Draft for consultation

Digital Technologies
Hangarau Matihiko

Minister's Foreword

Tēnā tatou katoa

New Zealanders are now living in a digital society. Our young people need to be confident and fully equipped to contribute and flourish in the economy of the future.

Many of our young people are already 'digital natives', born into an age where computers, mobile devices and the Internet are so familiar they cannot imagine life without them. But the digital world is fast moving and ever changing. Young people need to keep ahead of this change, understand the theory and science behind the technologies they use, and be able to participate in the digital world as the creators – not just users – of innovations and inventions.

We also need to prepare them now to adapt to technology and jobs that have not yet been invented – robotics, artificial intelligence, nanotechnology, and advances in connectivity all offer the potential to revolutionise business and industry.

New learning in Digital Technologies | Hangarau Matihiko will equip our young people for this digital future. A quality curriculum empowers our children to be the best they can possibly be, bolsters their understanding of the world around them, and expands what they experience at school. It reflects the needs of the learner, their family and whānau, and our society as a whole.

As tomorrow's business leaders, data scientists, artists, health workers, chefs, engineers, user experience designers, urban planners, farmers or navigators, creating and developing digital technologies will be a core requirement for success. The new curriculum will enable students to learn the foundations of digital technologies and better understand how it's connected to other fields of learning from all the way from Year 1 to Year 13.

It is critical that we enable our children to succeed, from their first year in school or kura.

A curriculum is effective only if we equip skilled teachers to deliver it. While the new curriculum introduces opportunities for students, it also presents exciting change for the teaching workforce. Many New Zealand schools and kura already teach digital skills as part of their curriculum, and these changes will enable them to build on this.

It is essential for parents, whānau, Communities of Learning | Kāhui Ako, schools and kura to work together and make a contribution to the ongoing development of our curriculum. Your input will be important to ensure that the content will suit the learning needs of our children and young people.

I am excited to present the new Digital Technologies | Hangarau Matihiko curriculum content. I thank the experts who helped to design, develop and test it. I acknowledge the teachers, kaiako and leaders who will bring it to life for, and with, our young people.

The new curriculum has the potential to be the ultrafast broadband of learning. Working together will ensure the very best and brightest futures for young New Zealanders now and into the digital age.

Ngā mihi

Hon Nikki Kaye
Minister of Education

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Learning and thriving in the digital world

New Zealand is a digital nation. Digital technologies are transforming how we live; shaping our homes and our workplaces, changing the way that we interact with each other and live our everyday lives.

Our education system needs to change how we prepare our children and young people to participate, create and thrive in this fast-moving digital world. Incorporating digital technologies will support young people to develop the confidence and skill not only to use digital technologies (DT) but to design and build digital systems.

The Technology Learning Area of the New Zealand Curriculum stresses the importance of intervention by design: the use of practical and intellectual resources to develop products and systems. These developments expand human possibilities by addressing needs and realising opportunities to meet new and emerging societal needs.

Technology is much more than designing and making technological outcomes, it involves critiquing past, existing and possible future technologies, while considering their environmental, social and cultural impact. For the first time the learning in digital technologies is explicit within the learning area.

From 2018, Digital Technologies | Hangarau Matihiko will be strengthened in *The New Zealand Curriculum* and *Te Marautanga o Aotearoa*, starting at Year 1.

Where have we come from?

In 2007 the New Zealand Curriculum described the learning that our children and young people needed to succeed in the world as we knew it. But in the digital world, a lot has changed. Our everyday lives are now shaped by smartphones and social media, and ideas like artificial intelligence and self-driving cars are moving rapidly from the realm of science fiction into reality. In the future, our learners will use, create and develop these technologies – and others which are yet to be invented. We have an opportunity to help our learners be innovators and inventors in this future.

How are we addressing this challenge?

We are strengthening Digital Technologies | Hangarau Matihiko into the Technology and Hangarau Learning Areas of The New Zealand Curriculum and Te Marautanga o Aotearoa.

Children and young people often already arrive at school knowing how to use digital technologies – but learners also need to be able to understand and create digital technologies to succeed in further education and the world of work. And in our wider economy, businesses struggle to find people with the right skills to drive digital innovation and economic growth – this learning needs to start in the classroom.

This change doesn't just involve adding to the National Curriculum – it will involve extensive support to parents, whānau, teachers, schools, kura and Communities of Learning | Kāhui Ako to support their learners in Digital Technologies | Hangarau Matihiko.

Where do we want to get to?

By the end of Year 10, all learners should be digitally capable – able to use and create digital technologies to solve problems and take advantage of opportunities. They will be equipped to apply their understanding of digital technologies to all aspects of their lives and careers, whatever path they follow.

For learners who study Digital Technologies through to Year 13, we expect that they will be on the pathway to specialising – meaning that they understand the targeted digital skills needed in the digital technologies industry, and how they can lead our next generation of innovators and trailblazers in the digital world.

How to be involved

This document summarises how the DT | HM curriculum content will look when incorporated into _The New Zealand Curriculum_. The content will continue to be refined throughout the year, and all the materials attached are in draft form.

This development reflects the effort of a number of leading curriculum and Technology Area experts across the country, including teachers, kaiako, leaders and representatives from subject associations. These experts have identified the key technological areas that provide the clearest framework for illustrating student progression in Technology.

Our priority is to ensure that the new curriculum content will work for teachers, kaiako, schools and kura, so our learners can achieve the best possible learning outcomes. We need your feedback to ensure we have got it right. Your feedback will also be invaluable for determining the supports leaders and teachers will need to effectively implement the new curriculum content in their Kāhui Ako, schools and kura. There will be opportunities around the country to learn more and provide feedback over July and August 2017.

Feedback can also be submitted online via an online survey at:
https://education.govt.nz/digital-technology-consultation

Or by email to:
digi.tech@education.govt.nz

When you provide feedback we encourage you to consider the following questions:

Consistency
- To what extent does the updated Technology Learning Area reflect the vision of the New Zealand Curriculum and Te Marautanga o Aotearoa?

Connections
- To what extent are the linkages between the proposed new content and the rest of the curriculum clear?
- How might we reflect digital technologies learning in the name of the Technology Learning Area?

Adaptability
- How useful is the consultation material in considering how to integrate and adapt the proposed DT|HM content to design local curriculum for your students?

Clarity
- In relation to the consultation material, how easy to understand was:
  - How all the elements of the changes fit together?
  - How the elements of the changes fit with the existing Technology Learning Area?
  - The various parts of the proposed new curriculum content?

Coherency
- Consider whether the proposed new curriculum content:
  - Helps me to understand student progress in Computational Thinking for Digital Technologies
  - Helps me to understand student progress in Designing and developing digital outcomes

Future Focus
- To what extent do you agree that the proposed new content ensures students have the skills, knowledge and capabilities they need to fully participate in the 21st century and beyond?
- To what extent do you agree that the intent and direction of the proposed new content will have a positive impact on students' competencies in thinking, using language, symbols and texts, and participating in and contributing to communities of the future?

Making use of the new curriculum content
- What do you anticipate being the biggest challenge in teaching and integrating the DT | HM curriculum content into teaching programmes?
- What support do you think you might need to strengthen your teaching practice across the Technology Learning Area?

How the Technology Learning Area has changed

The addition of Digital Technology into Technology requires changes to the structure of the Technology Learning Area.

Learning Area Statement

The current Technology Learning Area Statement describes the essential purpose of learning in Technology: why students need to study technology, what Technology 'is about', and how Technology aligns with the vision, values, principles and key competencies of *The New Zealand Curriculum*.

This now clearly outlines the expectations for learning in Digital Technologies, within the Technology Learning Area.
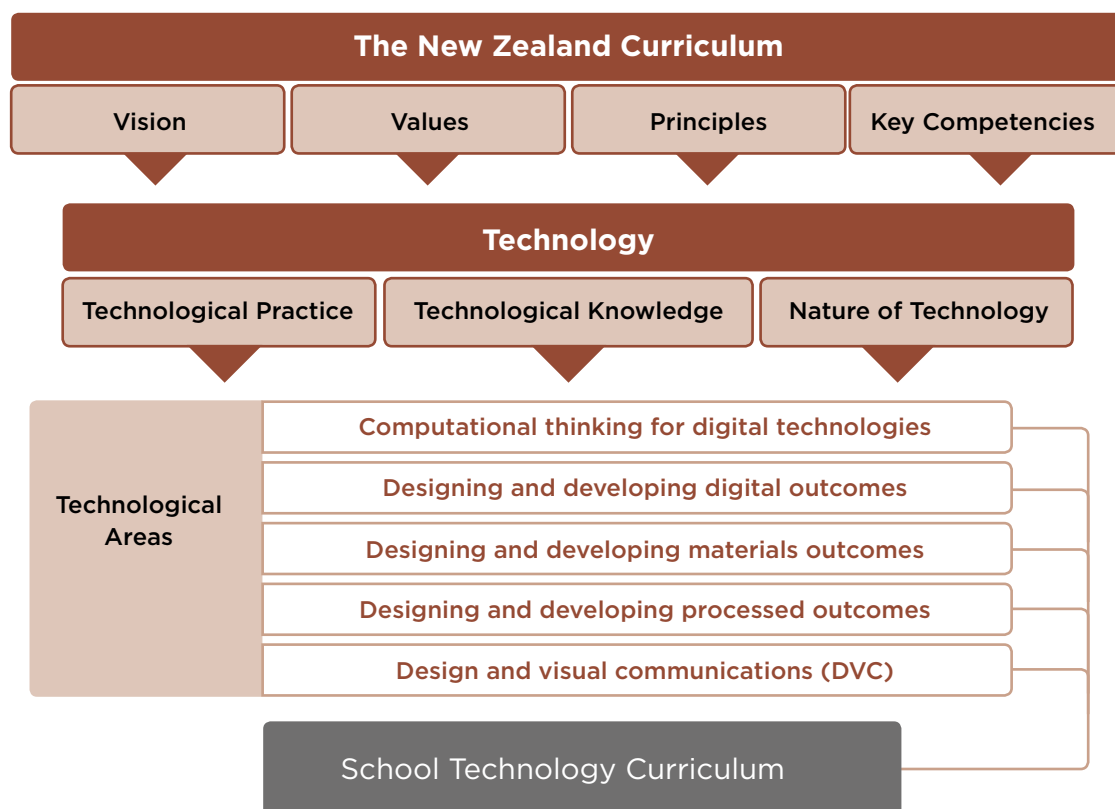
Structure of the Learning Area

Previously, the Technology Learning Area was centred on three strands: Technological Practice, Technological Knowledge, and the Nature of Technology. This suggested that the three strands ought to be taught separately – when in reality, they are integral parts of all learning in Technology, and are not readily separated.

The reorganised Technology Learning Area recognises this. The three strands remain, but the Learning Area now also identifies five technological areas:

- Computational thinking for digital technologies

- Designing and developing digital outcomes

- Designing and developing materials outcomes

- Designing and developing processed outcomes

- Design and visual communication

These represent the contexts and settings in which students might learn about Technology. Each technological area describes unique learning – though the three strands will apply to all Technology learning, regardless of which area that learning is in.

The New Zealand Curriculum			
Vision	Values	Principles	Key Competencies

Technology

Technological Practice	Technological Knowledge	Nature of Technology

Technological Areas
- Computational thinking for digital technologies
- Designing and developing digital outcomes
- Designing and developing materials outcomes
- Designing and developing processed outcomes
- Design and visual communications (DVC)

School Technology Curriculum

Introducing progress outcomes to Technology

To ensure that our learners have rich learning experiences in Digital Technologies, The New Zealand Curriculum must provide clear, accessible expectations for what students will learn in Digital Technologies. Progress outcomes clearly describe the significant steps learners take as they progress in Digital Technologies from school entry to the end of Year 13.

For example, when looking at programming (in the Digital Technologies area), progress outcomes identify that students start by learning to program simple instructions in-person (such as stepping out a set of actions on the floor). Later progress outcomes describe how this learning progresses over time, for example students can develop software or program robots.

Progress outcomes identify the key learning steps that need to be developed through teaching and learning programmes. While the steps are uneven, we have mapped the progress outcomes to curriculum/ year levels to show how progress outcomes and achievement levels work together.

We have only designed progress outcomes for Digital Technologies – learning in the other technological areas continue to be defined by achievement objectives.

Outcome Statements

An outcome statement describes what learners, parents and whānau, employers and our wider society can expect from a student at key points in their education. For Digital Technologies, this means describing the skills, knowledge and attitudes of a digitally capable learner at the end of their compulsory Digital Technologies education in Year 10, and of a learner on the path to specialisation in Digital Technologies at the end of Year 13.

The outcome statements describe the expected learning at these key transition points, ensuring the education sector and our communities are working towards a shared understanding of what our learners should be capable of in Digital Technologies.

1. Revised Learning Area Statement

The current Technology Learning Area Statement describes the essential purpose for learning in Technology, specifically answering the questions of why study technology and what it is about, in line with the Vision, Values, Principles and Key Competencies of The New Zealand Curriculum.

This has been revised to make more explicit expectations for learning in Digital Technologies from school entry and right across the learning pathway.

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Revised Technology Learning Area Statement

What is technology about?

Technology is intervention by design. Design is the use of intellectual and practical resources to create and develop technological outcomes that expand human possibilities by addressing needs and realising opportunities. Design is characterised by innovation and adaptation and is at the heart of technological practice. Design is informed by critical and creative design thinking and awareness of practices such as design processes and computational thinking.

Technology's strength is that it makes enterprising use of a range of skills and knowledge of practices for exploration and communication, some specific to areas within technology and some from other disciplines. These include visual literacy; the ability to make sense of images and the ability to make images that make sense, digitally-aided design, programming, software development and other forms of technological modelling.

Why study technology?

With its focus on design thinking, technology education supports students to be innovative, reflective and critical in designing new models, products, software, systems and tools that will benefit people, while expressing empathy for the cultural, ethical, environmental, political, and economic conditions of the day. The aim is for students to develop a broad technological knowledge, practices and dispositions that will equip them to participate in society as informed citizens as well as providing a platform for technology-related careers. They learn about technology as the result of human activity, experiencing and/or exploring historical and contemporary examples of technology in a variety of contexts. They also expand their discipline-specific-capabilities as they develop fit for purpose outcomes.

Learning area structure

The learning area comprises five technological areas: computational thinking for digital technologies, designing and developing digital outcomes, designing and developing materials outcomes, designing and developing processed outcomes, and design and visual communication (DVC). The three strands of technological practice, technological knowledge and the nature of technology are embedded within each of these technological areas.

The Five Technological Areas

■ *Computational thinking for digital technologies*

Computational thinking enables a student to express problems, and formulate solutions in a way that means a computer (an information processing agent) can be used to solve them.

Students develop computational and algorithmic thinking skills, and an understanding of the computer science principles that underlie all digital technologies. They become aware of what is, and is not, possible with computing, so they are able to make judgements and informed decisions as citizens of the digital world. Students learn core programming concepts and how to take advantage of the capabilities of computers, so that they can become creators of digital technologies, not just users. They will develop an understanding of how computer data is stored, how all the information within a computer system is presented using digits, and the impact that different data representations have on the nature and use of this information.

■ *Designing and developing digital outcomes*

Students understand that digital applications and systems are created for humans by humans. They develop increasingly sophisticated understandings and skills related to designing and producing quality, fit-for-purpose, digital outcomes.

They develop their understanding of the digital information technologies that people need in order to locate, analyse, evaluate, and present digital information efficiently, effectively, and ethically. They become more expert in manipulating and combining data, using information management tools to create an outcome. They become aware of the unique intellectual property issues that arise in digital systems, particularly approaches to copyright and patents.

Students also become more aware of how to build, install, maintain, and support computers, networks, and systems so that they are secure and efficient.

Students develop knowledge and skills in using different creative digital technologies to create digital content for the web, interactive digital platforms, and print. They construct digital media outcomes that integrate media types and incorporate original content. They also learn about the way electronic components and techniques are used to design digital devices, and become increasingly skilled in integrating electronic components and techniques to assemble and test an electronic environment.

■ *Designing and developing materials outcomes*

Students develop knowledge and skills to form, transform and manipulate resistant materials, textiles and fashion in order to create both conceptual and prototype technological outcomes that solve human problems and satisfy needs and opportunities.

They develop an increasing awareness and understanding of the systems, structures, machines and techniques used in manufacturing products. They gain experience from using manufacturing processes and related quality assurance procedures to produce prototypes, batches or multiple copies of a product.

Students demonstrate increasingly critical, reflective and creative thinking as they evaluate and critique technological outcomes in terms of the quality of their design, their fitness for purpose and their impact and influences on societies and the environment. They become increasingly skilled in applying their growing knowledge of design principles to create innovative and feasible outcomes that realise opportunities or resolve current and future-focused real world issues.

■ *Designing and developing processed outcomes*

Students develop knowledge of the materials and ingredients that are used to formulate food, chemical, and biotechnological products. They develop their expertise in forming, transforming and manipulating materials or ingredients to develop conceptual, prototype and final technological outcomes that will meet the needs of an increasingly complex society.

Students engage in a range of processes related to food technology, biotechnology, chemical technology, and agricultural technologies. They explore the impact of different economic and cultural concepts on the development of processed products, including their application to product preservation, packaging, and storage.

They also develop understandings of the systems, processes and techniques used in manufacturing products and will gain experience from using these, along with related quality assurance procedures, to produce prototypes or multiple copies of a product.

Students demonstrate increasingly critical, reflective and creative thinking as they evaluate and critique technological outcomes in terms of the quality of their design, their fitness for purpose and their wider impacts. They become increasingly skilled in applying their growing knowledge of design principles to creating desired, feasible outcomes that resolve real world issues.

■ *Design and visual communication*

Students learn to apply design thinking and develop an awareness of designing by using visual communication to conceptualise and develop potential design ideas in response to a brief. In doing so they develop a visual literacy; the ability to make sense of images and the ability to make images that make sense. Students apply their visual literacy by using sketching, digital modes and other modelling techniques to produce effective communication and presentation of design ideas.

Draft for consultation

Students draw on their knowledge of design to understand that designers identify the qualities and potential of design ideas in terms of the broad principles of design (aesthetics and function) and of sustainability, and that they are influenced by human, societal, environmental, historical, and technological factors.

The Three Strands of Technology

The three strands of technology are embedded within each of these five technological areas. In the **technological practice** strand, students examine the practice of others and undertake their own. They develop a range of outcomes, including concepts, plans, briefs, technological models, and fully realised products or systems. Students investigate issues and existing outcomes and use the understandings gained, together with design principles and approaches, to inform their own practice. They also learn to consider ethics, legal requirements, protocols, codes of practice, and the needs of and potential impacts on stakeholders and the environment.

Through the **technological knowledge** strand, students develop knowledge particular to technological enterprises and environments and understandings of how and why things work. Students learn how functional modelling is used to evaluate design ideas and how prototyping is used to evaluate the fitness for purpose of systems and products as they are developed. An understanding of material properties, uses, and development is essential to understanding how and why products work the way they do. Similarly, an understanding of the constituent parts of systems and how these work together is essential to understanding how and why systems operate in the way they do.

Through the **nature of technology** strand, students develop an understanding of technology as a discipline and of how it differs from other disciplines. They learn to critique the impact of technology on societies and the environment and to explore how developments and outcomes are valued by different peoples in different times. As they do so, they come to appreciate the socially embedded nature of technology and become increasingly able to engage with current and historical issues and to explore future scenarios.

Over the pathway from years 1–10, students will gain learning and experience in all five technological areas. Knowledge and skills are learned in context. By offering a variety of contexts, teachers help their students to recognise links and develop generic understandings. Students should be encouraged to access relevant knowledge and skills from other learning areas.

In years 11–13, students work with fewer contexts in greater depth. This requires them to continue to draw fully on learning from other disciplines. For example, students working with materials and/or food technology will need to refer to chemistry, and students working on an architectural project will find that an understanding of art history is invaluable. Some schools may offer courses such as electronics and horticultural science as technology specialisations.

Learning for senior students opens up pathways that can lead to technology-related careers. Students may access the workplace learning opportunities available in a range of industries or move on to further specialised tertiary study.

2. Computational Thinking for Digital Technologies and Designing and Developing Digital Outcomes

Progress Outcomes

Learning in Digital Technologies is divided into two Technological Areas *Computational Thinking for Digital Technologies* and *Designing and Developing Digital Outcomes*. To provide clear expectations for learning in these areas we have designed progress outcomes.

The Progress Outcomes provide clear and discrete descriptors of the significant steps learners take as they progress in Digital Technologies from school entry to the end of Year 13.

Progress outcomes identify the key learning steps that need to be developed through teaching and learning programmes in Technology. While the steps are uneven, we have mapped the progress outcomes to curriculum/year levels.

Outcome Statements

An Outcome Statement describes what students, parents, employers and society in general can expect as a result of the effort of the education system. For Technology, this is about describing what it is to be a digitally capable learner (in terms of skills, knowledge and attitudes) at the end of Year 10, and of a learner on the path to specialisation in one or more areas of Technology at the end of Year 13.

The Outcome Statements draw from the learning described in the learning progressions. They describe the expected learning at the end of these key transition year levels, ensuring the schooling sector and industry partners are all working towards shared and desirable outcomes for New Zealand society.

We have designed Outcome Statements for *Computational Thinking for Digital Technologies* and *Designing and Developing Digital Outcomes*

The progress outcomes and outcome statements for *Computational Thinking for Digital Technologies* and *Designing and Developing Digital Outcomes* are outlined in this section.
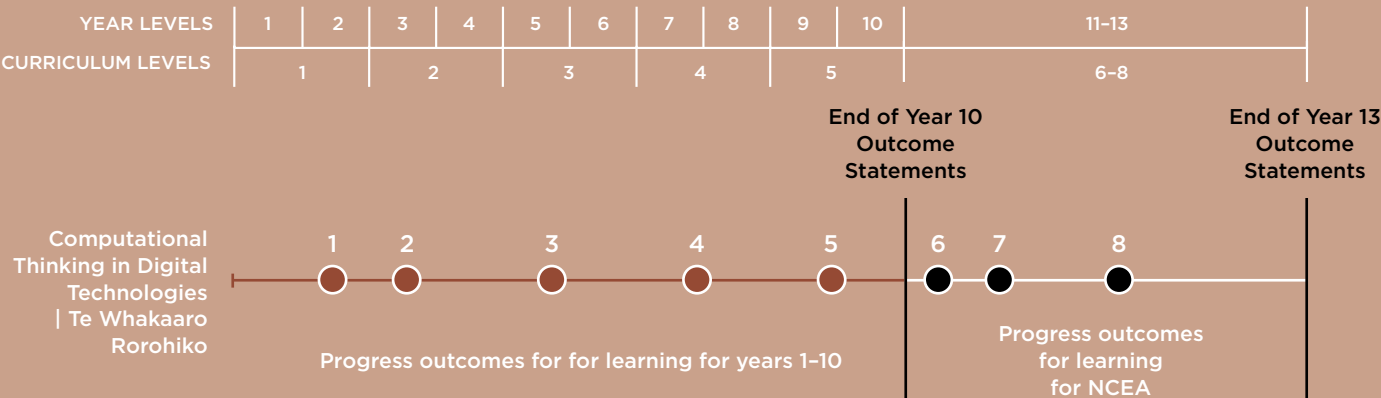
For consultation

2A. Computational Thinking for Digital Technologies

Computational thinking for digital technologies

Computational thinking enables a student to express problems, and formulate solutions in a way that means a computer (an information processing agent) can be used to solve them.

Students develop computational and algorithmic thinking skills, and an understanding of the computer science principles that underlie all digital technologies. They become aware of what is, and is not, possible with computing, so they are able to make judgements and informed decisions as citizens of the digital world. Students learn core programming concepts and how to take advantage of the capabilities of computers, so that they can become creators of digital technologies, not just users. They will develop an understanding of how computer data is stored, how all the information within a computer system is presented using digits, and the impact that different data representations have on the nature and use of this information.

YEAR LEVELS	1	2	3	4	5	6	7	8	9	10	11–13
CURRICULUM LEVELS	1		2		3		4		5		6–8

End of Year 10 Outcome Statements

End of Year 13 Outcome Statements

Computational Thinking in Digital Technologies | Te Whakaaro Rorohiko

1   2   3   4   5   6   7   8

Progress outcomes for for learning for years 1–10

Progress outcomes for learning for NCEA

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Progress Outcome 1

Students break down a simple non-computerised task into a set of precise, unambiguous, step by step instructions (algorithmic thinking). They are able to give these instructions, and identify if they have gone wrong and correct them (simple debugging). By doing this they show that they can use their decomposition skills to take a task and break it down into its smallest steps.

Progress Outcome 2

Students understand that an algorithm is a step-by-step process to solve a problem, that we can use these to write computer programs, and these programs need to have precise and unambiguous instructions so that the computer can follow them. Students can give, follow, and debug simple algorithms in both computerized and non-computerized environments. They can use these algorithms to create a simple program involving input, output and sequencing in an age-appropriate programming environment.

Progress Outcome 3

Students understand what algorithms are, the difference between algorithms and programs, and that there can be more than one algorithm for the same problem. They are able to decompose problems into step-by-step instructions to create an algorithm for a computer program, and use logical thinking to predict the behaviour of these programs. They are able to develop and debug simple programs that use inputs, outputs, sequence and loops. Students understand that computers store data using just two states, represented by binary digits (bits).

Progress Outcome 4

Students can decompose a problem to create an algorithm using three building blocks of programing: sequencing (putting instructions one after the other), selection (choosing which part of the algorithm to execute based on some values), and iteration (repeating part of the algorithm with a loop). They can implement the algorithm by creating a program that uses inputs, outputs, sequencing, loops and basic selection using comparative operators. They can debug simple algorithms and programs by identifying if things have gone wrong with their instructions, correcting them, and are able to explain why it went wrong and how they fixed it. Students understand that computers can represent data with binary digits, and that computers have a way to detect errors that have occurred in data storage and transmission. Students evaluate different algorithms in terms of their efficiency as they recognise that computers need to search and sort a lot of data.

Progress Outcome 5

Students can independently decompose problems into an algorithm that is articulated in such a way that a computing device can understand. They can implement the algorithm by creating a program which uses inputs, outputs, sequencing, loops, variables of different data types, and selection using comparative operators and logical operators. Students can determine when to use different types of control structures. Students can explain/document their programs and use an organised approach for testing and debugging. Students understand how computers store more complex types of data using binary digits.

Progress Outcome 6

Students are able to determine and compare the cost (computational complexity) of two different iterative algorithms for the same problem size (searching and/or sorting) in relation to the number of comparisons and time taken. Students understand the concept of coding information (e.g. compression, encryption, error control), typical uses of coded information, and how widely used technologies are enabled by coding. Students are able to apply a modular structure to a program to make it more efficient and store data in collections.

Progress Outcome 7

Students understand that some computational problems cannot be solved by algorithms, and that some are intractable (no machine exists that has the power to execute the algorithm) so we need to use a heuristic solution. Students can discuss the purpose of a selection of data structures and evaluate the use of a data structure in terms of tradeoffs between performance and storage requirements and their suitability with different algorithms. Students can use an iterative process to design, develop, document and test an advanced computer program.

Progress Outcome 8

Students can analyse a selection of areas of computer science (e.g. formal languages, network communication protocols, complexity and tractability, artificial intelligence, graphics and visual computing, big data) in relation to how the area is underpinned by the key ideas of algorithms, data representation and programming. They can evaluate how the synthesis of these key ideas is applied effectively when developing real world applications. Students can use an accepted software engineering methodology to design, develop, document and test a complex computer program.

Draft for consultation

Outcome Statements – Computational Thinking for Digital Technologies

In addition to the progress outcomes, the learning progressions are defined by two Outcome Statements, which represent the skills, knowledge and attitudes of a digitally capable learner at the end of Year 10, and of a learner on the path to specialisation in one or more areas of digital technologies at the end of Year 13. These are the bookends for NCEA, representing the start and end points for learners at senior secondary level.

These draft outcome statements are the basis for the reviewed NCEA Level 1 achievement standards for Digital Technologies.

END OF YEAR 10	END OF YEAR 13
Students understand that there can be multiple algorithms for the same problem, some are better than others, and by recognising patterns between problems they can generalise known algorithms so they can re-apply these.	Students can analyse a selection of areas of computer science (e.g. formal languages, network communication protocols, complexity and tractability, artificial intelligence, graphics and visual computing, big data) in relation to how the area is underpinned by the key ideas of algorithms, data representation and programming.
Students can independently decompose problems into algorithms and distinguish between algorithms and computer programs.	They can evaluate how the synthesis of these key ideas is applied effectively when developing real world applications.
They can implement algorithms by creating programs which uses inputs, outputs, sequence, loops and selection using comparative operators and logical operators.	Students can use an accepted software engineering methodology to design, develop, document and test a complex computer program.
Students can explain/document their programs and use an organised approach for testing and debugging.	
Students understand how computers represent different types of data using binary digits and can use variables of different data types within their programs.	

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Not for consultation

Sample Exemplars – Computational Thinking for Digital Technologies

To help you understand the progress outcomes we have provided a number of sample exemplars illustrating the learning that the progress outcomes describe

Sample Exemplars – Computational Thinking for Digital Technologies

PROGRESS OUTCOME ① EXEMPLAR

Bees

Progress Outcome ①

Students break down a simple non-computerised task into a set of precise, unambiguous, step by step instructions (algorithmic thinking). They are able to give these instructions, and identify if they have gone wrong and correct them (simple debugging). By doing this they show that they can use their decomposition skills to take a task and break it down into its smallest steps.

Annotation

Cheryl-Ann responds to the task of getting the bee to the hive by breaking the problem down into a set of precise of instructions. She tests these instructions with a peer to make sure they work.

Background

The class is studying bees as part of a school-wide science inquiry about insects and have been investigating the way in which bees collect pollen from different plants and take it back to their hive. The teacher decides to link their study of bees to other work they have been doing on giving and following instructions.

Task

The students are given a grid and asked to create a set of instructions for a bee to follow in order to collect pollen from each flower and take it to the hive. As a class, they compile a list of "direction" words that they can refer to.

The students then give their instructions to a peer to test.
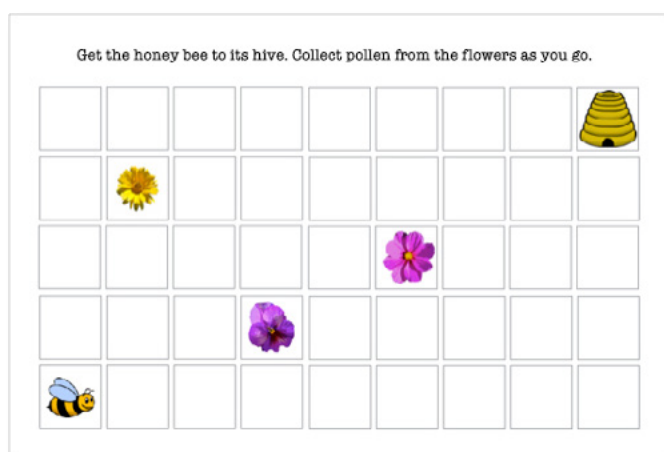
Student response

> **Teacher:** *What did you notice when Hemi tested your instructions?*
>
> **Cheryl-Ann:** *They worked. He went to each plant and got to the beehive.*

Get the honey bee to its hive. Collect pollen from the flowers as you go.

PROGRESS OUTCOME 2 EXEMPLAR

Repeating Bees

Progress Outcome 2

Students understand that an algorithm is a step-by-step process to solve a problem, that we can use these to write computer programs, and these programs need to have precise and unambiguous instructions so that the computer can follow them. Students can give, follow, and debug simple algorithms in both computerized and non-computerized environments. They can use these algorithms to create a simple program involving input, output and sequencing in an age-appropriate programming environment.

Annotation

The set of instructions that Harry creates demonstrates that he can break down the task of getting the bee to the hive and collect the pollen on the way into stages that include sequence and repetition.

Harry then tests his instructions on the template that his teacher has put into the introductory programming environment. He makes an input error in his initial attempt, so uses a simple debugging strategy by counting the squares to make it work.

Background

The class is studying bees as part of a school-wide science inquiry about insects and have been investigating the way in which bees collect pollen from different plants and take it back to their hive. The teacher decides to link their study of bees to other work they have been doing on giving and following instructions.

Task

The students are given a grid and asked to create a set of instructions for the bee to follow in order to collect pollen from each flower and take it to the hive. As a class, they create a list of "direction" words that they can refer to.

The teacher then puts a template of the grid into an introductory programming environment (Scratch Junior) so that the students are able to test their instructions.
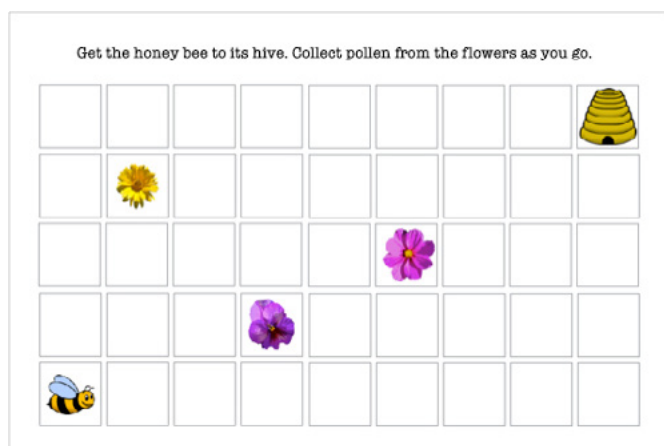
Get the honey bee to its hive. Collect pollen from the flowers as you go.

Student response
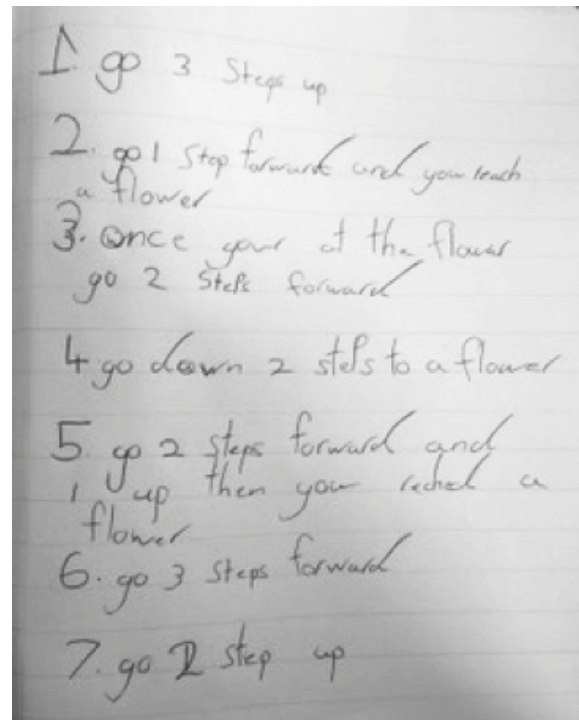
Teacher: *What happened when you put your instructions into the program? Did your bee get to the hive?*

Harry: *My bee got to the hive. The first time I tried I didn't put it in properly so it didn't work. So I did it again.*

Not for consultation

PROGRESS OUTCOME ③ EXEMPLAR

Animation

Progress Outcome ③

Students understand what algorithms are, the difference between algorithms and programs, and that there can be more than one algorithm for the same problem. They are able to decompose problems into step-by-step instructions to create an algorithm for a computer program, and use logical thinking to predict the behaviour of these programs. They are able to develop and debug simple programs that use inputs, outputs, sequence and loops. Students understand that computers store data using just two states, represented by binary digits (bits).

Annotation

Sarah's response to the task demonstrated that she:

- could develop a basic computer programs in a block-based programming environment

- understood the need to be precise because computers cannot infer

- can make algorithms more efficient through the use of iteration (repeats/loops)

- understands that multiple algorithms can have the same outcome but are not necessarily equally efficient.

Background

The students have had some experience in working with a block-based programming (Scratch). They completed an activity that involved animating the individual letters of their name during which the teacher noticed that most students programmed the letters to activate only once and kept clicking the start button to repeat actions.

The teacher then facilitated a whole class discussion using examples of students' work from the animated letter activity. The students observe that it is frustrating to have to click the 'go' button or the individual sprites to make the letters animate each time. It is explained that loops are about seeing patterns. Students discuss everyday examples of loops such as daily routines. Working in pairs, they were given a pattern card similar to the following and asked to write as few instructions as possible for their partner to re-create the pattern.

🔺🔴🟨🟨⭐🔺🔴🟨🟨⭐🔺🔴🟨🟨⭐🔺🔴🟨🟨⭐

The students compared their answers to see how different people solved the same problem.

Task

Using their new knowledge of loops, the students are asked to create an animated character that moves to music using the block-based program, Scratch. The animation needs to show choreographed repetition of dance moves so that the same sequence of movements is shown for the chorus of the song.

Student response

Not for consultation
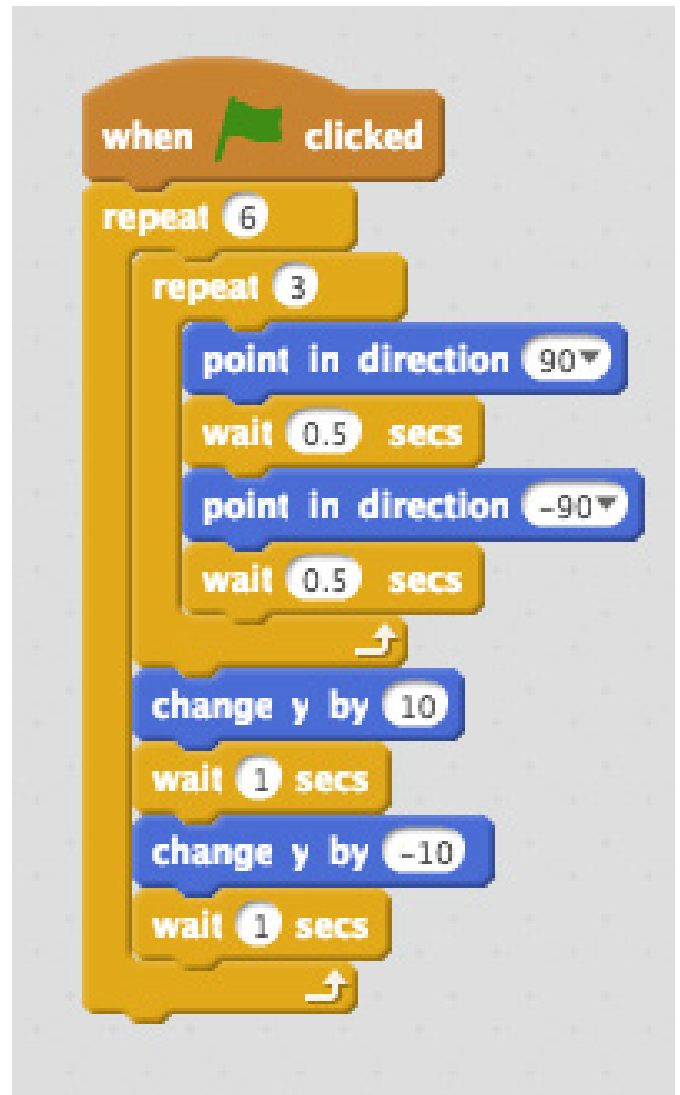
Beat the Goalie Game

Progress Outcome **4**

Students can decompose a problem to create an algorithm using three building blocks of programing: sequencing (putting instructions one after the other), selection (choosing which part of the algorithm to execute based on some values), and iteration (repeating part of the algorithm with a loop). They can implement the algorithm by creating a program that uses inputs, outputs, sequencing, loops and basic selection using comparative operators. They can debug simple algorithms and programs by identifying if things have gone wrong with their instructions, correcting them, and are able to explain why it went wrong and how they fixed it. Students understand that computers can represent data with binary digits, and that computers have a way to detect errors that have occurred in data storage and transmission. Students evaluate different algorithms in terms of their efficiency as they recognise that computers need to search and sort a lot of data.

Annotation

After playing the 'Beat the Goalie Game', Kiri and Ben modelled the computational thinking strategy of decomposition by breaking a programming problem down into basic functional requirements and then further breaking down each functional requirement into a step by step algorithm. They understand the difference between functional requirements, algorithms and computer programs.

Kiri and Ben created a computer program to implement an algorithm for one smaller part of the program. They used variables to store data (timer), sequence (wait 1 second, change score by -1) and iteration with conditional logic (repeat until timer = 0).

They debugged the code, after a discussion with the teacher about what happens on every repeat of a loop, by moving the set variable block outside of the loop.

Background

The students had prior experience with developing programs in a block based IDE.

This task is one part of activity for developing the "Beat the Goalie Game" in a block-based coding language. Other parts of the activity had students writing and implementing the algorithms for all the functional requirements. The final programs included conditional logic (if/else), sequential logic and iteration (repeats/loops).

Task

Students were shown a game that was already programmed called "Beat the Goalie". They were not able to view the code for the game, but only see the final game in action. Based on what they could see, they were asked to develop a set of "functional requirements" for the game. These functional requirements described the game play objectives and how the player would interact with the game.

Next, the students (in pairs) developed an algorithm for the functional requirement "the countdown timer should count down from 30 and stop the game when time is up".

Finally, they created the programming code to implement their algorithm for the countdown timer. They tested their algorithm and code by running the timer program.

The students submitted their responses to the teacher using template PowerPoint screens for the three parts of the task.

Not for consultation

Student response

Functional Requirements for the Beat the Goalie Game

After playing the "Beat the Goalie Game" write down the informal instructions here:

1. Timer counts down from 30 to 0 seconds untill game is over.
2. Use left and right arrow keys to move the goalie.
3. The ball will move from left to right automatically.
4. Use spacebar to shoot at the goal and then you get a point.
5. The goalie will say goal or save depends on if you score or not.
6. Score as many goals as you can in the time limit.

Algorithm for a countdown timer

1. Make a timer variable
2. Set timer to 30
3. Start at 30 seconds
4. –1 every second until timer= 0
5. Stop the game

**Teacher:** *What is the difference between an algorithm and informal instructions?*
Kiri: *A computer needs to know every step because it can't skip steps like a human. Computers need step-by step instructions to follow.*
Teacher: *Can you copy your algorithm into Scratch to make a program?*
Ben: *No because it won't know how to run it. I need to use the code blocks that are in Scratch to make the computer run my program*
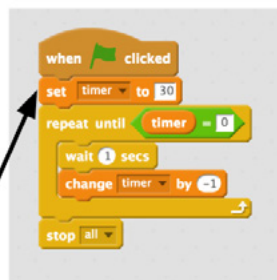
Computer Program in Scratch for a Countdown Timer

Add a screenshot of your computer program here. If it did not work the first time, add that code and write why it didn't work.
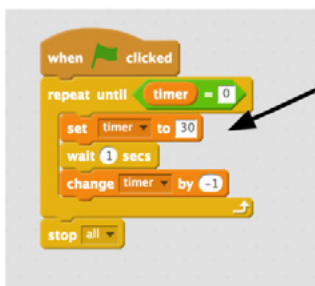
The first code didn't work because we had the "set timer to 30" inside the repeat block. It just kept resetting every time it did the repeat and it nev`r counted down.

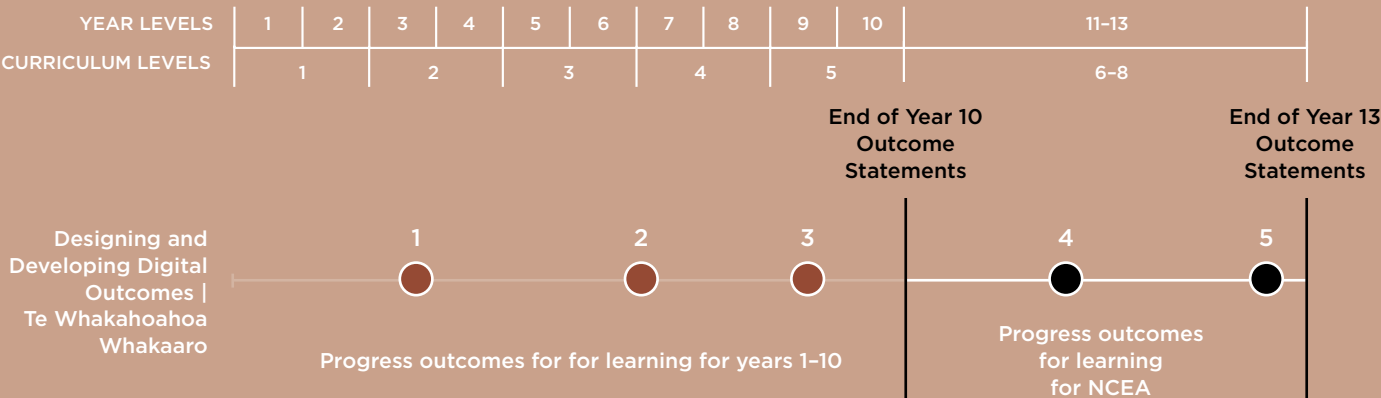We moved it out of the repeat so it only sets the time once at the start.

2B. Designing and Developing Digital Outcomes

Designing and developing digital outcomes

Students understand that digital applications and systems are created for humans by humans. They develop increasingly sophisticated understandings and skills related to designing and producing quality, fit-for-purpose, digital outcomes.

They develop their understanding of the digital Information technologies that people need in order to locate, analyse, evaluate, and present digital information efficiently, effectively, and ethically. They become more expert in manipulating and combining data, using information management tools to create an outcome. They become aware of the unique intellectual property issues that arise in digital systems, particularly approaches to copyright and patents.

| YEAR LEVELS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11–13 | |
| CURRICULUM LEVELS | | 1 | | 2 | | 3 | | 4 | | 5 | 6–8 | |

End of Year 10 Outcome Statements

End of Year 13 Outcome Statements

Designing and Developing Digital Outcomes | Te Whakahoahoa Whakaaro

1   2   3   4   5

Progress outcomes for for learning for years 1–10

Progress outcomes for learning for NCEA

Draft for consultation

Progress Outcome 1

Can participate in a teacher-led development to create, manipulate, store, retrieve and share content. This will include:

• Identifying digital devices and their purpose and knowing that humans made them.

• Identify the inputs and outputs of a system.

• An awareness of some applications and their purpose (face-time, draw studio).

• An understanding that computers store content and we can retrieve it later.

Progress Outcome 2

Given some parameters/criteria and tools and/or techniques they are able to make decisions (largely independently) about creating, manipulating, storing, retrieving, sharing and or testing content (developed for a specific purpose) within a fundamental system. This includes:

• Understanding that digital devices develop/change over time & the influence/impact they have on humans/society.

• Understanding the particular roles of components in a fundamental input, process, output system and how they work together.

• Understanding that inputs are transformed into outputs within a fundamental system and the "control" role that humans have in this.

• Purposefully use an increasing range of applications (software and file type).

Progress Outcome 3

Given some parameters they are able to make decisions (largely independently) about the best tools/techniques to solve the problem. They work through an iterative process to design, develop, create, store, test and evaluate digital content that meets its purpose.

This includes:

• Select appropriate software and file types for particular purposes based on key features, and justify selection. Use selected software to develop and combine digital content to create an outcome.

• Understand the role of operating systems in managing personal computer hardware, security, and application software. Explain the conventions of file management procedures and use of storage devices.

Progress Outcome 4

Able to independently work through an iterative process to design, develop, create, store, test and evaluate digital content that meets its purpose.

Note: In the continuum between progress outcome 4 and 5 there is increasing flexibility, confidence, improved optimisation of tools and techniques and applying more specialised contexts.

Progress Outcome 5

Able to integrate their knowledge of digital applications and systems to plan, design, develop/test and create quality, fit-for-purpose digital outcomes that meet design specifications. This knowledge includes:

• Understanding the hardware components, protocols, and network architecture, used in a Local Area Network (LAN) and apply this to assemble, configure, and manage a LAN.

• Discussing, designing, constructing, and debugging complex electronic environments and embedded systems in terms of their sub-systems and programming structures.

• Understanding how an information system adds value to an organisation. Explaining the interaction of the main components of an information system (hardware, software, data procedures and people) and the importance of end-users and security management.

• Effectively applying an iterative software engineering process to develop digital outcomes.

Note

Exemplars for Designing and Developing Digital Outcomes are currently in development

Draft for consultation

Outcome Statements – Designing and Developing Digital Outcomes

END OF YEAR 10	END OF YEAR 13
Students will be able to use a range of software to develop and combine digital content to create an outcome. They can work through an iterative process to design, develop, create, store, test and evaluate digital content that meets its purpose. They will recognise social and end-user considerations that are relevant when developing digital content. They will be able to make decisions (largely independently) about appropriate tools/techniques, software and file types to use when developing digital outcomes, and be able to explain their decisions. Students understand the role of operating systems in managing personal computer hardware, security, and application software. They can apply file management conventions when creating and storing digital content and use a range of appropriate storage devices.	Students can work independently or within collaborative, cross-functional teams to effectively apply a refined, iterative development process to develop quality, fit-for-purpose digital outcomes that meet design specifications. They will synthesise social and end-user considerations that are relevant to the outcome when developing digital content. Student developed outcomes will integrate specialised knowledge of digital applications and systems from a range of areas: • LAN (local area network) architecture • Internet of Things (development of a system of interrelated computing devices, hardware and applications) • complex electronics environments and embedded systems • digital information systems • user experience design • complex management of digital information • creative digital media

Draft for consultation
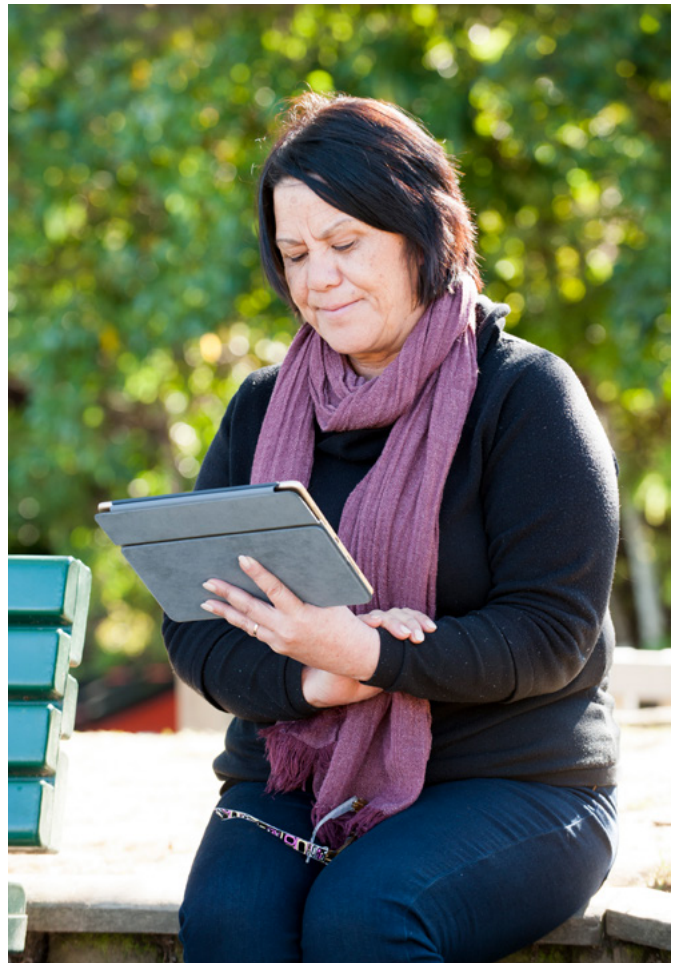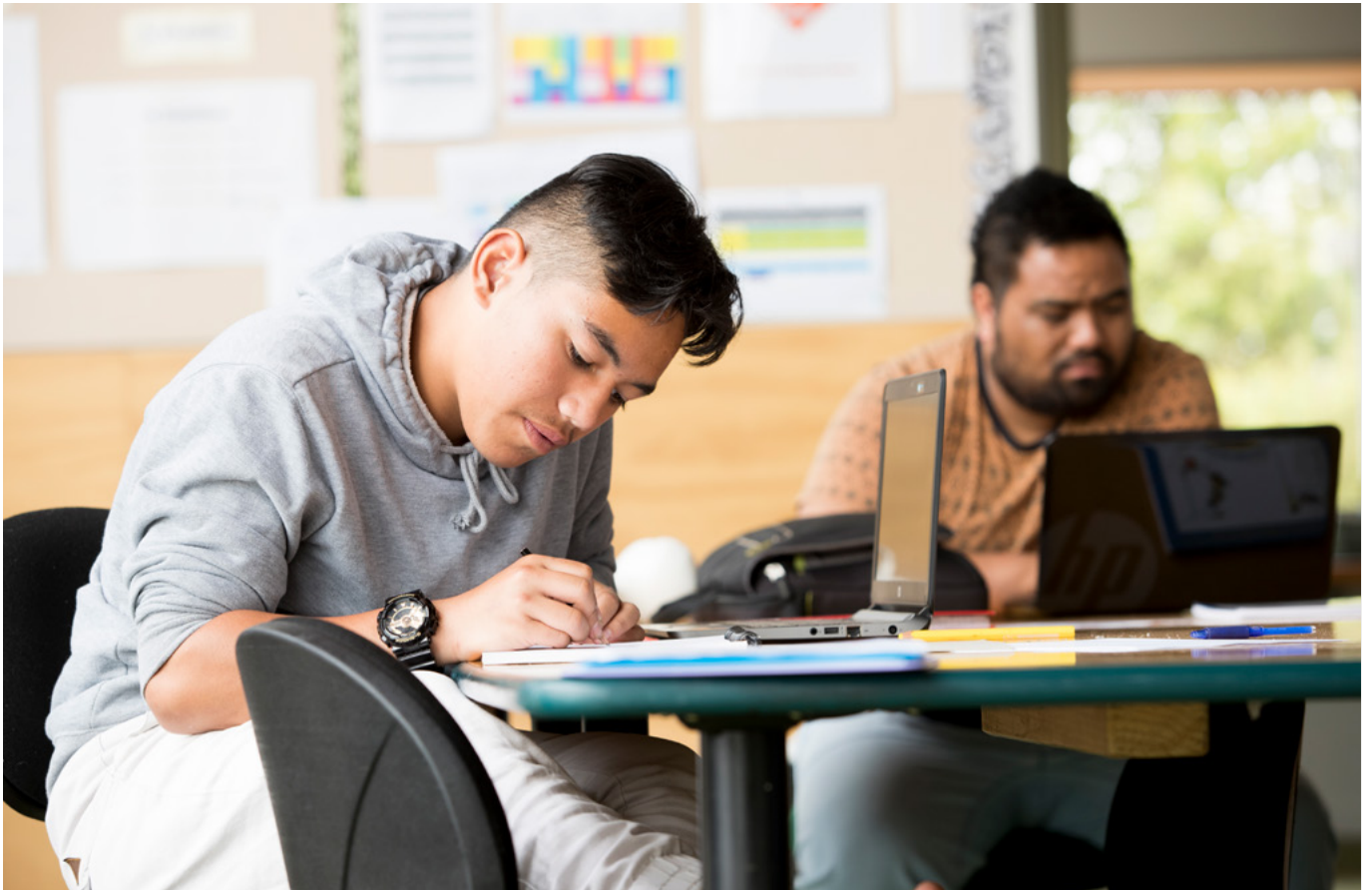
Achievement Objectives

The Remaining Technological Areas

The current Achievement Objectives have been retained.

We are reorganising the Technology Learning Area to allow for the incorporation of Digital Technologies into the curriculum – and that reorganisation is evident from the revised Learning Area Statement. There is no change to the curriculum content in the existing technological areas:

• Designing and developing materials outcomes

• Designing and developing processed outcomes

• Design and visual communication

The unchanged achievement objectives for those technological areas are set out in this section.

LEVEL ONE

Technological Practice

Students will:

Planning for practice

- Outline a general plan to support the development of an outcome, identifying appropriate steps and resources.

Brief development

- Describe the outcome they are developing and identify the attributes it should have, taking account of the need or opportunity and the resources available.

Outcome development and evaluation

- Investigate a context to communicate potential outcomes. Evaluate these against attributes; select and develop an outcome in keeping with the identified attributes.

Technological Knowledge

Students will:

Technological modelling

- Understand that functional models are used to represent reality and test design concepts and that prototypes are used to test technological outcomes.

Technological products

- Understand that technological products are made from materials that have performance properties.

Technological systems

- Understand that technological systems have inputs, controlled transformations, and outputs.

Nature of Technology

Students will:

Characteristics of technology

- Understand that technology is purposeful intervention through design.

Characteristics of technological outcomes

- Understand that technological outcomes are products or systems developed by people and have a physical nature and a functional nature.

LEVEL TWO

Technological Practice

Students will:

Planning for practice

- Develop a plan that identifies the key stages and the resources required to complete an outcome.

Brief development

- Explain the outcome they are developing and describe the attributes it should have, taking account of the need or opportunity and the resources available.

Outcome development and evaluation

- Investigate a context to develop ideas for potential outcomes. Evaluate these against the identified attributes; select and develop an outcome. Evaluate the outcome in terms of the need or opportunity.

Technological Knowledge

Students will:

Technological modelling

- Understand that functional models are used to explore, test, and evaluate design concepts for potential outcomes and that prototyping is used to test a technological outcome for fitness of purpose.

Technological products

- Understand that there is a relationship between a material used and its performance properties in a technological product.

Technological systems

- Understand that there are relationships between the inputs, controlled transformations, and outputs occurring within simple technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand that technology both reflects and changes society and the environment and increases people's capability.

Characteristics of technological outcomes

- Understand that technological outcomes are developed through technological practice and have related physical and functional natures.

LEVEL THREE

Technological Practice

Students will:

Planning for practice

- Undertake planning to identify the key stages and resources required to develop an outcome. Revisit planning to include reviews of progress and identify implications for subsequent decision making.

Brief development

- Describe the nature of an intended outcome, explaining how it addresses the need or opportunity. Describe the key attributes that enable development and evaluation of an outcome.

Outcome development and evaluation

- Investigate a context to develop ideas for potential outcomes. Trial and evaluate these against key attributes to select and develop an outcome to address the need or opportunity. Evaluate this outcome against the key attributes and how it addresses the need or opportunity.

Technological Knowledge

Students will:

Technological modelling

- Understand that different forms of functional modelling are used to inform decision making in the development of technological possibilities and that prototypes can be used to evaluate the fitness of technological outcomes for further development.

Technological products

- Understand the relationship between the materials used and their performance properties in technological products.

Technological systems

- Understand that technological systems are represented by symbolic language tools and understand the role played by the "black box" in technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function.

Characteristics of technological outcomes

- Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures.

LEVEL FOUR

Technological Practice

Students will:

Planning for practice

- Undertake planning that includes reviewing the effectiveness of past actions and resourcing, exploring implications for future actions and accessing of resources, and consideration of stakeholder feedback, to enable the development of an outcome.

Brief development

- Justify the nature of an intended outcome in relation to the need or opportunity. Describe the key attributes identified in stakeholder feedback, which will inform the development of an outcome and its evaluation.

Outcome development and evaluation

- Investigate a context to develop ideas for feasible outcomes. Undertake functional modelling that takes account of stakeholder feedback in order to select and develop the outcome that best addresses the key attributes. Incorporating stakeholder feedback, evaluate the outcome's fitness for purpose in terms of how well it addresses the need or opportunity.

Technological Knowledge

Students will:

Technological modelling

- Understand how different forms of functional modelling are used to explore possibilities and to justify decision making and how prototyping can be used to justify refinement of technological outcomes.

Technological products

- Understand that materials can be formed, manipulated, and/or transformed to enhance the fitness for purpose of a technological product.

Technological systems

- Understand how technological systems employ control to allow for the transformation of inputs to outputs.

Nature of Technology

Students will:

Characteristics of technology

- Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.

Characteristics of technological outcomes

- Understand that technological outcomes can be interpreted in terms of how they might be used and by whom and that each has a proper function as well as possible alternative functions.

LEVEL FIVE

Technological Practice

Students will:

Planning for practice

- Analyse their own and others' planning practices to inform the selection and use of planning tools. Use these to support and justify planning decisions (including those relating to the management of resources) that will see the development of an outcome through to completion.

Brief development

- Justify the nature of an intended outcome in relation to the need or opportunity. Describe specifications that reflect key stakeholder feedback and that will inform the development of an outcome and its evaluation.

Outcome development and evaluation

- Analyse their own and others' outcomes to inform the development of ideas for feasible outcomes. Undertake ongoing functional modelling and evaluation that takes account of key stakeholder feedback and trialling in the physical and social environments. Use the information gained to select and develop the outcome that best addresses the specifications. Evaluate the final outcome's fitness for purpose against the brief.

Technological Knowledge

Students will:

Technological modelling

- Understand how evidence, reasoning, and decision making in functional modelling contribute to the development of design concepts and how prototyping can be used to justify ongoing refinement of outcomes.

Technological products

- Understand how materials are selected, based on desired performance criteria.

Technological systems

- Understand the properties of subsystems within technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand how people's perceptions and acceptance of technology impact on technological developments and how and why technological knowledge becomes codified.

Characteristics of technological outcomes

- Understand that technological outcomes are fit for purpose in terms of time and context. Understand the concept of malfunction and how "failure" can inform future outcomes.

LEVEL SIX

Technological Practice

Students will:

Planning for practice

- Critically analyse their own and others' past and current planning practices in order to make informed selection and effective use of planning tools. Use these to support and justify ongoing planning that will see the development of an outcome through to completion.

Brief development

- Justify the nature of an intended outcome in relation to the need or opportunity and justify specifications in terms of key stakeholder feedback and wider community considerations.

Outcome development and evaluation

- Critically analyse their own and others' outcomes to inform the development of ideas for feasible outcomes. Undertake ongoing experimentation and functional modelling, taking account of stakeholder feedback and trialling in the physical and social environments. Use the information gained to select, justify, and develop a final outcome. Evaluate this outcome's fitness for purpose against the brief and justify the evaluation, using feedback from stakeholders.

Technological Knowledge

Students will:

Technological modelling

- Understand the role and nature of evidence and reasoning when managing risk through technological modelling.

Technological products

- Understand how materials are formed, manipulated, and transformed in different ways, depending on their properties, and understand the role of material evaluation in determining suitability for use in product development.

Technological systems

- Understand the implications of subsystems for the design, development, and maintenance of technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand the interdisciplinary nature of technology and the implications of this for maximising possibilities through collaborative practice.

Characteristics of technological outcomes

- Understand that some technological outcomes can be perceived as both product and system. Understand how these outcomes impact on other outcomes and practices and on people's views of themselves and possible futures.

LEVEL SEVEN

Technological Practice

Students will:

Planning for practice

- Critically analyse their own and others' past and current planning and management practices in order to develop and employ project management practices that will ensure the effective development of an outcome to completion.

Brief development

- Justify the nature of an intended outcome in relation to the issue to be resolved and justify specifications in terms of key stakeholder feedback and wider community considerations.

Outcome development and evaluation

- Critically analyse their own and others' outcomes and evaluative practices to inform the development of ideas for feasible outcomes. Undertake a critical evaluation that is informed by ongoing experimentation and functional modelling, stakeholder feedback, and trialling in the physical and social environments. Use the information gained to select, justify, and develop an outcome. Evaluate this outcome's fitness for purpose against the brief. Justify the evaluation, using feedback from stakeholders and demonstrating a critical understanding of the issue.

Technological Knowledge

Students will:

Technological modelling

- Understand how the "should" and "could" decisions in technological modelling rely on an understanding of how evidence can change in value across contexts and how different tools are used to ascertain and mitigate risk.

Technological products

- Understand the concepts and processes employed in materials evaluation and the implications of these for design, development, maintenance, and disposal of technological products.

Technological systems

- Understand the concepts of redundancy and reliability and their implications for the design, development, and maintenance of technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand the implications of ongoing contestation and competing priorities for complex and innovative decision making in technological development.

Characteristics of technological outcomes

- Understand that technological outcomes are a resolution of form and function priorities and that malfunction affects how people view and accept outcomes.

LEVEL EIGHT

Technological Practice

Students will:

Planning for practice

- Critically analyse their own and others' past and current planning and management practices in order to develop and employ project management practices that will ensure the efficient development of an outcome to completion.

Brief development

- Justify the nature of an intended outcome in relation to the context and the issue to be resolved. Justify specifications in terms of key stakeholder feedback and wider community considerations.

Outcome development and evaluation

- Critically analyse their own and others' outcomes and fitness-for-purpose determinations in order to inform the development of ideas for feasible outcomes. Undertake a critical evaluation that is informed by ongoing experimentation and functional modelling, stakeholder feedback, trialling in the physical and social environments, and an understanding of the issue as it relates to the wider context. Use the information gained to select, justify, and develop an outcome. Evaluate this outcome's fitness for purpose against the brief. Justify the evaluation, using feedback from stakeholders and demonstrating a critical understanding of the issue that takes account of all contextual dimensions.

Technological Knowledge

Students will:

Technological modelling

- Understand the role of technological modelling as a key part of technological development, justifying its importance on moral, ethical, sustainable, cultural, political, economic, and historical grounds.

Technological products

- Understand the concepts and processes employed in materials development and evaluation and the implications of these for design, development, maintenance, and disposal of technological products.

Technological systems

- Understand operational parameters and their role in the design, development, and maintenance of technological systems.

Nature of Technology

Students will:

Characteristics of technology

- Understand the implications of technology as intervention by design and how interventions have consequences, known and unknown, intended and unintended.

Characteristics of technological outcomes

- Understand how technological outcomes can be interpreted and justified as fit for purpose in their historical, cultural, social, and geographical locations.

What's Next

This document is just the start of our conversation with you about Digital Technologies | Hangarau Matihiko.

Next steps

From here, our priority is to receive and consider your feedback on this document, to ensure that your voice is taken into account as we move towards the release of the new Digital Technologies | Hangarau Matihiko curriculum content at the end of 2017.

At the same time, we are working to:

- Develop a range of resources, so that learners, their families and whānau, teachers, schools, kura and Communities of Learning | Kāhui Ako are equipped to support our learners in Digital Technologies | Hangarau Matihiko;

- Psychometrically test the progress outcomes in Digital Technologies and Hangarau Matihiko with learners. This process ensures that the progression in each of the technological areas that relate to Digital Technologies and Hangarau Matihiko is accurately described; and

- Trial and refine the new achievement standards and assessment resources for NCEA Level 1 to support learning in Digital Technologies and Hangarau Matihiko.

Glossary

Glossary of Terms

Technology | Hangarau Learning Area is the body of skills, knowledge and capabilities which are important to learning in Technology or Hangarau.

The Learning Area Statement explains the fundamental ideas, concepts and purpose which underpin learning in this Technology and Hangarau Learning Areas. This statement tells you what the Technology and Hangarau learning areas are about, why you would study Technology or Hangarau, and how Technology and Hangarau are structured.

Technological areas are the contexts for learning in Technology. These include two technological areas tied specifically to Digital Technologies and Hangarau Matihiko (Computational Thinking for Digital Technologies, and Designing and Developing Digital Outcomes).

Progress outcomes show the significant learning steps as learners develop expertise in a technological area over the course of their primary and secondary education.

Outcome statements identify the knowledge, capabilities and attitudes we expect learners to have learned by the end of Year 10 and the end of Year 13.

Achievement Objectives identify learning at each curriculum level in the non digital areas of the Technology and Hangarau Learning Areas. We are using Progress Outcomes to describe learning in Digital Technologies | Hangarau Matihiko.