



Waikato Journal of Education

ISSN 2382-0373
Website: <http://wje.org.nz>



Wilf Malcolm Institute
of Educational Research
Te Pātahi Rangahau Mātauranga o Wilf Malcolm
THE UNIVERSITY OF WAIKATO

Title of Issue/section: Volume 23, Issue 2, 2018

Guest Editor: Dianne Forbes

Editor: Noeline Wright

To cite this article: Kellow, J.-M. (2018). Digital Technologies in the New Zealand Curriculum. *Waikato Journal of Education*, 23(2), 75-82. doi: 10.15663/wje.v23i2.656.

To link to this volume: 10.15663/wje.v23i2

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Digital Technologies in the New Zealand Curriculum

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Abstract

The revised Technology Curriculum for years 1 - 13 now includes two Digital Technologies areas: 'computational thinking for Digital Technologies' and 'designing and developing digital outcomes'. By 2020, all schools are expected to address these curriculum additions.

This article outlines some of the background stated purposes for introducing this curriculum addition. I also examine some of the challenges including teacher readiness and resourcing, professional development and some resources to accompany the changes. The article also discusses how curriculum integration, including the use of authentic contexts, and the use of 'unplugged' resources might alleviate some potential challenges.

Keywords

Education; curriculum; Digital Technology

Introduction

The Technology Curriculum area of the New Zealand Curriculum underwent a consultation and review process during 2017 while the final version was released in time for implementing in term one 2018. By 2020 all schools will be addressing its requirements. In Year 1-10 (learners are likely to be between 5 and 14 years old), the digital areas of the curriculum develop skills and capabilities before any specialisation occurs in years 11- 13, when students are about 14-18 years old.

A number of challenges and issues arise when new learning areas are introduced. These include teacher readiness in terms of confidence, knowledge and capability, resourcing, the kinds of professional learning and development (PLD) available for teachers, how the implementation of the new curriculum is undertaken, timeframes involved, how to create and use authentic learning contexts and how the new parts of the curriculum work with the existing established curriculum areas.

The early version of the Technology strand of the New Zealand Curriculum (NZC) had three inter-related strands: Technological Practice, Technological Knowledge and The Nature of Technology, each with their own achievement objectives across seven technological areas. These included Electronics and Control technology, and Information and communication technology.



Contexts for these were overlapping, such as home, personal, business and industrial (Ministry of Education, 1995).

This changed with the introduction of the Digital Technologies area of the Technology Learning Area in both NZC (English version), and Te Marautanga o Aotearoa from 2018, based around six themes:

- Algorithms
- Data representation
- Digital applications
- Digital devices and infrastructure
- Humans and computers
- Programming

This change resulted from the government’s Science and Society Strategic Plan, *A Nation of Curious Minds: Te Whenua Hihiri i te Mahara*. One of its initiatives was a review of the positioning of the content related to Digital Technologies (Ministry of Business, Innovation & Employment, 2014; New Zealand Government, 2016). Digital Technologies sits within the Technology Learning Area rather than being separate because technology is much more than designing and making things. It involves critiquing past, existing and possible future technologies, while considering their environmental, social and cultural impacts. The new Digital Technologies and Hangarau Matihiko additions to Technology use both the same approach and many of the same skills, such as identifying user needs and responding to them (Ministry of Education, 2018c).

From the consultation feedback, a number of changes were made to the draft curriculum (Ministry of Education, 2017e). These included making digital citizenship, ethics, Te Ao Māori and Te Tiriti o Waitangi more explicit. The importance of authentic contexts for learning was emphasised by the addition of the words “In authentic contexts...” to all progress outcomes (Ministry of Education, 2017g).

The three strands

The three strands from the 1995 Technology Learning Area, that is, Technological Practice, Technological Knowledge and The Nature of Technology, remain, but are embedded within five new areas: Computational Thinking for Digital Technologies and Designing and Developing Digital Outcomes, Designing and Developing Materials Outcomes, Designing and Developing Processed Outcomes, and Design and Visual Communication. The Digital Technologies content fits within two of these:

- *Computational Thinking for Digital Technologies* (CTDT). This is the area where students will develop and understanding of computer science principles that underlie all Digital Technologies, learning core programming concepts to become creators of Digital Technology, rather than users. This area incorporates algorithms, data representation and programming themes
- *Designing and Developing Digital Outcomes* (DDDO). In this area, students are learning how to design quality, fit-for-purpose digital solutions. It includes themes of digital applications, digital devices and infrastructure and humans and computers (Ministry of Education, 2017g).

There is however, crossover between these two areas. For example, it would be difficult to work on programming without also considering the best device and application to use. When authentic contexts facilitate the learning, as required in the progress outcomes, it is highly likely that crossovers will result. In DDDO Exemplar 4: Bottle-cap Music for example, students will use algorithms, data representation and programming using an application like Scratch to create music using a Makey Makey controller.

While CTDT is a new area, DDDO incorporates aspects of the Electronics and Control Technology, and Information and Communication Technology areas from the earlier curriculum. The two Digital Technology areas aim to develop students' capabilities in creating digital products for specific purposes (Ministry of Education, 2017g). A key intent is to increase students' knowledge of understanding of computer science principles and these principles in turn, drive Digital Technologies (Ministry of Education, 2017a).

A Māori medium version of the addition to the Technology Learning Area accompanies the English version (Ministry of Education, 2017d). In Te Marautanga o Aotearoa, Hangarau Matahiko, a Digital Technologies aho (line or thread) is now in place. This aho is not a direct translation of the English version, but addresses the principles for Māori medium contexts. The focus of this article, however, is on the English medium version.

Another change is the use of progress outcomes rather than achievement objectives for the two new areas. Progress outcomes represent key learning steps and are not specifically linked to a curriculum or year level as other learning areas are arranged. This represents both a departure from the curriculum as a whole and the three Technology Learning Areas which retain achievement objectives. Years 1-10 students are expected to be exposed to this curriculum addition, while senior school students in Years 11-13, may specialise.

Rationale and aims

The world has changed greatly since the Technology Learning Area outline was released in 2007 within the broader NZC and Digital Technologies have been a huge part of those changes. For most people in New Zealand Digital Technology, whether it be encountered via a computer, smartphone, tablet, wearable, scanner, smart tv or some other device, is a part of their everyday lives. The New Zealand Government (2017) believe that all students will need Digital Technology skills and capabilities in order to fully participate in society, both now and in the future, regardless of the career path they choose to follow.

While some people in industry (Education Gazette Editors, 2017) see the new curriculum areas as necessary to overcome a shortfall of workers in the Digital Technology sector, others see that Digital Technologies are integral to a wide range of occupations. While some students will follow career paths that require programming knowledge, the aims of the Digital Technologies addition to the curriculum goes beyond teaching students to code. Aims include preparing students to be adaptable, participate in, create and thrive in world that is marked by an accelerating pace of change (Ministry of Education, 2017c). The Digital Technologies areas of the curriculum emphasise creating, problem-solving and innovating with Digital Technologies, shifting away from using Digital Technologies to support learning. Instead, students are to be creators (Ministry of Education, 2017b).

Linking to other curriculum learning areas

There are many links between the new focus and other learning areas. The Curriculum Advisory group (2017, p.7) noted that “its digital nature is such that, like literacy and numeracy, it is embedded in all

learning”, implying cross-curricular opportunities. All the progress outcomes in the Digital Technologies areas (Ministry of Education 2018g, p.1) begin with “In authentic contexts...” emphasising the opportunities for applying the Digital Technologies learning to other subject area contexts. Authentic contexts are by their nature cross-curricula. Turnbull (2002, p.39) states that:

Authentic learning in technology education means that students need to be involved in practices which reflect understanding of the culture of real technological practice. Skills and knowledge are far less relevant and meaningful if taught in isolation. Students need to, and have a right to, understand the relevance and place of their learning.

In the revised curriculum (Ministry of Education, 2017g, p.4) computational thinking is described as thinking that “enables students to express problems and formulate solutions in ways that means a computer... can be used to solve them”. It asks that students develop an understanding of how computers work so they can use them to create Digital Technologies. The progress outcomes in the computational thinking area describe how, in authentic contexts, students learn to break down tasks (decomposition) into step-by-step instructions (algorithmic thinking). They create increasingly complex programs in authentic contexts, keeping the end user in mind. They identify and correct any errors (debugging) and use logical thinking to predict how programs they develop will behave. They also develop an understanding of binary digits and their importance in computing.

In the process of using computational thinking students will use and develop a range of skills, understandings and strategies from other curriculum areas. Computational thinking skills have similarities to those used in both mathematical and scientific thinking (National Research Council, 2011; Sterling, 2016; Wing, 2008). Binary numbers are an obvious example of crossover with the Maths Curriculum.

Viewing the exemplars (Ministry of Education 2018a) shows links with other NZ Curriculum learning areas. Exemplar 1 for Computational thinking Progress Outcome 1 ‘Collecting Pollen’, for example, has links to literacy (giving and following instructions) and the geometry strand in maths (positional language). Exemplar 2 ‘Teaching Robots to Dance’, has links to Health and Physical Education and the development of skills for cooperation.

In the Designing and Developing Digital Outcomes area (Ministry of Education, 2017g, p.13) students will, amongst other things, “make decisions about creating, manipulating, storing, retrieving, sharing and testing digital content for a specific purpose” whilst keeping the end user in mind. They will evaluate digital content and examine the impact of Digital Technologies on humans. Students will learn to make informed decisions about the most appropriate software and hardware to use for a specific task, and develop and apply their understanding of a range of privacy and security considerations.

The DDDO exemplars (Ministry of Education 2018a) also contain examples of links to other curriculum areas. In Exemplar 8 ‘Digital Debate’, for example, students debate the statement ‘Robotics will be the downfall of mankind’. This links the literacy skills of debating and researching a topic with the DDDO outcome of understanding the impact of digital devices on humans and society. In DDDO Exemplar 3 ‘Animating a song’, in addition to the DDDO outcomes, students are creating visual texts and performing music.

Integrating the new areas with the existing curriculum areas should go some way to addressing concerns expressed in feedback on the draft curriculum about adding additional content to an already crowded curriculum (Jenkins, 2017). Taking a cross-curricular approach for implementation should, as shown in the exemplars, support learning in other curriculum learning areas as well as the Digital Technologies content.

Challenges

The consultation on the draft curriculum identified a number of areas of concern from teachers, school leaders and Boards of Trustees, especially around the implementation of the new content (Jenkins, 2017). The main challenges identified were resourcing, workload, PLD and teacher capability. For teachers, the timeframe for implementation was of particular concern, with many feeling that not enough time was being allowed to develop teacher capability.

The Curriculum Advisory Group (2017), while supporting the timeline for introduction, noted the low baseline capacity of teachers and suggested implementation would need to be well resourced and managed. They mentioned the current teacher shortage and workload issues for teachers as factors that would need to be taken into consideration.

Perceptions and beliefs

While overall the response has been positive, some parents and teachers have expressed concerns about the intent and direction of the new content (Jenkins, 2017). One misconception is that it is solely about coding and training students to be coders or work with computers. For some there appears to be a lack of understanding of the purpose of introducing the new content and that it is more than just coding. While coding will indeed be a significant part of the new areas, the scope is much wider than this, incorporating computational thinking and an understanding of a wide variety of Digital Technologies. This is designed to enable students to make informed choices about the applications and devices they will use, how they work and how to “use and create Digital Technologies to solve problems” (Ministry of Education, 2017c, p.1).

For teachers, it is important that they understand the purpose of, and benefits for, students learning this new content. If they do not see the importance of it, they are less likely to make it a priority when making decisions about what they teach and especially the time they will allocate. As Timperley (2008) notes “Teachers’ moment-by-moment decisions about lesson content and process are shaped by multiple factors... Such factors include teachers’ knowledge and their beliefs about what is important to teach...” It is important that PLD makes explicit the links between the new content and valued student outcomes. For teachers with lower capability and confidence in these areas, this is likely to have even greater importance. If you find using Digital Technologies difficult or you do not feel confident with them and don’t see it as important there is little motivation to make it a priority in your classroom (Inan & Lowther, 2010).

Resourcing, supports and PLD

The importance of sufficient resourcing for successful implementation was noted during the consultation process (Jenkins, 2017). The Ministry of Education (2018a) has since released a number of resources to support the new content. Exemplars have been provided for the Computational Thinking progress outcomes 1 -5 and the Digital Outcomes progress outcomes 1 -3 to support the new content and more are planned for release. Given the low capability and/or confidence of many teachers in this area (Curriculum Advisory Group, 2017; McSweeney, 2017) these are going to have an important place in ensuring teachers are able to implement the content effectively. Some of these teachers will need support in adapting these exemplars to their own classroom context.

The Ministry of Education has set aside \$40 million to support the implementation of the new content. A number of support programmes have been announced (Ministry of Education, 2017c). Some, such as the curriculum resources and the targeted PLD, are directly aimed at supporting teachers to implement the new content. Others, such as the scholarships and digital championships are aimed at students and the 'Digital Technologies for All' programme is aimed at addressing inequities, especially for priority students.

Three targeted PLD programmes have been announced (Ministry of Education, 2018b) with the option chosen by schools related to their level of readiness for implementing the new curriculum content:

1. Digital Fluencies - to support teachers to confidently use Digital Technologies in their classrooms;
2. Digital Readiness Programme - for schools and teachers who want to find out more about the new curriculum content;
3. Tailored Digital Technologies PLD for those schools who feel they understand the new content and are ready to integrate it with their school curriculum.

These are all ongoing rather than one-off PLD programmes and hopefully will meet the criteria for change noted by Timperley (2008):

To make significant changes to their practice, teachers need multiple opportunities to learn new information and understand its implications for practice. Furthermore, they need to encounter these opportunities in environments that offer both trust and challenge... Learning is cyclical rather than linear, so teachers need to be able to revisit partially understood ideas as they try them out in their everyday contexts.

The Virtual Learning Network and existing social networks such as Twitter, Google+ and teacher-led Facebook groups may also provide support for some teachers. Ministry of Education sites such as 'Enabling e-Learning', 'Te Kete Ipurangi', 'Education Counts' and 'Curriculum Online' are already providing some information resources and supports to teachers. The existing Connected Learning Advisory (CLA) will also have a role in supporting the implementation of the new content, especially in supporting schools to make decisions around strategic planning, devices and infrastructure and managing use of Digital Technologies in the classroom.

There are many existing resources to support coding and computational thinking. Hour of Code, Scratch, Tynker, Code Avengers to name a few, but unless there is effective PLD in integrating the content there is a risk of teachers using activities from these apps and sites in isolation. This PLD would show teachers how they could integrate some of these resources into their existing programmes and ensure there are links with authentic practice. Turnbull (2002) concludes that:

There is overwhelming evidence that technology programmes developed for children need to focus on authentic technological practice and culture. Our students need to be fully aware of, and immersed in technological practice to ensure their learning is relevant and valuable (p. 38).

Unplugged resources

Some parents and teachers have voiced concerns about the use of Digital Technologies for primary-aged students. Feedback from some Steiner Waldorf schools for example (Jenkins, 2017), recognised the role of technology in education but did not see it as appropriate for primary aged (or younger) students. There were also some concerns voiced around funding for software and hardware to support

implementation, yet the Ministry of Education does not directly fund devices (Ministry of Education, 2017f). To address some of these misgivings about appropriateness and access to devices, there are a number of ‘unplugged’ options.

‘Unplugged’ resources are those that support the teaching of computer science and computational thinking without the use of digital devices or tools. They often involve games, puzzles and physical activities. There are many existing unplugged activities available, CSUnplugged.org for example has many units for teaching topics such as binary numbers and searching algorithms, without the use of devices. Several of the exemplars for the first progress outcome in both Digital Technology areas are unplugged activities or could easily be adapted for use without devices.

The progress outcomes for the Computational Thinking for Digital Outcomes area do not require the use of a computer or other digital device at the first stage and allow for task completion in both computerised and non-computerised contexts in the second stage. Given that Progress Outcome 2 is aligned with mid curriculum level 3, students in the early years of primary could complete Progress Outcome 1 and begin work on Progress Outcome 2 without using a computer at all if desired.

For the Designing and Developing Digital Outcomes area, students will work with digital content in order to fully achieve the outcomes. However, Progress Outcome 1 is aligned with mid-late curriculum level 2 and Progress Outcome 2 is aligned with mid-level 4. This means that young students could initially work on unplugged activities to develop understanding before using digital tools. For most schools, a mix of computerised and non-computerised, that is ‘unplugged’, activities will offer some flexibility for both schools and learners.

Summary

The new digital part of the Technology Learning Area, focuses on creating, innovating and problem-solving with Digital Technologies. The expectation is that they occur in contexts that represent authentic technological practice, and develop students’ understanding and knowledge of computer science principles (Ministry of Education, 2017a), but not as standalone content, unless it is specialised in the senior areas of secondary schooling. Professional development for teachers and the provision of appropriate resources are essential for this to happen.

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