Oxford
International
Curriculum

Lower Secondary

Computing Curriculum

OXFORD

LETTER TO EDUCATORS WORLDWIDE

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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.

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 What if our skills are out of date?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 systems and our students.

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:

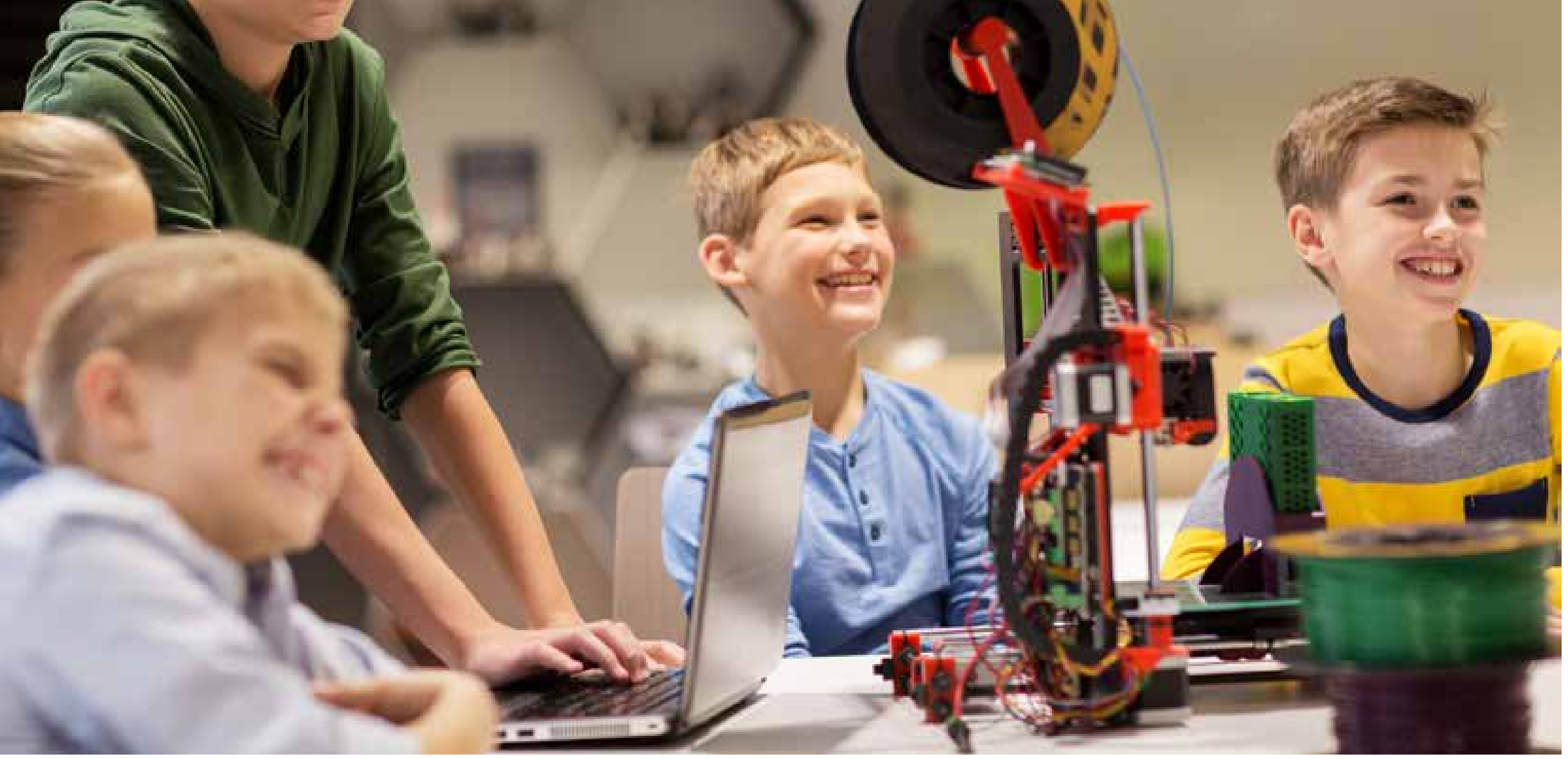
> Policy makers working with education providers (traditional and non-traditional) could do more to improve basic STEM skills through the school systems, put a new emphasis on creativity as well as critical and systems thinking, and foster adaptive and life-long learning.[6]

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/featured-insights/employment-and-growth/technology-jobs-and-the-future-of-work
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.

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.

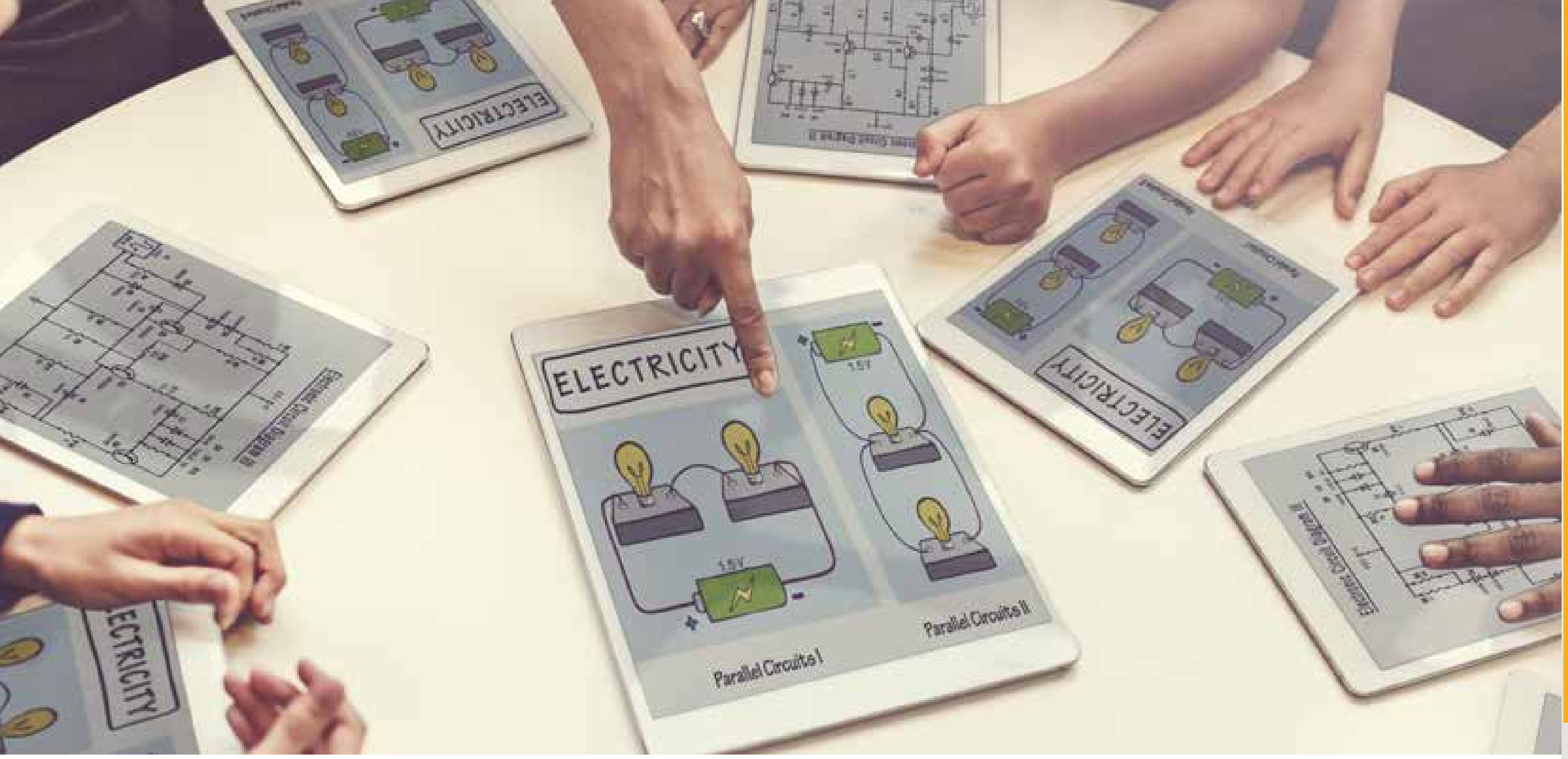
MEETING THE **NEED**

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:

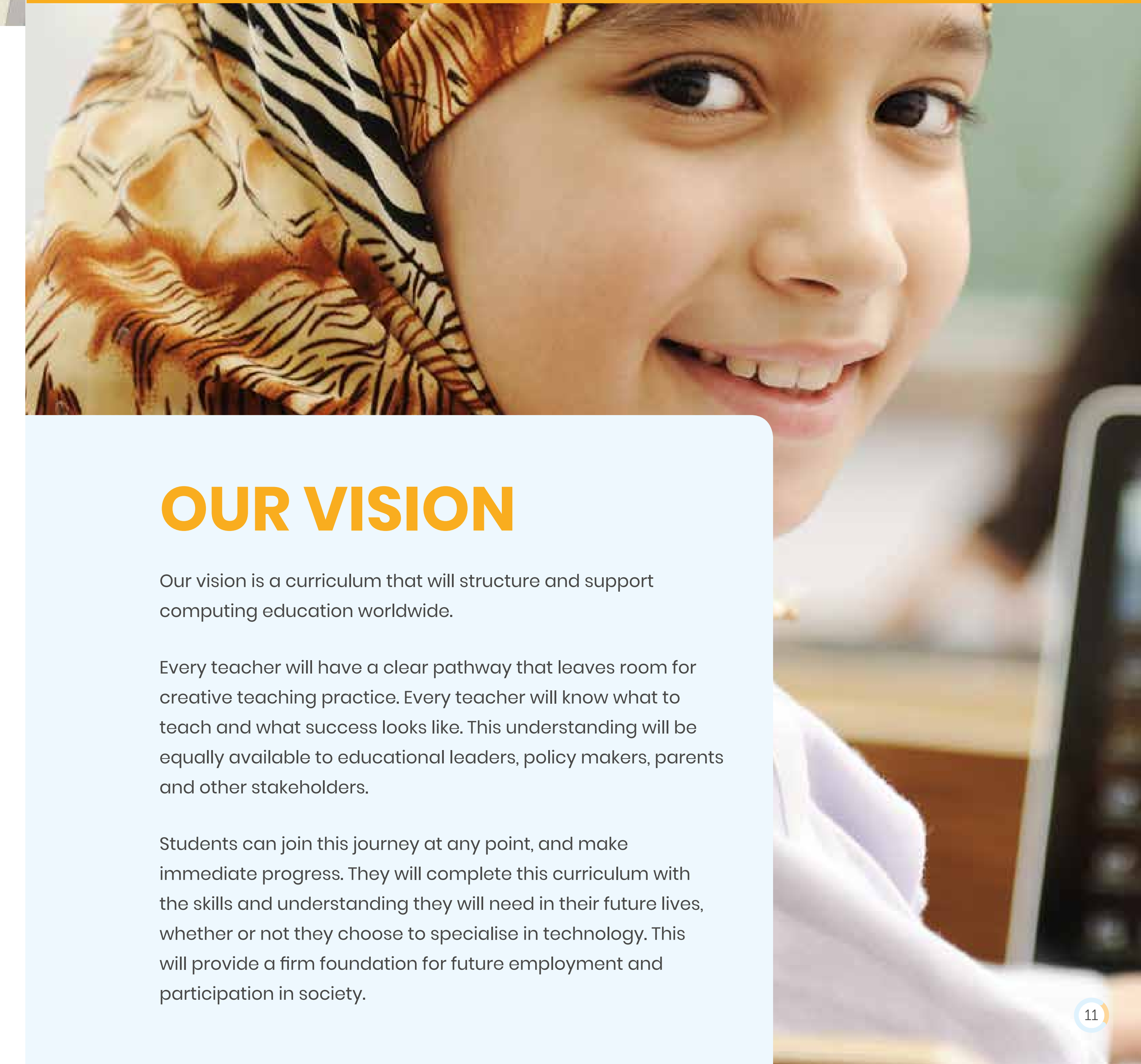
- **Relevant:** The framework of skills and understanding is designed to enhance the prospects of young learners. The content of the curriculum is directly tailored to meet their needs as future participants in work and society.
- **Realistic and deliverable:** The curriculum does not expect teachers 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.

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



- **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.

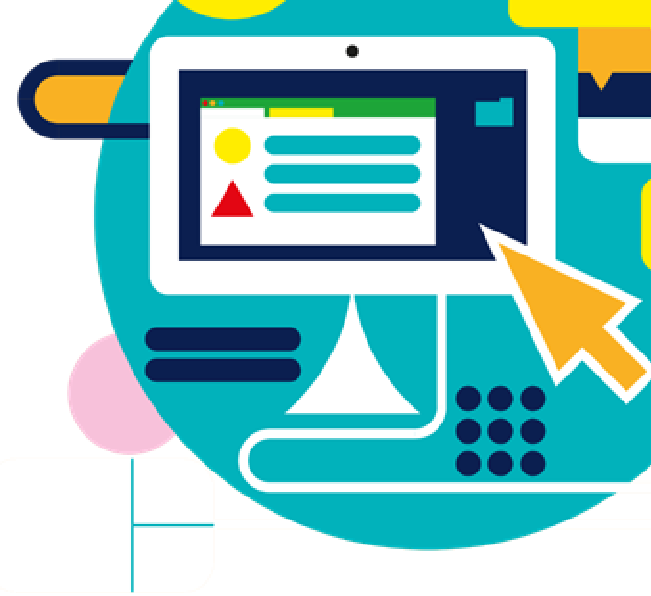
OVERVIEW

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

The curriculum matrix for Lower Secondary has learning outcomes for Year 7 (ages 11–12 years), Year 8 (ages 12–13 years) and Year 9 (ages 13–14 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 19)

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, using 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 software tools 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 19)

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 Lower Secondary curriculum revisits and develops themes that were introduced at Primary level.

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 EXTERNAL EXAMS

At the end of the Lower Secondary stage, students will choose their subjects for external or public examination, for example the iGCSE in computer science.. Students who wish to study for computer science qualifications will be well prepared. OIC Lower Secondary computing is aligned to the requirements of the computer science examination syllabus. During Lower Secondary study, students will be introduced to topics – such as binary maths, programming, data structures and Boolean logic – which are central to the exam syllabus. However, those students who wish to specialise in other areas will complete Lower Secondary computing with a good general grounding in the computing skills that they will need to support other subject areas and future employment.

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.

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.

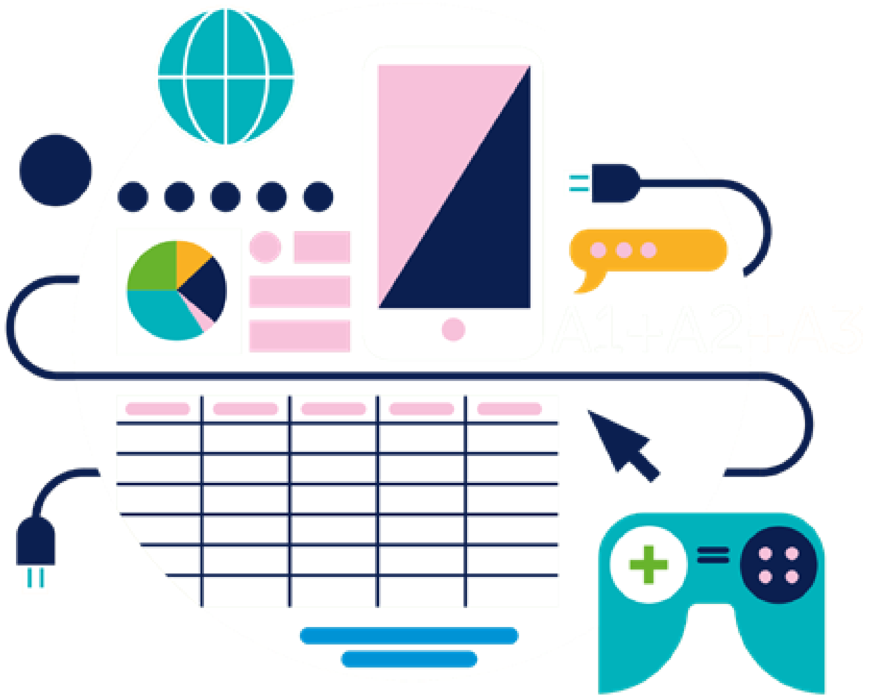
ARTIFICIAL **INTELLIGENCE**

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.

YEAR-ON-YEAR **DEVELOPMENT**

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

Year	Learning outcome
7	Describe how program commands are stored and executed (7.1a) Use more than one programming language (7.1b)
8	Compare alternative algorithms to solve a problem (for example, searching) (8.1b) Write a modular program that uses procedures or functions (8.1c)
9	Design an abstract model based on a real-world system (9.1a) Use a program to find solutions to a real-world problem (9.1b) Describe some computational techniques that enable artificial intelligence (AI) (9.1c) Outline the structure of a processor, its components and how they work together (9.3b) Describe some technical innovations that enable modern robotics (9.3c)



OIC **LOWER SECONDARY** CURRICULUM AT-A-GLANCE

Theme	Year 7	Year 8	Year 9
1 Programming computational thinking	**7.1a:** Describe how program commands are stored and executed **7.1b:** Use more than one programming language **7.1c:** Write programs in a text-based language **7.1d:** Remove a range of errors to improve a program	**8.1a:** Write a program that processes a data structure (for example, a list) **8.1b:** Compare alternative algorithms to solve a problem (for example, searching) **8.1c:** Write a modular program that uses procedures or functions	**9.1a:** Design an abstract model based on a real-world system **9.1b:** Use a program to find solutions to a real-world problem **9.1c:** Describe some computational techniques that enable artificial intelligence (AI)
2 Productivity and creativity	**7.2a:** Create digital media **7.2b:** Improve digital media for an audience **7.2c:** Create a single-table data file **7.2d:** Check data input for accuracy	**8.2a:** Select and use suitable technology for a given purpose **8.2b:** Use technology creatively **8.2c:** Use technology to analyse data	**9.2a:** Use software to plan a project and track its progress **9.2b:** Create and combine multimedia content
3 The nature of technology	**7.3a:** Describe how different types of data can be represented in binary digital form **7.3b:** Convert between decimal and binary integers **7.3c:** Perform simple binary additions	**8.3a:** Explain how computers communicate **8.3b:** Describe internet services (for example, cloud storage)	**9.3a:** Use or describe simple electronic logic gates (for example, AND, OR and NOT gates) **9.3b:** Outline the structure of a processor, its components and how they work together **9.3c:** Describe some technical innovations that enable modern robotics
4 Digital literacy	**7.4a:** Use content from online sources responsibly **7.4b:** Explain risks associated with internet use **7.4c:** Discuss how data may be collected when working online	**8.4a:** Carry out an online research project **8.4b:** Explain how computers can help with learning and discovery	**9.4a:** Understand how to use social media safely, responsibly and with regard to others

OIC ASSESSMENT FRAMEWORK

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

YEAR **SEVEN**

Introduction

In Year 7 and above, computing should be taught by specialist teaching staff. More than one hour a week may be required to deliver the learning goals. Students will learn a professional text-based programming language such as Python. They will use computers to carry out large projects and learn a wider range of technical terms. Students should be given access to multimedia devices such as cameras, sound-recording equipment or video cameras if these are available.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 7. During the year, every student will:

- **7.1a:** Describe how program commands are stored and executed
- **7.1b:** Use more than one programming language
- **7.1c:** Write programs in a text-based language
- **7.1d:** Remove a range of errors to improve a program
- **7.2a:** Create digital media
- **7.2b:** Improve digital media for an audience
- **7.2c:** Create a single-table data file
- **7.2d:** Check data input for accuracy
- **7.3a:** Describe how different types of data can be represented in binary digital form
- **7.3b:** Convert between decimal and binary integers
- **7.3c:** Perform simple binary additions
- **7.4a:** Use content from online sources responsibly
- **7.4b:** Explain risks associated with internet use
- **7.4c:** Discuss how data may be collected when working online

Students will use computers to create multimedia digital content. They will learn how data is stored electronically and they will be introduced to binary number systems. They will begin to program in a professional text-based programming language. These outcomes can be delivered through project work, and learning may be integrated with other subject areas.

Assessment criteria

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

7.1a: Describe how program commands are stored and executed

Developing: The student identifies what running a program means.

Secure: The student describes what source code is.
The student describes what executable code is.

Extended: The student explains how source code is translated into executable code.

7.1b: Use more than one programming language

Developing: The student identifies commands in more than one programming language.

Secure: The student writes programs using more than one programming language.

Extended: The student selects a suitable programming language for a task.

7.1c: Write programs in a text-based language

Developing: The student writes a program in a text-based language.

Secure: The student writes a program using loops and conditional structures.

Extended: The student selects the right program structure to meet a requirement.

7.1d: Remove a range of errors to improve a program

Developing: The student fixes syntax errors in a program.

Secure: The student finds and removes logical or run-time errors from a program.

Extended: The student makes programs more usable and readable.

7.2a: Create digital media

Developing: The student makes a digital recording (for example, photos, sound and/or video).

Secure: The student makes a digital recording to meet a purpose.

Extended: The student makes a digital recording that is well-suited to a purpose.

7.2b: Improve digital media for an audience

Developing: The student has made changes to digital media content.

Secure: The student has made improvements to digital media content.

Extended: The student can describe ways of improving digital media content.

7.2c: Create a single-table data file

Developing: The student inputs data into a table.

Secure: The student organises data into fields and records.
The student uses a formula to calculate new data values in a table.

Extended: The student uses a key field to identify unique data records in a table.

7.2d: Check data input for accuracy

Developing: The student identifies inaccurate or invalid data.

Secure: The student creates checks to identify or screen input errors (for example, validation).

Extended: The student designs interface features to reduce input errors (for example, menus, error messages or input prompts).

7.3a: Describe how different types of data can be represented in binary digital form

Developing: The student states that the computer holds data in digital form.

Secure: The student describes how text data is held in digital form (for example, using ASCII or Unicode).
The student outlines how non-text data is held in digital form (for example, bitmap images).

Extended: The student explains how real-world data can be held by the computer.

7.3b: Convert between decimal and binary integers

Developing: The student states that binary is base two and decimal is base ten.

Secure: The student converts binary numbers to decimal (up to one byte).
The student converts decimal integers to binary (from 0 to 255).

Extended: The student explains that number value depends on place value.

7.3c: Perform simple binary additions

Developing: The student knows what a bit and a byte are.

Secure: The student adds two bytes (with no overflow).

Extended: The student adds two bytes, identifying overflow.

7.4a: Use content from online sources responsibly

Developing: The student identifies the source of online content.

Secure: The student uses online content legally and responsibly.
The student knows when online content may not be used.

Extended: The student describes issues affecting the right to use online content (for example, fair use, IPR or creative commons).

7.4b: Explain risks associated with internet use

Developing: The student protects their online identity.

Secure: The student identifies online risks (for example, malware, hacking or phishing).

Extended: The student describes how to avoid online risks (for example, by using virus checks and trusted websites).

7.4c: Discuss how data may be collected when working online

Developing: The student identifies examples of data collection (for example, filling in an online form).

Secure: The student identifies other examples of data that may be collected when browsing the internet (for example, location or browsing history).

Extended: The student discusses how data may be used by third parties online.

YEAR **EIGHT**

Introduction

In Year 8, computing should be taught by specialist teaching staff. There should be suitable resources and dedicated timetable hours. This will ensure that students develop strong computing skills. In Year 8, students cover the fundamentals of using computers, which will help them in their later studies and careers. Developing understanding of computing ensures that students will be able to participate in society as digital citizens.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 8. During the year, every student will:

- **8.1a:** Write a program that processes a data structure (for example, a list)
- **8.1b:** Compare alternative algorithms to solve a problem (for example, searching)
- **8.1c:** Write a modular program that uses procedures or functions
- **8.2a:** Select and use suitable technology for a given purpose
- **8.2b:** Use technology creatively
- **8.2c:** Use technology to analyse data
- **8.3a:** Explain how computers communicate
- **8.3b:** Describe internet services (for example, cloud storage)
- **8.4a:** Carry out an online research project
- **8.4b:** Explain how computers can help with learning and discovery

Students will work creatively, selecting several different software applications. They will learn to process data structures using alternative algorithms. They will carry out an online research project. Some of this work may overlap with other subject areas and support learning across the curriculum.

Assessment criteria

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

8.1a: Write a program that processes a data structure (for example, a list)

Developing: The student writes a program that puts data into a simple structure (for example, a list).

Secure: The student writes a program that processes a simple data structure (for example, traversing and printing the values in a list).

Extended: The student writes a program that edits or reorganises a data structure (for example, deleting or inserting values, or using sort functions).

8.1b: Compare alternative algorithms to solve a problem (for example, searching)

Developing: The student identifies alternative algorithms to solve a problem (for example, linear and binary search algorithms).

Secure: The student compares the advantages and limitations of alternative algorithms.

Extended: The student implements at least one of the alternative algorithms.

8.1c: Write a modular program that uses procedures or functions

Developing: The student writes a program that uses a procedure or function (for example, a predefined function).

Secure: The student writes a program that defines a procedure or function.
The student writes a program that calls a user-defined procedure or function.

Extended: The student evaluates the advantages of using procedures or functions.

8.2a: Select and use suitable technology for a given purpose

Developing: The student identifies a range of software and hardware options, explaining some key uses of each one.

Secure: The student reviews a range of software and hardware options and selects suitable technology for a given task.
The student uses more than one software application with suitable hardware to meet a requirement.

Extended: The student imports or copies content between different software applications to meet a given purpose.

8.2b: Use technology creatively

Developing: The student develops content using digital technology (for example, graphics, video or audio).

Secure: The student uses technology creatively to produce new and original digital content.

Extended: The student makes creative choices to produce well-developed digital content.

8.2c: Use technology to analyse data

Developing: The student carries out calculations.

Secure: The student analyses data (for example, to show summary values or trends).

Extended: The student draws conclusions from analysis of data (for example, explaining the meaning or implications of results).

8.3a: Explain how computers communicate

Developing: The student can connect to networks, including the internet.

Secure: The student explains in basic terms a range of ways that computers can be connected to networks (for example, via Wi-Fi or cabling).
The student can explain what it means to connect to a network.

Extended: The student can trouble-shoot simple problems with network connectivity.

8.3b: Describe internet services (for example, cloud storage)

Developing: The student identifies that internet services are accessed through a remote connection.

Secure: The student describes some internet services such as storage, software and web hosting.

Extended: The student can distinguish remote and local content or services.

8.4a: Carry out an online research project

Developing: The student selects information found online with attention to relevance.

Secure: The student carries out an online investigation to collect information to meet a given requirement.
The student finds and selects data of suitable quality and relevance.

Extended: The student presents the results of an online research project with attention to audience impact.

8.4b: Explain how computers can help with learning and discovery

Developing: The student uses technology to learn and find things out (for example, in geography, music, chemistry or history).

Secure: The student discusses some ways that computers can help with learning (for example, in scientific investigations).

Extended: The student describes real-life examples of people using computers to make new discoveries.

YEAR **NINE**

Introduction

Delivery of the learning outcomes in Year 9 requires specialist teaching, suitable resources and dedicated timetable hours. All students will improve their computing skills. The outcomes in Year 9 provide a solid foundation for students who wish to move on to computing qualifications such as iGCSE computer science. For students who do not wish to specialise, Year 9 will ensure that they have a good understanding of what computers are, what they can do and how we use technology to shape our world. Students should conclude the year as active users rather than passive consumers of the products of technology.

Learning outcomes

These learning outcomes set out a programme of study in computing for Year 9. During the year, every student will:

- **9.1a:** Design an abstract model based on a real-world system
- **9.1b:** Use a program to find solutions to a real-world problem
- **9.1c:** Describe some computational techniques that enable artificial intelligence (AI)
- **9.2a:** Use software to plan a project and track its progress
- **9.2b:** Create and combine multimedia content
- **9.3a:** Use or describe simple electronic logic gates (for example, AND, OR and NOT gates)
- **9.3b:** Outline the structure of a processor, its components and how they work together
- **9.3c:** Describe some technical innovations that enable modern robotics
- **9.4a:** Understand how to use social media safely, responsibly and with regard to others

Learning in Year 9 should be enjoyable, creative and fulfilling. Students will use multimedia tools to create a group project. They will use programming to model a real-life system. They will explore innovative techniques that underpin artificial intelligence (AI) and modern robotics. Students will finish the year confident and capable at using computers, whatever their future goals may be.

Assessment criteria

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

9.1a: *Design an abstract model based on a real-world system*

Developing: The student identifies some values used in an abstract model.

Secure: The student creates an abstract model by identifying how values are altered or processed.

Extended: The student evaluates some of the advantages and limitations of a model.

9.1b: *Use a program to find solutions to a real-world problem*

Developing: The student enters values into a model and notes the results.

Secure: The student creates a program to match an abstract model. The student uses a model to create useful results.

Extended: The student changes the inputs to a model and evaluates the effects.

9.1c: *Describe some computational techniques that enable artificial intelligence (AI)*

Developing: The student can describe what artificial intelligence (AI) means and some of its uses or potential uses.

Secure: The student can describe computational techniques used to develop AI systems (for example, heuristics, pattern matching, data mining, expert systems and machine learning).

Extended: The student can evaluate computational techniques (for example, their uses and limitations as techniques for AI development).

9.2a: *Use software to plan a project and track its progress*

Developing: The student identifies the outcomes and end date of a project.

Secure: The student uses software to record the end product(s) and end date of a project.
The student uses software to plan some tasks of a project.

Extended: The student uses software to record progress against the project plan.

9.2b: *Create and combine multimedia content*

Developing: The student creates multimedia digital content such as video or audio.

Secure: The student combines items of multimedia digital content to meet a requirement (for example, adding an audio track to a video).

Extended: The student produces multimedia content to meet a requirement and appeal to an identified audience.

9.3a: *Use or describe simple electronic logic gates (for example, AND, OR and NOT gates)*

Developing: The student draws diagrams to represent the AND, OR and NOT gates.

Secure: The student draws truth tables to match the AND, OR and NOT gates.

Extended: The student creates simple logic circuits using the AND, OR and NOT gates and describes their possible states.

9.3b: *Outline the structure of the processor, its components and how they work together*

Developing: The student labels a diagram to show the relationship between the processor, input, output and storage in a computer system.

Secure: The student draws a simple diagram to represent the structure of the processor including the control unit, memory unit and ALU. The student briefly describes how these components work together during the fetch-execute cycle.

Extended: The student explains how the features of a computer system can be modified to affect performance.

9.3c: *Describe some technical innovations that enable modern robotics*

Developing: The student can describe what robotics means.

Secure: The student can describe innovative technologies used to develop robotic systems (for example, real-time operating system, embedded processors and use of sensors).

Extended: The student can evaluate the benefits and limitations of using robotics in the modern world.

9.4a: *Understand how to use social media safely, responsibly and with regard to others*

Developing: The student's behaviour online is generally sensible and polite. The student identifies the need to treat others with respect.

Secure: The student interacts online with due regard to the safety and value of all individuals.
The student describes appropriate ways of using social media.

Extended: The student interacts with others constructively and cooperatively, to promote positive online communities and interactions.

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