oxford International Computing curriculum meets the needs of educators. It is designed to prepare students for future employment and participation in the digital world, whether or not they are destined to become digital specialists. And it is a practical framework that will leave no one behind – no teacher and no learner.

The key features of OIC are that it is:

- **Relevant:** The framework of skills and understanding is designed to enhance the prospects of young learners. The content of the curriculum is directly tailored to meet their needs as future participants in work and society.
- **Realistic and deliverable:** The curriculum does not expect teachers to do the impossible. These learning outcomes can be achieved with the resources that exist right now in schools throughout the world, by the educators who are already in place.

- **Flexible:** The curriculum is designed to be adaptable as technology changes and to be flexible between communities where different types of technology are in everyday use. No community will be excluded by a requirement to use unrealistically expensive hardware or software. Communities are creative and innovative in making the most of the available technology. This curriculum will not limit that flexibility.
- **Transparent:** A key feature of this curriculum is clear communication of exactly what students should be able to do and what they must be taught, year by year. All teachers, working with any age group, will understand what they need to teach and what students need to learn.
- **Measurable:** The curriculum is linked to an assessment framework that will enable teachers to evaluate, measure and record individual students' progress. There are clear criteria for success, based on students' ability to complete practical tasks demonstrating their developing skills.
- **Universal:** All students can achieve mastery of the given digital goals. This is a curriculum for all learners.
- **Stretching:** There is a risk that any universal curriculum may provide insufficient challenge for the quickest and most confident students. This curriculum includes more challenging outcomes at every level to address this issue. No students will be held back. Their additional achievement will be supported and recognised.
- **Supported:** Alongside the curriculum, Oxford University Press will provide a complete support package of high-quality materials and training for teachers. This will equip them to deliver the digital skills that will be needed in the future, to the learners of today.

OXFORD INTERNATIONAL COMPUTING



OUR VISION

Our vision is a curriculum that will structure and support computing education worldwide.

Every teacher will have a clear pathway that leaves room for creative teaching practice. Every teacher will know what to teach and what success looks like. This understanding will be equally available to educational leaders, policy makers, parents and other stakeholders.

Students can join this journey at any point, and make immediate progress. They will complete this curriculum with the skills and understanding they will need in their future lives, whether or not they choose to specialise in technology. This will provide a firm foundation for future employment and participation in society.

OVERVIEW

This curriculum is structured as a simple matrix with an associated assessment framework.

The OIC Primary curriculum has learning outcomes for every year from Year 1 (ages 5–6 years) to Year 6 (ages 10–11 years). The learning outcomes are organised into four themes:

- Programming and computational thinking
- Using software for creativity and productivity
- The nature of technology
- Digital literacy.

The assessment framework provides measurable and unambiguous criteria against each learning outcome. These criteria describe how teachers can confirm that learners have achieved the outcomes set out in the curriculum.

Curriculum at-a-glance (page 18)

THE **FOUR** THEMES

The four themes encompass the full spectrum of skills and understanding that young learners will need to develop to prepare them to use technology effectively and with understanding in later life.

1

Programming and computational thinking: Students will learn programming skills, first with a visual language, and later with a professional text-based language. They will learn the computational skills that underpin the creative and conceptual basis of program development and artificial intelligence (AI).

2

Using software for creativity and productivity: Students will learn to use software to analyse data and to create text and multimedia content. Students will not be tied to particular applications or types of software but will learn to use available and up-to-date technologies to fulfil tasks and meet the needs of particular audiences.

3

The nature of technology: Students will learn how technology works, the different types of technology that are available and the concepts that underpin future developments, including robotics and control systems. They will understand the advantages and limitations of technology and how it is used both in and out of work.

4

Digital literacy: Students will be prepared for participation in the online world. They will be able to interact respectfully and safely with other users and make use of a range of technologies that make up our online world.

ASSESSMENT **FRAMEWORK**

Curriculum at-a-glance (page 18)

The assessment framework provides assessment criteria linked to every learning outcome in the curriculum. Teachers will assess students against these criteria, to monitor and confirm students' progress.

Students can be assessed at one of three levels:

- **Developing:** The student has made some progress, but has not yet achieved the specified learning outcome.
- **Secure:** The student has fully achieved the learning outcome.
- **Extended:** The student has exceeded the learning outcome and achieved additional skills or deeper understanding beyond those specified.

These criteria allow the teacher to acknowledge the achievement of struggling students or those with additional learning needs. They provide a sound framework to confirm that the class as a whole has reached mastery of the universal learning outcomes, and a route to exceptional achievement for students who wish to move more quickly and extend their skills and understanding.

THE **SPIRAL** MODEL

The underlying structure of the curriculum has a spiral development model. This means that each learning theme is analysed into skills areas. These are revisited each year at higher levels of complexity and depth.

The spiral development model reinforces learning and builds on previous achievement. It makes it easier for students to develop and gives coherence and structure to the learning journey.

PREPARATION FOR LOWER SECONDARY

When they complete this Primary curriculum, students will move on to Lower Secondary (Years 7–9). OIC Lower Secondary computing provides a complete programme of learning for older learners. Its structure and content are aligned to the Primary curriculum and students leaving OIC Primary computing will be well prepared to take on its new challenges.

THE FUTURE OF TECHNOLOGY

Computing is a changing field. Technology is constantly developing, offering new challenges and opportunities. Our curriculum is designed to be flexible. Rather than requiring the use of specific software or hardware, we emphasise constructive and intelligent utilisation of technology. This emphasis will not change as technology changes, but will prepare our learners for a life of changing technology.

There are two specific areas where we anticipate that technology will develop significantly in the lifetimes of our current learners. These are:

- robotics
- artificial intelligence (AI).

Students must be conceptually equipped to understand the principles underlying these developments and to grasp the opportunities that they provide. Therefore, our curriculum ensures that students receive a grounding in the principles, implementation and impact of these technologies.

Under our spiral model, the technologies are revisited at increasing levels of complexity during the nine-year student journey.

ROBOTICS

Robotics means the use of computer systems to control autonomous physical movement of machines. Robotics is a discipline that incorporates aspects of engineering, electronics and computer science. Computer systems control physical action and movement, via sensory feedback and information processing. These technologies allow us to develop machines that can substitute for humans and replace human actions.

These topics are revisited at increasing levels of complexity. The following learning outcomes demonstrate the path of learners to increasing confidence, understanding and skill in relation to the technology of robotics, its social implications and the impacts it may have on our communities.

ARTIFICIAL **INTELLIGENCE**

Artificial intelligence (AI) means the use of technology to imitate human reasoning or to replicate human judgements and capabilities. That could include social, linguistic and creative behaviours. One significant approach to AI is the development of computational algorithms and mathematical models that can simulate human judgements and cognition and define expert systems. A second important strategy is the development and use of non-traditional processing models, for example neural networks and evolutionary models. A range of computational methods is deployed such as heuristics, machine learning, pattern recognition and abstraction.

Our learning journey develops students' understanding of algorithms, mathematical and logical processing, abstract modelling and, in their final year, the modern cognitive and computational techniques that underpin the development of AI.

YEAR-ON-YEAR **DEVELOPMENT**

Under our spiral model, the technologies are revisited at increasing levels of complexity. For example:

Year	Learning outcome
2	Say what an algorithm is and what running a program means (2.1a) Say some things a computer can do and some things a computer cannot do (2.3b)
3	Describe a simple plan for a program that changes inputs into outputs (3.1a) Create a program that produces varied output in response to user inputs (3.1b)
4	Identify a range of modern devices which contain computer processors (for example, embedded processors) (4.3b)
6	Make an algorithm to solve a problem using logical reasoning (6.1a) Write a program that controls or simulates physical movement (6.1b) Describe the technology of robotics and control systems (6.3a) Discuss the potential and the limitations of robotics and control systems (6.3b)

OIC **PRIMARY** CURRICULUM AT-A-GLANCE

Theme	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
1 Programming and computational thinking	**1.1a:** Run and use a simple program made by somebody else **1.1b:** Describe a program by saying what its inputs and outputs are **1.1c:** Edit a program and say how that will change what it does	**2.1a:** Say what an algorithm is and what running a program means **2.1b:** Say what a program will do by looking at its commands **2.1c:** Create a simple program and remove errors so it runs	**3.1a:** Describe a simple plan for a program that changes inputs into outputs **3.1b:** Create a program that produces varied output in response to user inputs **3.1c:** Find and correct the errors in a program so it works the way you want	**4.1a:** Plan and create a program that uses a named variable **4.1b:** Plan and create a program that uses a conditional structure **4.1c:** Create a program to meet a given purpose **4.1d:** Make programs with different types of input and output	**5.1a:** Create and describe an algorithm that includes a loop **5.1b:** Create a program with a loop controlled by an exit condition **5.1c:** Adapt a program to meet a new requirement	**6.1a:** Make an algorithm to solve a problem using logical reasoning **6.1b:** Write a program that controls or simulates physical movement **6.1c:** Solve a problem by breaking it into smaller parts or modules
2 Using software for productivity and creativity	**1.2a:** Make simple images using computer software **1.2b:** Enter words and numbers into the computer	**2.2a:** Make a document with words and pictures **2.2b:** Enter numbers into a computer and find the answer to a sum **2.2c:** Save your work as a file in storage	**3.2a:** Use software to improve the appearance of a document that includes text and images **3.2b:** Use software to enter number data and make calculations	**4.2a:** Use software to format a document and fix mistakes **4.2b:** Use software tools to process numerical data and see summary results, including a graph	**5.2a:** Make and share images to suit an audience and a purpose **5.2b:** Amend an image to increase its impact **5.2c:** Use a spreadsheet to answer questions by finding out what happens when numbers change	**6.2a:** Use technology to collect or record data **6.2b:** Use software to structure, sort and filter data **6.2c:** Work as a team using technology (for example, to give a group presentation)
3 The nature of technology	**1.3a:** Say what a computer is **1.3b:** Say some things that can be done with a computer in school and out of school	**2.3a:** Name the main parts of a typical computer and say what they are for **2.3b:** Say some things a computer can do and some things a computer cannot do	**3.3a:** Describe a range of familiar digital devices **3.3b:** Describe tasks where computers can be helpful	**4.3a:** Describe what storage is and why it is important **4.3b:** Identify a range of modern devices which contain computer processors (for example, embedded processors) **4.3c:** Describe how computers may be used in the world of work	**5.3a:** Explain that digital devices can be connected by communication links **5.3b:** Explain what the internet is and some internet services such as the world wide web **5.3c:** Describe some ways the internet helps us work together in the modern world	**6.3a:** Describe the technology of robotics and control systems **6.3b:** Discuss the potential and the limitations of robotics and control systems
4 Digital literacy	**1.4a:** Find something out using the computer **1.4b:** Be safe and polite in the computer room **1.4c:** Say who can help you if you are worried	**2.4a:** Download useful words or images **2.4b:** Use computers safely to help with learning **2.4c:** Keep personal information private	**3.4a:** Use technology to send and receive messages **3.4b:** Describe the parts of a message **3.4c:** Explain how to respond to an unsuitable communication	**4.4a:** Find information using a web search **4.4b:** Describe how to spot unsuitable internet content and behaviour **4.4c:** Describe several ways you can report your concerns	**5.4a:** Obtain information from online sources and describe the sources used **5.4b:** Choose information from online sources and give reasons for choices **5.4c:** Explain how online searches select and show useful information	**6.4a:** Create a simple web page with text and images **6.4b:** Review web content to check if appropriate, and amend if needed **6.4c:** Act responsibly and with respect for others when using the computer

OIC ASSESSMENT FRAMEWORK

This section sets out the criteria for each level of achievement against each learning outcome.

YEAR **ONE**

Introduction

In Year 1, computing may be delivered by non-specialist staff. Computing will compete for time with other subjects of great importance like literacy and numeracy. It is also important that young learners have time for playful activities.

The Year 1 syllabus is designed to introduce the early skills and understanding that will support further learning over the years to come. The activities are suitable for the age of the learners and can be enjoyably integrated into the early classroom. Half an hour per week will give plenty of time to deliver the learning outcomes.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 1. During the year, every student will:

- **1.1a:** Run and use a simple program made by somebody else
- **1.1b:** Describe a program by saying what its inputs and outputs are
- **1.1c:** Edit a program and say how that will change what it does
- **1.2a:** Make simple images using computer software
- **1.2b:** Enter words and numbers into the computer
- **1.3a:** Say what a computer is
- **1.3b:** Say some things that can be done with a computer in school and out of school
- **1.4a:** Find something out using the computer
- **1.4b:** Be safe and polite in the computer room
- **1.4c:** Say who can help you if you are worried

These outcomes can be delivered in any order and integrated with play and the development of reading and number skills. Students will get used to sitting at the computer and using simple tools such as the mouse and keyboard. They will learn to work safely and sensibly.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

1.1a: *Run and use a simple program made by somebody else*

Developing: The student sits quietly and safely at the computer.
The student uses input and output devices.

Secure: The student runs a program.
The student provides inputs and observes outputs.

Extended: The student controls a program, working independently.

1.1b: *Describe a program by saying what its inputs and outputs are*

Developing: The student talks about what they did when they ran the program.

Secure: The student says what they did and what the program did in response.

Extended: The student describes how to control a program and how to choose what the program does.

1.1c: *Edit a program and say how that will change what it does*

Developing: The student has made changes to a program.

Secure: The student has made changes and the edited program runs. The student can explain the changes made.

Extended: The student changes the program to meet a given requirement.

1.2a: *Make simple images using computer software*

Developing: The student makes lines or shapes.

Secure: The student makes simple images out of lines or shapes.

Extended: The student makes simple changes to images (for example, adding new colours).

1.2b: *Enter words and numbers into the computer*

Developing: The student uses the keyboard and mouse.

Secure: The student types words and numbers into a file.

Extended: The student makes changes to words and numbers in a file.

1.3a: *Say what a computer is*

Developing: The student can use the computer for simple tasks.

Secure: The student shows they know what a computer is and can name it correctly.

Extended: The student can draw a simple sketch of a computer and write in labels to indicate devices such as screen and keyboard.

1.3b: *Say some things that can be done with a computer in school and out of school*

Developing: The student can say some things they have done at school using the computer.

Secure: The student can say some things that are done outside of school using a computer.

Extended: The student can explain how using a computer can make tasks easier, and why people might decide to use a computer.

1.4a: *Find something out using the computer*

Developing: The student looks at images and/or text on the screen with attention.

Secure: The student can express what they found out from the computer.

Extended: The student selects and evaluates content to pick the best or most useful examples.

1.4b: *Be safe and polite in the computer room*

Developing: The student attempts to work with care but may need to develop further.

Secure: The student uses equipment with care.
The student works sensibly and safely with others.

Extended: The student helps keep the classroom safe by being an example of good behaviour and/or helping others.

1.4c: *Say who can help you if you are worried*

Developing: The student confirms or agrees that they will tell a suitable adult such as a teacher if they see something that worries or upsets them when using the computer.

Secure: The student can identify a suitable adult and say that they will tell the adult if they see something that worries or upsets them.

Extended: The student helps to create a communication about staying safe online, such as a poster or a play.

YEAR **TWO**

Introduction

Year 2 computing may be delivered by non-specialist teachers. There may be limited time and access to resources. Other subjects, and time for play and social development, compete for classroom time. Nevertheless, it is important that students continue to develop their skills and understanding so they can approach computing in later years with confidence and interest. A half-hour or hour-long computing slot every week should give ample time to deliver these learning outcomes.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 2. During the year every student will:

2.1a: Say what an algorithm is and what running a program means

2.1b: Say what a program will do by looking at its commands

2.1c: Create a simple program and remove errors so it runs

2.2a: Make a document with words and pictures

2.2b: Enter numbers into a computer and find the answer to a sum

2.2c: Save your work as a file in storage

2.3a: Name the main parts of a typical computer and say what they are for

2.3b: Say some things a computer can do and some things a computer cannot do

2.4a: Download useful words or images

2.4b: Use computers safely to help with learning

2.4c: Keep personal information private

These outcomes can be delivered in any order and integrated with play and other learning activities in the classroom. Students will learn to name the parts of a computer and use a computer to make documents and run programs. Students will develop their computing skills alongside maturing literacy and numeracy.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

2.1a: *Say what an algorithm is and what running a program means*

Developing: The student says that running a program means making the computer carry out the commands in the program.

Secure: The student also explains that an algorithm is a plan setting out actions to solve a problem or complete a task.
The student explains that an algorithm can be turned into a program.

Extended: The student creates a simple algorithm that can be turned into a program.

2.1b: *Say what a program will do by looking at its commands*

Developing: The student gives some description of what a program does, perhaps after running the program.

Secure: The student can point to or describe the sequence of commands of a program.
The student can describe what the program will do, before running it.

Extended: The student can amend a program to make it do something different.

2.1c: *Create a simple program and remove errors so it runs*

Developing: The student assembles some or all of the parts of a program.

Secure: The student makes a program and the program runs.
The student removes errors from a program they have written or someone else has written.

Extended: The student makes a program that matches an algorithm.

2.2a: *Make a document with words and pictures*

Developing: The student uses a keyboard to type words.

Secure: The student enters text accurately into a document.
The student inserts an image into a document.

Extended: The student fixes errors in a document or makes edits to improve it.

2.2b: *Enter numbers into a computer and find the answer to a sum*

Developing: The student enters some number values into a spreadsheet.

Secure: The student enters some numbers into the correct places in a spreadsheet.
The student reports or identifies the result of a calculation from these numbers.

Extended: The student changes the numbers in a spreadsheet and explains how this changes the outputs.

2.2c: *Save your work as a file in storage*

Developing: The student saves work using the default file name.

Secure: The student saves a file using a suitable file name.

Extended: The student opens a file they made, makes changes and saves it again.

2.3a: *Name the main parts of a typical computer and say what they are for*

Developing: The student names or draws peripherals such as keyboard, mouse or screen (or equivalent parts of a device such as a tablet).

Secure: The student describes computer devices or parts and explains how they are used.
The student explains the difference between input and output devices or parts.

Extended: The student compares the way we use devices or parts (for example, comparing a keyboard with a 'touchscreen').

2.3b: *Say some things a computer can do and some things a computer cannot do*

Developing: The student says some things a computer can do.

Secure: The student expresses a range of things a computer can and cannot do.

Extended: The student evaluates whether a computer will help with different tasks.
The student expresses ways in which computers might be used in future.

2.4a: *Download useful words or images*

Developing: The student looks with attention at remote content such as a web page.

Secure: The student obtains or reads information from a web page by downloading content.

Extended: The student selects information or content from a web page, making good choices with reference to a requirement.

2.4b: *Use computers safely to help with learning*

Developing: The student works with care for the physical safety of self and others.

Secure: The student uses resources for appropriate learning activities.

Extended: The student explains how to use computers safely to help with learning.

2.4c: *Keep personal information private*

Note: Personal information is often collected when we work online. Sometimes this is for good reason, for example when we fill in a form or give bank details to an e-commerce site. Older learners will develop a nuanced understanding of when information can be legitimately asked for and provided. However, as these youngest students venture online they should learn not to share personal data unless they have discussed it with a responsible adult (reinforcing this message from Year 1). This is an appropriate working approach at this age.

Developing: The student agrees that they should keep their name and address private when working online, and acts accordingly.

Secure: The student identifies personal information and keeps it safe when working online.

Extended: The student explains that personal information should be kept private when working online.

YEAR **THREE**

Introduction

In Year 3, computing may be delivered by a school specialist or by a non-specialist teacher. Learners can draw on developing literacy and numeracy skills to support their use of computers, so they can make more progress and take on bigger challenges. Half an hour to an hour per week in a room with computers available to all students will allow the delivery of these outcomes.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 3. During the year, every student will:

- **3.1a:** Describe a simple plan for a program that changes inputs into outputs
- **3.1b:** Create a program that produces varied output in response to user inputs
- **3.1c:** Find and correct the errors in a program so it works the way you want
- **3.2a:** Use software to improve the appearance of a document that includes text and images
- **3.2b:** Use software to enter number data and make calculations
- **3.3a:** Describe a range of familiar digital devices
- **3.3b:** Describe tasks where computers can be helpful
- **3.4a:** Use technology to send and receive messages
- **3.4b:** Describe the parts of a message
- **3.4c:** Explain how to respond to an unsuitable communication

These outcomes can be delivered in any order. Typically, one well-developed computing activity could provide evidence to confirm achievement against multiple outcomes. Students will learn to use computers to find and correct errors, to send and receive messages and to carry out calculations.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

3.1a: *Describe a simple plan for a program that changes inputs into outputs*

Developing: The student writes a description of what they want a program to do.

Secure: The student makes a written plan of three or four short steps in a correct sequence.
The student makes a plan that includes inputs and outputs.

Extended: The student plans a program with several different inputs.

3.1b: *Create a program that produces varied output in response to user inputs*

Developing: The student assembles some program components in sequence.

Secure: The student makes a simple working program with inputs and outputs.

Extended: The student makes several versions of a program that work in different ways.

3.1c: *Find and correct the errors in a program so it works the way you want*

Developing: The student finds and removes at least one error from a program.

Secure: The student removes all errors from a program, which then works correctly.

Extended: The student describes how they found and fixed errors in a program.

3.2a: *Use software to improve the appearance of a document that includes text and images*

Developing: The student enters text into software such as a word-processing application.

Secure: The student uses software tools to format, reorganise and correct a document.

Extended: The student produces several versions of a document by varying formatting features.

3.2b: *Use software to enter number data and make calculations*

Developing: The student enters number values into a software application such as a spreadsheet.

Secure: The student enters formulas to produce a calculated result.

Extended: The student explains or shows the meaning of calculated results.

3.3a: *Describe a range of familiar digital devices*

Developing: The student names or indicates some digital devices such as tablets, smartphones and laptops.

Secure: The student describes the features and uses of familiar digital devices.

Extended: The student evaluates and compares familiar digital devices (for example, for usability or portability).

3.3b: *Describe tasks where computers can be helpful*

Developing: The student identifies at least one task where the computer has helped.

Secure: The student describes a range of tasks where computers can help.

Extended: The student explains the types of task where a computer may be helpful or less helpful.

3.4a: *Use technology to send and receive messages*

Developing: The student receives and reads an email or similar message.

Secure: The student receives, replies to and forwards an email or similar message.
The student composes and sends a new email or similar message.

Extended: The student sends an email or similar message with additional material such as a file attachment or an embedded image.

3.4b: *Describe the parts of a message*

Developing: The student reads an email and can say what it is about.

Secure: The student identifies the subject, the sender, the date and the body text of an email (or similar parts of an electronic message of another kind).

Extended: The student recognises, saves and reuses contact details.

3.4c: *Explain how to respond to an unsuitable communication*

Developing: The student uses email responsibly in class.

Secure: The student explains how to respond to an unsuitable email message – principally to mention it to a responsible adult, to ignore it without response and not to open any attachments.

Extended: The student discusses some of the risks associated with email such as computer viruses.

YEAR **FOUR**

Introduction

In Year 4, the learning outcomes are more challenging than in previous years. Students will plan and write simple programs using variables and conditionals. They will use software to improve their documents, analyse number data and carry out internet searches. Computing begins to contribute skills that will support learning in other syllabus areas. An hour a week will allow students to progress rapidly through the syllabus. Improved use of computers may benefit their learning in other subjects.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 4. During the year, every student will:

- **4.1a:** Plan and create a program that uses a named variable
- **4.1b:** Plan and create a program that uses a conditional structure
- **4.1c:** Create a program to meet a given purpose
- **4.1d:** Make programs with different types of input and output
- **4.2a:** Use software to format a document and fix mistakes
- **4.2b:** Use software tools to process numerical data and see summary results, including a graph
- **4.3a:** Describe what storage is and why it is important
- **4.3b:** Identify a range of modern devices which contain computer processors (for example, embedded processors)
- **4.3c:** Describe how computers may be used in the world of work
- **4.4a:** Find information using a web search
- **4.4b:** Describe how to spot unsuitable internet content and behaviour
- **4.4c:** Describe several ways you can report your concerns

These outcomes may be delivered in any order. Learning could be integrated with work in other subject areas. Students will use computers to do internet research, to process number data and to format documents. They will plan and create programs with variables and conditional structures.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

4.1a: *Plan and create a program that uses a named variable*

Developing: The student creates and runs a working program that uses at least one variable – it may use a default name.

Secure: The student makes a simple program plan that includes storing at least one value as a variable.
The student makes a working program that matches the plan they made and uses a named variable.

Extended: The student chooses suitable identifying names for variables used in work.

4.1b: *Plan and create a program that uses a conditional structure*

Developing: The student creates and runs a working program that includes a condition such as 'if… then'.

Secure: The student makes a program plan that includes at least one logical test, with a conditional structure depending on the result of the test.
The student makes a working program that matches the plan they made.

Extended: The student makes a plan and program using an 'if… then… else…' structure.

4.1c: *Create a program to meet a given purpose*

Developing: The student creates a working program.

Secure: The student makes a program that meets a simple brief or given requirement.

Extended: The student adapts or repurposes a program to meet a new requirement.

4.1d: *Make programs with different types of input and output*

Developing: The student makes working programs with user controls (for example, keyboard, mouse or touchscreen).

Secure: The student creates working programs with more than one type of output (for example, sound and visual (screen) output).

Extended: The student investigates a range of outputs that can be used in programs (for example, sounds they have recorded or control of physical systems).

4.2a: *Use software to format a document and fix mistakes*

Developing: The student makes a document using software.

Secure: The student makes a document that is well laid-out, with headings or titles, and with spelling mistakes corrected.

Extended: The student uses 'search and replace', advanced spelling tools or other features to make blanket changes to a document.

4.2b: *Use software tools to process numerical data and see summary results, including a graph*

Developing: The student enters number values into a spreadsheet accurately and in the right position.

Secure: The student creates a spreadsheet that calculates and shows summary values.

The student creates a spreadsheet that includes a chart or graph of numerical data.

Extended: The student selects chart features to ensure that key facts are communicated.

4.3a: *Describe what storage is and why it is important*

Developing: The student saves and retrieves their work using a suitable method.

Secure: The student saves and retrieves their work regularly.
The student explains why they save their work and how their work is saved.

Extended: The student evaluates a range of alternative storage methods.

4.3b: *Identify a range of modern devices which contain computer processors (for example, embedded processors)*

Developing: The student names and briefly describes familiar examples of digital technology such as computers, mobile devices and smartphones.

Secure: The student names and briefly describes further examples of digital technology such as those used in factories, shops or hospitals.

Extended: The student explains the benefits of using digital technology in a range of contexts.

4.3c: *Describe how computers may be used in the world of work*

Developing: The student joins in discussions or activities about how computers are used at work.

Secure: The student expresses some of the ways computers are used in the world of work.

Extended: The student explains how computers can make people more effective at their job.

4.4a: *Find information using a web search*

Developing: The student follows links and reads web content to find things out.

Secure: The student uses a web search to find out about a given topic.
The student selects content and information from a web page such as text and images.
The student describes or shows what they found.

Extended: The student uses local features such as menus or local searches to find useful information inside a website.
The student bookmarks useful pages in a website.

4.4b: *Describe how to spot unsuitable internet content and behaviour*

Developing: The student listens carefully to advice about unsuitable or upsetting internet content and behaviour online.

Secure: The student confirms understanding of advice about unsuitable or upsetting internet content and behaviour, and acts accordingly if needed.

Extended: The student critically evaluates the different types of experience one may have with internet content.

4.4c: *Describe several ways you can report your concerns*

Developing: The student outlines or states a process for reporting concerns about internet content or behaviour.

Secure: The student confirms their understanding of school policy about unsuitable or upsetting internet content and behaviour.
The student follows school policy about use of the internet.

Extended: The student identifies online features that allow them to report unsuitable content.
The student can take a record of an online event to support a report of concerns.

YEAR **FIVE**

Introduction

In Year 5, students will use computers with increasing understanding and skill. An hour a week or more of dedicated study will provide a good basis for learning. Consider using specialist support staff to help teach this subject.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 5. During the year, every student will:

- **5.1a:** Create and describe an algorithm that includes a loop
- **5.1b:** Create a program with a loop controlled by an exit condition
- **5.1c:** Adapt a program to meet a new requirement
- **5.2a:** Make and share images to suit an audience and a purpose
- **5.2b:** Amend an image to increase its impact
- **5.2c:** Use a spreadsheet to answer questions by finding out what happens when numbers change
- **5.3a:** Explain that digital devices can be connected by communication links
- **5.3b:** Explain what the internet is and some internet services such as the world wide web
- **5.3c:** Describe some ways the internet helps us work together in the modern world
- **5.4a:** Obtain information from online sources and describe the sources used
- **5.4b:** Choose information from online sources and give reasons for choices
- **5.4c:** Explain how online searches select and show useful information

Students will develop problem-solving skills. They will create algorithms and programs that use loops. They will use technology to explore, to find out and to communicate with impact. As always, outcomes may be delivered in any order and one activity may support multiple outcomes.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

5.1a: *Create and describe an algorithm that includes a loop*

Developing: The student describes what they want a program to do before they start work.

Secure: The student makes a plan for a program.
The student creates a plan that includes actions repeated inside a loop and a condition to stop the loop.

Extended: The student explains the difference between a loop controlled by a counter and a loop controlled by a condition or test.

5.1b: *Create a program with a loop controlled by an exit condition*

Developing: The student uses a loop without an exit condition in a program.

Secure: The student makes a program with a loop that includes an exit condition.

Extended: The student creates programs that use loops of different kinds, with different exit conditions.

5.1c: *Adapt a program to meet a new requirement*

Developing: The student creates a working program to meet a requirement.

Secure: The student amends a program to produce a required change.

Extended: The student chooses the most suitable from a range of ways to meet a requirement.

5.2a: *Make and share images to suit an audience and a purpose*

Developing: The student creates images using a digital device.

Secure: The student creates images using a digital device that are relevant to a specified audience and purpose.
The student selects images and presents them in an accessible format.

Extended: The student uses images as part of a structured communication such as a presentation or report.

5.2b: *Amend an image to increase its impact*

Developing: The student makes some changes to an image.

Secure: The student edits one or more images to improve their appeal to an audience or suitability to a purpose.

Extended: The student explains how amendments to an image have increased its appeal or suitability.

5.2c: *Use a spreadsheet to answer questions by finding out what happens when numbers change*

Developing: The student makes a spreadsheet with values and formulas.

Secure: The student changes some of the stored values in a spreadsheet.
The student answers questions by checking the effect of changes on calculated results.

Extended: The student uses the analysis of a scenario to support a decision, giving reasons.

5.3a: *Explain that digital devices can be connected by communication links*

Developing: The student identifies devices that are connected via a communication link.

Secure: The student explains how devices are connected in simple terms.
The student expresses understanding that communication links are needed for computers and other devices to send messages and share data.

Extended: The student explains how devices are connected and what must be in place to establish a network.

5.3b: *Explain what the internet is and some internet services such as the world wide web*

Developing: The student identifies that the internet is a global network that connects computers together.

Secure: The student explains the world wide web as a service provided over the internet.

Extended: The student describes some features of the internet (for example, that it has no overall controlling body and how hyperlinks connect websites together).

5.3c: *Describe some ways the internet helps us work together in the modern world*

Developing: The student describes some ways the internet affects our lives.

Secure: The student describes how the internet helps people to communicate, share multimedia content and work together.

Extended: The student evaluates some of the positive and negative impacts of the internet on the modern world.

5.4a: *Obtain information from online sources and describe the sources used*

Developing: The student carries out an internet search on a given topic, obtaining information from at least one source.

Secure: The student obtains information from multiple sources.
The student records the sources they have used.

Extended: The student uses information with correct attribution to sources.

5.4b: *Choose information from online sources and give reasons for choices*

Developing: The student obtains information on a topic by searching the internet.

Secure: The student carries out an internet search and selects good-quality information relevant to a topic.
The student reviews the information they have selected and gives reasons.

Extended: The student discusses some of the criteria used to evaluate the quality of information.

5.4c: *Explain how online searches select and show useful information*

Developing: The student explains how to use a search engine to find information.

Secure: The student explains in basic terms how a search engine finds and compiles links.
The student gives some reasons why some links are displayed by the search engine with higher priority (for example, more current and relevant sites, and sponsored content).

Extended: The student describes in basic terms how search engines rank or prioritise web links.

YEAR **SIX**

Introduction

Year 6 students will work with confidence on the computer if they have followed the programme of study set out for previous years. At least an hour a week timetabled in a computing room is recommended to support the learning outcomes. The use of suitable software and hardware resources will allow students to explore building devices controlled by processors, carry out independent investigations and create their own web pages. Specialist staff, or staff who have received development training, will provide effective support for the subject.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 6. During the year, every student will:

- **6.1a:** Make an algorithm to solve a problem using logical reasoning
- **6.1b:** Write a program that controls or simulates physical movement
- **6.1c:** Solve a problem by breaking it into smaller parts or modules
- **6.2a:** Use technology to collect or record data
- **6.2b:** Use software to structure, sort and filter data
- **6.2c:** Work as a team using technology (for example, to give a group presentation)
- **6.3a:** Describe the technology of robotics and control systems
- **6.3b:** Discuss the potential and the limitations of robotics and control systems
- **6.4a:** Create a simple web page with text and images
- **6.4b:** Review web content to check if appropriate, and amend if needed
- **6.4c:** Act responsibly and with respect for others when using the computer

Students will produce more complex and creative work including studying robotics, designing and creating a web page and writing a program that simulates physical movement. These outcomes may be delivered in any order, perhaps through projects and group work.

Assessment criteria

The assessment criteria allow the teacher to assess the level of achievement of each student.

6.1a: *Make an algorithm to solve a problem using logical reasoning*

Developing: The student creates an algorithm with some actions to solve a problem.

Secure: The student creates an algorithm that solves a simple problem (for example, finding the largest of a list of numbers or moving a sprite through a maze).
The student checks that an algorithm solves a problem.

Extended: The student improves or corrects an algorithm to solve a problem.

6.1b: *Write a program that controls or simulates physical movement*

Developing: The student writes code that makes an object move (for example, movement of a device or an on-screen sprite).

Secure: The student writes code to control movement (for example, detecting and reacting to real or on-screen obstacles).

Extended: The student controls movement of multiple parts or objects.

6.1c: *Solve a problem by breaking it into smaller parts or modules*

Developing: The student identifies and solves one part of a larger problem.

Secure: The students breaks a problem into smaller parts.
The student assembles smaller parts to solve a problem (for example, simple modules).

Extended: The student develops parts to solve a problem (for example, writing a simple module).

6.2a: *Use technology to collect or record data*

Developing: The student identifies technology that can be used to collect data.

Secure: The student collects real-life data using technology (for example, using a data logger or timer, or pressing a button on a hand-held device).

Extended: The student finds out about technology that can be used to collect and record data.

6.2b: *Use software to structure, sort and filter data*

Developing: The student puts data into a structure (for example, a table).

Secure: The student sorts data.
The student searches or filters data.

Extended: The student analyses data (for example, calculating or selecting a result to answer a question).

6.2c: *Work as a team using technology (for example, to give a group presentation)*

Developing: The student helps with a team activity that uses technology.

Secure: The student contributes fully to a team activity using technology.

Extended: The student takes a significant role in a team activity (for example, making decisions, using advanced skills or helping others).

6.3a: *Describe the technology of robotics and control systems*

Developing: The student identifies some features of robotics and control systems.

Secure: The student describes key features of the technology of robotics and control systems.

Extended: The student discusses the results of research into the technology of robotics and control systems.

6.3b: *Discuss the potential and the limitations of robotics and control systems*

Developing: The student gives some examples of the use of robotics and control systems in real life.

Secure: The student evaluates some advantages and limitations of robotics and control systems.

Extended: The student expresses the results of research into the uses of robotics and control systems (for example, current uses or future possibilities).

6.4a: *Create a simple web page with text and images*

Developing: The student uploads some content to a developing web page.

Secure: The student creates a web page that presents both text and images relevant to a chosen topic.

Extended: The student creates a web page with well-chosen content and formatting.

6.4b: *Review web content to check if appropriate, and amend if needed*

Developing: The student checks web content and corrects one or more errors.

Secure: The student reviews a web page and makes changes to improve it.

Extended: The student makes recommendations for further improvements to a web page.

6.4c: *Act responsibly and with respect for others when using the computer*

Developing: The student's interactions with others in person are polite and responsible when using the computer (for example, sharing access to equipment).

Secure: The student's interactions with others are polite and responsible when interacting online (for example, giving polite feedback).

Extended: The student provides supportive feedback to others using online technology.

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