Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders

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Abstract

Recognising the growing demand for digital skills in the 21st century, the Ministry of Education (MoE) introduced a Digital Technologies (DT) element to the Technology Curriculum in 2018, aiming to equip students with the knowledge and capabilities to thrive in a technology-driven world. However, the implementation of this new curriculum, mandated to start in 2020, presented challenges for schools, leaders and teachers, particularly regarding teacher confidence, skill development, and pedagogical approaches.

This thesis examines the implementation of the digital technologies content of the New Zealand Technology Curriculum (DTC) in New Zealand middle schools, specifically focusing on how schools can effectively implement DT programmes. The research adopts a qualitative, interpretivist, collective Case Study approach, focusing on two middle schools in the Waikato region. Data was gathered through focus groups, document analysis, classroom observations, and interviews with teachers and leaders at the participating schools. This data was then analysed thematically.

The findings highlight the crucial roles that both school leaders and teachers play in the effective implementation of DT programmes. The research identified two central themes: 'Leaders as Catalysts for Digital Advancement' and 'Teachers as Digital Technologies Champions'.

Leaders were found to catalyse digital advancement by:

- Establishing clear goals and expectations.
- Allocating resources strategically.
- Attending to their own learning.
- Supporting teachers to build their confidence and competence in DT.

Teachers, in turn, championed successful DT programmes by:

- Understanding and responding to the rationale and purposes for digital technologies.
- Demonstrating learning dispositions towards innovation and change.
- Deliberately utilising a range of DT tools.
- Leveraging pedagogical strategies to enhance engagement and achievement.

The research emphasises the importance of aligning leadership actions with teacher needs to create a supportive environment for DT implementation. Furthermore, a Digital Technologies Content Implementation Tool (DTCIT V2) has been proposed, through partnering the findings of the study with the TPACK model and other scholarship. Literature suggests that the challenges associated with

implementation of the DTC – confidence, skill and pedagogy, can be addressed through teachers developing their content knowledge, technological knowledge and curriculum integration.

The findings highlight the need for ongoing, tailored professional learning and development (PLD) opportunities to address teacher anxieties and build confidence and competence in delivering the DTC. It is hoped that the findings of this research will assist teachers and leaders to move through the challenges of implementing the DTC and develop effective Digital Technologies programmes for their learners.

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Terminology

AO	Achievement Objective
CK	Content Knowledge
BDT	Bloom's Digital Taxonomy
BES	Best Evidence Synthesis Iteration
CTDT	Computational Thinking for Digital Technologies
DDDO	Designing and Developing Digital Outcomes
DT	Digital Technologies
DTC	Digital technologies content in the New Zealand Technology Curriculum
DTCIT	Digital Technologies Content Implementation Tool
DTIST	Digital Technology Implementation Support Tool
EP	Education Perfect
ERO	Education Review Office
ICT	Information Communication Technology
LCF	Leadership Capability Framework
MoE	Ministry of Education
PK	Pedagogical Knowledge
PLD	Professional Learning and Development
PO	Progress Outcome
TK	Technological Knowledge
TKI	Te Kete Ipurangi
TPACK (TPCK)	Technological Pedagogical Content Knowledge

Chapter One: Introduction

This thesis investigates the implementation of digital technologies content (DTC) within the New Zealand Technology Curriculum, a pivotal and relatively recent development in the country's education system. The integration of digital technologies, formalised with the introduction of Computational Thinking for Digital Technologies (CTDT) and Designing and Developing Digital Outcomes (DDDO) into the curriculum in 2018, was designed to prepare students with essential digital skills for the 21st century. However, as with any curriculum change, there have been challenges with implementation.

The central research question guiding this study is: How do schools implement effective digital technologies programmes? Supporting this inquiry are three sub-questions:

- What are the rationales and purposes for digital technologies programmes in New Zealand middle schools?
- How do teachers support the implementation of effective digital technologies programmes?
- What leadership actions are associated with effective digital technologies programmes?

This research focuses on middle schools (i.e. schools comprised of Year 7 and 8 students), where teachers often possess specialised knowledge in digital technologies. By drawing on the insights and experiences of teachers and leaders, the study explores the complexities of implementing effective digital technologies programmes, addressing challenges related to teacher confidence, pedagogical expertise, and the practical application of digital technologies.

Recognising the pivotal role of leadership in navigating these challenges, this study considers various frameworks for effective implementation. Models such as the Technological Pedagogical Content Knowledge (TPACK) framework and Bloom's Digital Taxonomy are examined alongside leadership tools such as the Raranga Matihiko Kaiako Framework and the Digital Technologies Implementation Support Tool provided by the Ministry of Education (MoE). Additionally, the research highlights the critical role of professional learning and development (PLD) in equipping teachers to successfully implement DTC programmes.

Utilising a qualitative Case Study approach, this thesis examines the perceptions and practices of teachers and school leaders regarding DTC implementation. Data was collected through a combination of focus groups, document analysis, classroom observations, and interviews to ensure a comprehensive and nuanced understanding of the subject. These methods explore the rationales for integrating digital

technologies into middle school programmes, how teachers design and implement effective programmes, and the leadership actions that support these efforts.

By addressing these themes, this research aims to contribute to the growing body of knowledge on the implementation of effective DTC programmes in New Zealand middle schools. It underscores the need for teachers to build their confidence, skills, and pedagogy while working within environments guided by strong and strategic leadership.

This thesis investigates the implementation of effective digital technology programmes in schools. Following this introduction, Chapter Two reviews relevant literature, and Chapter Three details the research methodology, including case selection, participant information, research design, and data collection methods. Chapter Four then presents the research findings, organised into two main themes and eight subthemes. Chapter Five analyses these findings in relation to existing literature, providing a deeper understanding of the identified themes. Finally, Chapter Six discusses the implications of this research for teachers, school leaders, and policymakers, ultimately seeking to answer the central research question: How do schools implement effective digital technologies programmes?

Chapter Two: Literature Review

Introduction

Kia whakatōmuri te haere whakamua

I walk backward into the future with my eyes fixed on my past (Rameka, 2016, p. 387).

Over the last two decades, digital technologies (DT) have undergone a significant transformation. The rapid pace of technological advancement has increased the scope and application of DT, which has paved the way for the inclusion of a digital technologies component into technology education in New Zealand schools. However, introducing digital technologies into the technology learning area, referred to in this review as the digital technologies content (DTC) has created more questions than answers about effectively implementing digital technologies into learning programmes. Adding two technological areas – with technical language, abstract concepts, and open-ended learning outcomes – to the existing Technology Curriculum has presented a challenge to schools, leaders and teachers. This change has required teachers to develop their knowledge, capability, confidence and the pedagogical skills to teach digital technologies effectively. Furthermore, leaders are charged with preparing, leading and innovating this change in their schools; regardless of their skill or will.

The potential for pedagogical efficacy in this field can be optimised by examining the insights and evidence accumulated by those who have pioneered digital technology practice and integration. Middle schools (i.e. schools comprised of Year 7-8 students) are of particular interest to me because these schools tend to have teachers with specialised knowledge and understanding of digital technologies. This literature review explores the link between the DTC and global effective digital technologies practice, specifically focusing on how middle schools can effectively implement effective DT programmes.

Looking Back - He Tirohanga Kōmuri

What is Digital Technologies?

ICT (Information and Communication Technology), e-learning (electronic learning), and Digital Technologies are interconnected within the realm of technology in education, yet each holds distinct meanings and emphases. The Ministry of Education (MoE) refer to these three terms across publications (MoE, 2008, n.d.g; Te Kete Ipurangi, n.d.-e). ICT is a historical term, predominantly used to refer to digital

devices such as computers, phones, the internet, and software like word processors and presentation tools (UNESCO, 2007). Knowledge and understanding of how to use ICT hardware and software effectively supports users to execute skills such as online information retrieval and digital communication (MoE, 2008). On the other hand, e-learning utilises ICT to deliver and facilitate learning experiences (Rhodes & Calder, 2022). The central emphasis in e-learning lies in leveraging technology to augment learning, enhancing accessibility, engagement, and personalisation (MoE, n.d.g). Digital technologies, as a broader term, encapsulates both ICT and the foundational principles underlying the functionality of these technologies. DT's focus extends beyond technical skills, to include critical thinking abilities such as computational thinking, problem-solving, and creativity (Rhodes & Calder, 2022). Students engaging with DT delve into understanding technologies' design, functionality and applications to create novel solutions (MoE, 2017a, 2018b; TKI, n.d.-c). While ICT establishes the foundation, e-learning builds upon it by leveraging ICT tools to facilitate learning, and DT explores the intricacies and rationales behind their functioning. All three elements are integral to cultivating digital literacy and equipping students for success in a technology-driven world; these together form the backbone of our New Zealand DTC. (MoE, 2017a, 2018b; TKI, n.d.-c).

Digital technologies, e-learning, and ICT provide a solid foundation for this literature review, but the field encompasses a broader range of terminology which includes, but is not limited to, the following expressions: digital learning, digital literacy, digital fluency, and digital citizenship. *Digital learning* is a vast field that includes using technology to learn and learning about technology and how it shapes learning. It goes beyond basic computer skills, aiming to develop fluency and ultimately, the ability to leverage technology effectively for learning (Forbes, 2019; Rennie & Smyth, 2019). *Digital literacy* is a core component of digital learning. It refers to the ability to find, evaluate, and create digital content meaningfully, requiring critical thinking and information literacy skills (National Library of New Zealand, n.d.). *Digital fluency* builds upon digital literacy and encompasses the confidence and proficiency needed to navigate digital environments and utilise technology effectively (TKI, n.d.-d). Finally, *digital citizenship* focuses on responsible and ethical behaviour within the digital world, encompassing aspects like online safety, privacy, and positive communication, it is underpinned by principles such as: ako, the combination of teaching and learning; whanaungatanga, relationships; and manaakitanga, wellbeing and respect (Netsafe, 2018). Grasping these interconnected terms facilitates a more comprehensive understanding of the dynamic relationship between digital technologies and the evolving educational landscape.

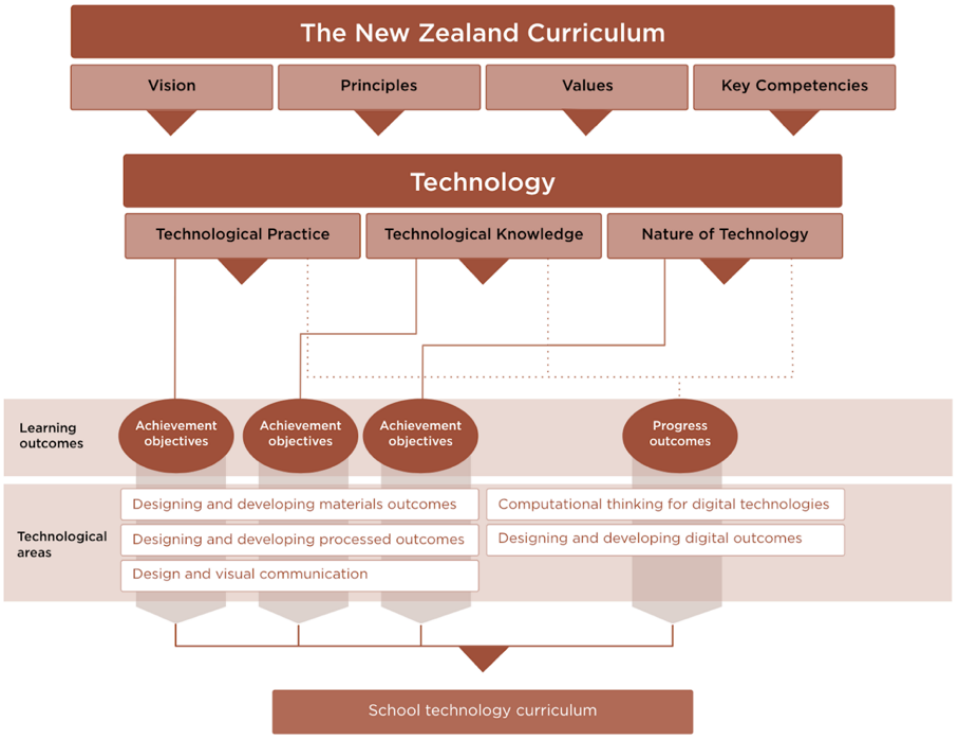
The History of the DTC

The incorporation of Digital Technologies and Hangarau Matihiko into the Technology Curriculum in 2018 marked a significant shift in the emphasis placed on technology education in New Zealand. Recognising the increasing relevance of digital skills in the 21st century, the Ministry of Education (MoE) adopted a strategic approach to strengthen the existing Technology Curriculum rather than establish a completely new one (MoE, 2017a). The DTC became mandatory for Years 1-10 in 2020 after a trial period (Education Review Office, 2019). The integration of DT into the Technology Curriculum involved the expansion of the three technology strands into five distinct technological areas. Figure 1 shows the addition of Computational Thinking for Digital Technologies (CTDT) and Designing and Developing Digital Outcomes (DDDO) to the learning area structure (MoE, 2018b). This broadened the scope of the curriculum, providing students with a more comprehensive understanding of digital technologies (MoE, 2018a).

Furthermore, the introduction of progress outcomes (POs) specific to CTDT and DDDO replaced the previous achievement objectives (AOs) (MoE, 2018a). This change aimed to provide a developmental lens for designing digital technologies programmes, focusing on the "significant learning steps students take as they develop their expertise" (MoE, 2018a, p. 4). Moreover, because digital technologies were nested within the Technology Curriculum and the POs began with the phrase "in authentic contexts…" there was an implication that they would be integrated across other strands and curriculum learning areas (Crow et al., 2019; Kellow, 2018). In essence, the revised curriculum design prioritised the development of digitally capable individuals adept at producing and utilising technology and innovating and creating solutions across various contexts (MoE, 2017a, 2018a; Te Kete Ipurangi, n.d.-c). This shift reflected the increasingly digital nature of our society and aimed to equip students with the skills needed to thrive in an interconnected world.

Figure 1

Learning Area Structure



Note. This content, along with all future curriculum-based content in this thesis has been migrated from the original TKI/Technology Online sites, to the new Tahurangi site. Therefore, the links provided in the Figures, Tables and references section will be redirected to Tahurangi. From Technology in the New Zealand Curriculum, by Ministry of Education, 2018b. (https://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Technology/Learning-area-structure#collapsible1). Used according to Crown Copyright legislation.

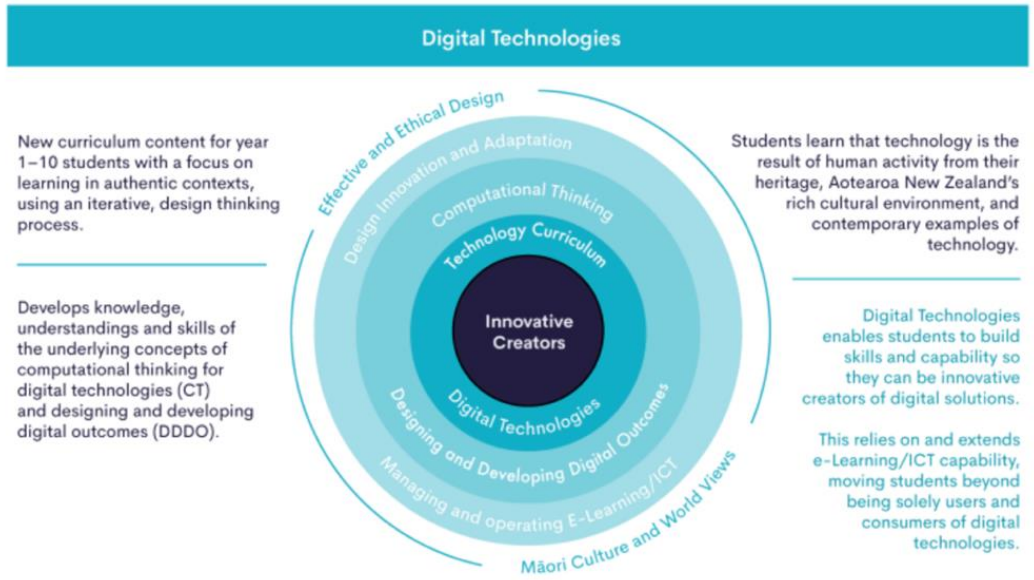
Over the past two decades, our understanding of effective technologies education in New Zealand has significantly transformed. This shift mirrors the exponential pace of technological advancement, catapulting us from the era of floppy disks into the 'cloud'. As recently as 20 years ago, classroom programmes focused on attaining ICT competencies as the definitive digital goal (Eickelmann, 2011). E-learning was a natural progression, paving the way for evolving pedagogical approaches and terminologies (Crow et al., 2019; Ertmer & Ottenbreit-Leftwich, 2010). Presently supporting students to become "digitally capable thinkers, producers, and creators of innovative digital solutions" (MoE, 2020, p.10) is the paramount digital aspiration of the New Zealand education system. Nevertheless, even though digital technologies build upon and expand our prior understanding of technologies learning,

adding a vital layer of depth and complexity, they do not negate the requirement for ICT, e-learning or other related digital terms discussed previously.

While ICT and e-learning are not synonymous with DT, it is crucial to recognise that they are components within the broader DT framework (MoE, n.d.g). For example, ICT and e-learning can be used in a DT programme when students create an electronic portfolio to demonstrate their understanding of block coding skills such as loops, conditionals and variables. Creating content with a specific purpose and intended audience aligns closely with the core principles of DT. However, achieving this task requires proficiency in utilising fundamental ICT skills such as screenshotting, use of Google Drive, and computer navigation to access the necessary applications and platforms. Despite the importance of the foundation skills of ICT and e-learning, solely focusing on their development would be deemed insufficient in a holistic DT programme. In other words, these systems are interdependent. Thus, to support comprehensive understanding, the literature sourced for this review includes scholarship related to ICT, e-learning, DT and other related terminology. This approach is employed by Duncan et al. (2017) and reinforced by a diagram provided by the MoE (n.d.g) in Figure 2, which illustrates the layers of the new DTC and the integration of ICT and e-learning.

Figure 2

Digital Technologies



Note. From Kia Takatū ā-Matahiko: Digital Readiness, by Ministry of Education, n.d.g. (https://technology.tki.org.nz/content/download/37863/191473/file/E-Learning_ICTCapacity%20visual%20v0.8-07-07%20(1).pdf). Used according to Crown Copyright legislation.

Frameworks and Models

Frameworks and models provide a helpful starting point for teachers and leaders looking to implement change. They provide vital concepts based on research and best practice relevant to the topic. Furthermore, they adapt to the context and individual requirements whilst giving structure. This section discusses conceptual frameworks relevant to implementing the DTC in middle school programmes.

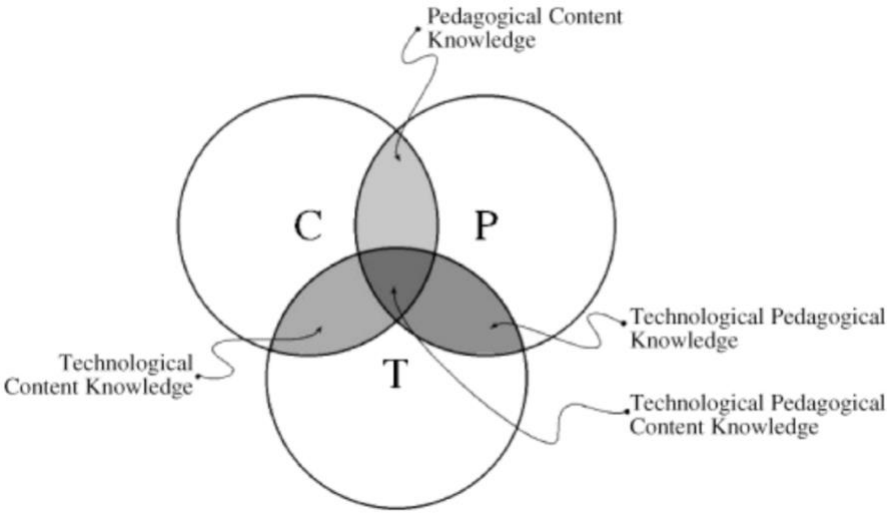
New Zealand teachers have utilised various models to support the implementation of the DTC. These include the Substitution Augmentation Modification Redefinition (SAMR) model, developed by Dr Ruben Puentedura (MoE, n.d.-f) and the Technological Pedagogical Content Knowledge (TPCK, or TPACK) model (Mishra & Koehler, 2006), based on the seminal work of Shulman (1986). There are many other models to do with digital technologies, including, but not limited to, the Innovative Digital School Model (IDI) (Ilomäki & Lakkala, 2018), Bloom's Digital Taxonomy (Churches, 2008), Replace, Amplify and Transform (RAT) (Kimmons & Hall, 2018) and Passive, Interactive, or Creative and Replace, Amplify, Transform (PICRAT) (Kimmons et al., 2020). The models chosen to frame this study are TPACK and Bloom's Digital Taxonomy. I selected these models because each aligns with the essence of the DTC and provides a clear framework for effective digital technology integration. These models will be unpacked further in the following section and used to frame New Zealand literature about the DTC in the review's 'Looking Forward' section.

TPACK

The TPACK model is grounded in the philosophy that "teaching is a highly complex activity that draws on many kinds of knowledge" (Mishra & Koehler, 2006, p. 1020). It illustrates how effective teaching requires understanding the interdependence between technology, pedagogy and content. Its design aims to support effective technological practice, which is not synonymous with implementing the DTC. However, whilst this model does not encompass the entirety of establishing effective DT programmes, its qualities and components will most certainly support an understanding of how to scaffold these. Figure 3 shows the components of the TPACK model (Mishra & Koehler, 2006), content knowledge (CK), technological knowledge (TK) and pedagogical knowledge (PK), and the interconnection between these components.

Figure 3

Technological Pedagogical Content Knowledge (TPCK) Framework



Note. Framework for effective technological practice. From *Technological pedagogical content knowledge: A framework for teacher knowledge*, by P. Mishra, and M. J. Koehler, 2006, Sage Publications. (https://doi.org/10.1111/j.1467-9620.2006.00684.x). Copyright 2013 by Teachers College, Columbia University.

Content knowledge

"Content knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught" (Mishra & Koehler, 2006, p. 1026). Subject teachers require knowledge about facts, theories and concepts relevant to their field to develop successful programmes.

Technological Knowledge

Technology knowledge (TK) is up-to-date knowledge about technologies in education. Evolving technologies necessitate teachers' ongoing learning to incorporate these technologies deliberately into learning programmes (Mishra & Koehler, 2006).

Pedagogical Knowledge

"Pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims" (Mishra & Koehler, 2006, p. 1026). Depth of pedagogical knowledge means teachers know how students learn and acquire skills (Mishra & Koehler, 2006). This pedagogical knowledge

informs how teachers weave their technological and content knowledge meaningfully to scaffold student understanding.

Mishra and Koehler (2006) argue that the full effect of this model is visible when concepts overlap. For example, when Technological Knowledge and Content Knowledge overlap, a teacher decides how to use technologies to support the learning of their curriculum content. Furthermore, they claim that effective practice happens when all three concepts overlap in the model's centre.

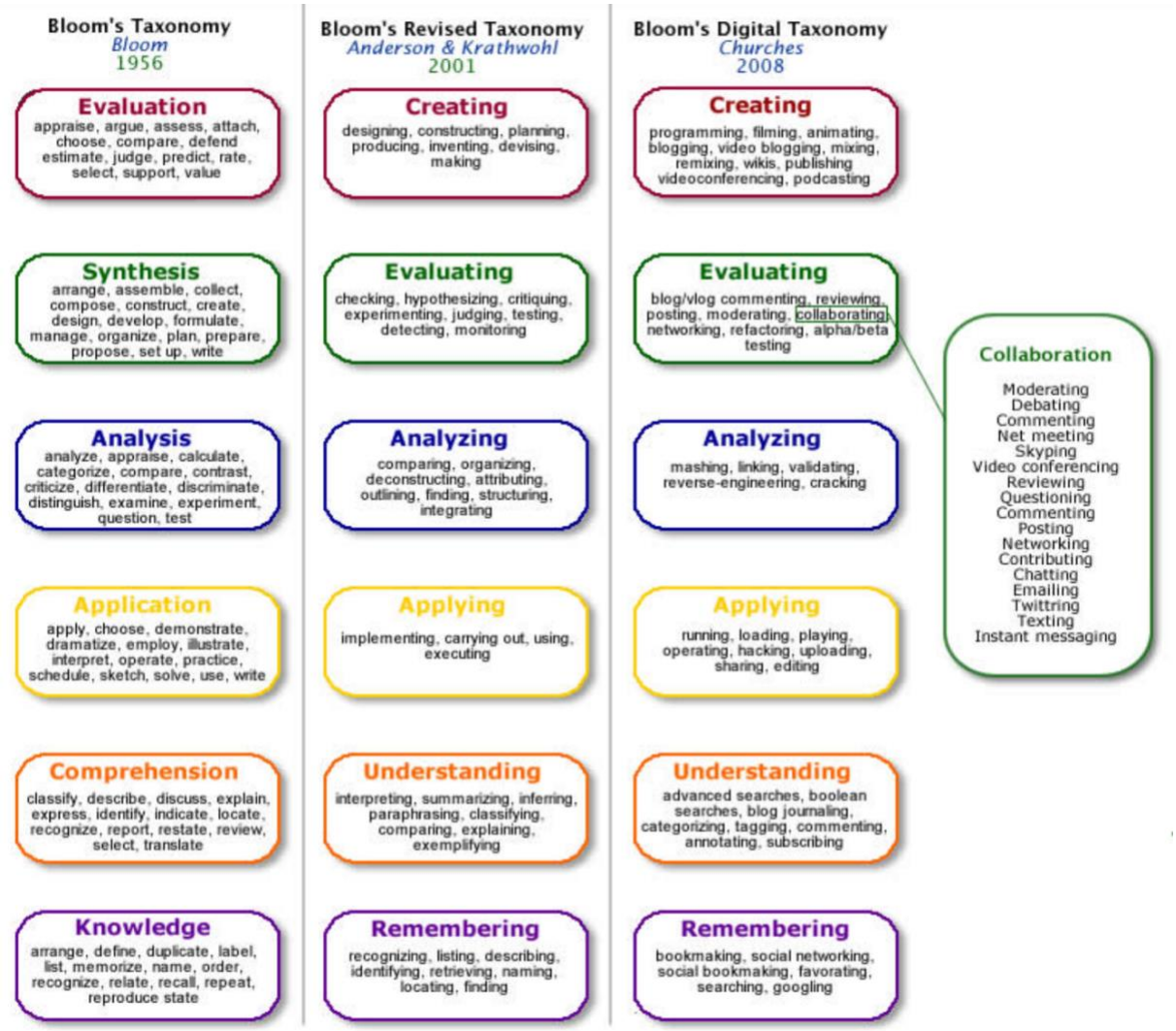
The ‘Looking Forward’ section of this review will take a closer look at the TPACK model in the context of the DTC.

Bloom’s Digital Taxonomy

Initially established in 1956 by Bloom, Bloom’s Taxonomy underwent revisions by Anderson and Krathwahl in 2001, with Churches (2008) further adapting it to incorporate digital technologies in 2008. Figure 4 illustrates the comparative evolution from the original taxonomy to the iteration proposed by Churches (Gonzalez-Major & Albright, 2008). This comparison reveals how digital technologies support learning at each cognitive level within learning programmes.

Figure 4

Comparison of three taxonomies



Note. Framework for effective technological practice. From *Modifying Bloom's taxonomy to meet 21st century pedagogies*, by Gonzalez-Major, J. & Albright, A, 2008. (https://www.rsu.lv/sites/default/files/documents/PIC/Publikacijas/Bloom's%20Digital%20Taxonomy.pdf). In the public domain.

Bloom's Digital Taxonomy (BDT) promotes a shift from memorisation to critical thinking and creation. By adding key verbs to each taxonomic element, Churches (2008) enhanced its practicality for teachers. The model's visual structure also empowers teachers to build strong programmes by clearly identifying higher-order thinking skills. Notably, the underlying premise of BDT assures teachers that neither step is independent of the previous one:

> Before we can **understand** a concept we have to r**emember** it
>
> Before we can **apply** the concept we must **understand** it
>
> Before we **analyse** it we must be able to **apply** to
>
> Before we can **evaluate** it we must have **analysed** it
>
> Before we can **create,** we must have **remembered, understood, applied, analysed,**
>
> and **evaluated.** (Churches, 2008, p. 5)

While Bloom's Digital Taxonomy addresses the integration of Information and Communication Technology (ICT) into the classroom (Churches, 2008), it was not explicitly designed to support the implementation of the DTC. The acknowledgement that all levels of the taxonomy are essential is a vital component of this model. This is complementary to the MoE's (n.d.g) argument about ICT, e-learning and digital technologies being interdependent. Both Bloom's Digital Taxonomy and the MoE's approach emphasise the need for foundational skills (remembering, understanding and applying in Bloom's; and ICT skills in the DTC), before students can achieve higher-order skills (analysing, evaluating and creating in Bloom's; and creating digital outcomes in the DTC).

Bloom's Digital Taxonomy and the DTC share a common goal of empowering students as creators, making them ideal complements. Both frameworks encourage students to move beyond being passive technology consumers to active creators who can think critically about the digital tools they use. The higher levels of Bloom's Digital Taxonomy prompt learners to analyse the strengths and weaknesses of digital tools, rather than accept their functions. Similarly, the DTC requires students to design and develop their own digital solutions, fostering a culture of innovation and creativity. By emphasising critical thinking and creativity, both Bloom's Digital Taxonomy and the DTC promote deeper learning, where individuals can apply their knowledge to practical problems. Through integrating Bloom's Digital Taxonomy with the DTC, educators can design learning experiences that develop individuals' digital literacy beyond basic tool usage, fostering critical thinking and problem-solving skills that lead to innovation and solution design.

Whilst Bloom's Digital Taxonomy does not provide all the answers to the implementation of effective DT programmes, when aligned with the DTC, components of this model can certainly support our understanding of how higher-order thinking skills and the incorporation of modern pedagogies can lead to effective programmes.

Leadership

Change Leadership Theories and Models

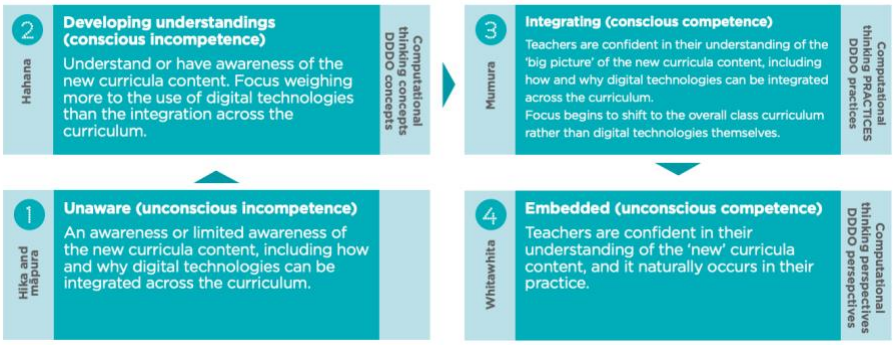
Strong leadership is imperative in periods of organisational change. There are many theories and models designed to describe practical ways to guide organisations through the change process, including, but not limited to, the ADKAR Model (Tang, 2019), Kotter's 8-Step Change Model (Tang, 2019), the Three Dimensions of Change model (Manucci, 2013), Appreciative Inquiry (Giles & Kung, 2010) and the Conscious-Competence model (Brennan & Resnick, 2012) which underpinned the Raranga Matihiko Kaiako Framework (MoE, 2019) and subsequent Digital Technologies Implementation Support Tool (MoE, 2019). While all models were considered for their relevance to this research, the Raranga Matihiko Kaiako Framework and the Digital Technologies Implementation Support Tool were ultimately chosen as the lens for analysing the literature. This selection aligns with the MoE's use of these frameworks to support schools implementing the DTC.

Raranga Matihiko Kaiako Framework

The Raranga Matihiko Kaiako Framework builds upon the Conscious Competence Ladder created by Noel Burch in the 1970s (MoE, n.d.-d) and is underpinned by the Conscious Competence model suggested by Brennan and Resnick (2012). The Raranga Matihiko Kaiako Framework, shown in Figure 5, starts by acknowledging the unconscious incompetence of the organisation concerning the implementation of the DTC and progresses through the conscious incompetence and conscious competence stages to arrive at the unconscious competence stage (MoE, 2019).

Figure 5

The Raranga Matihiko Kaiako Framework



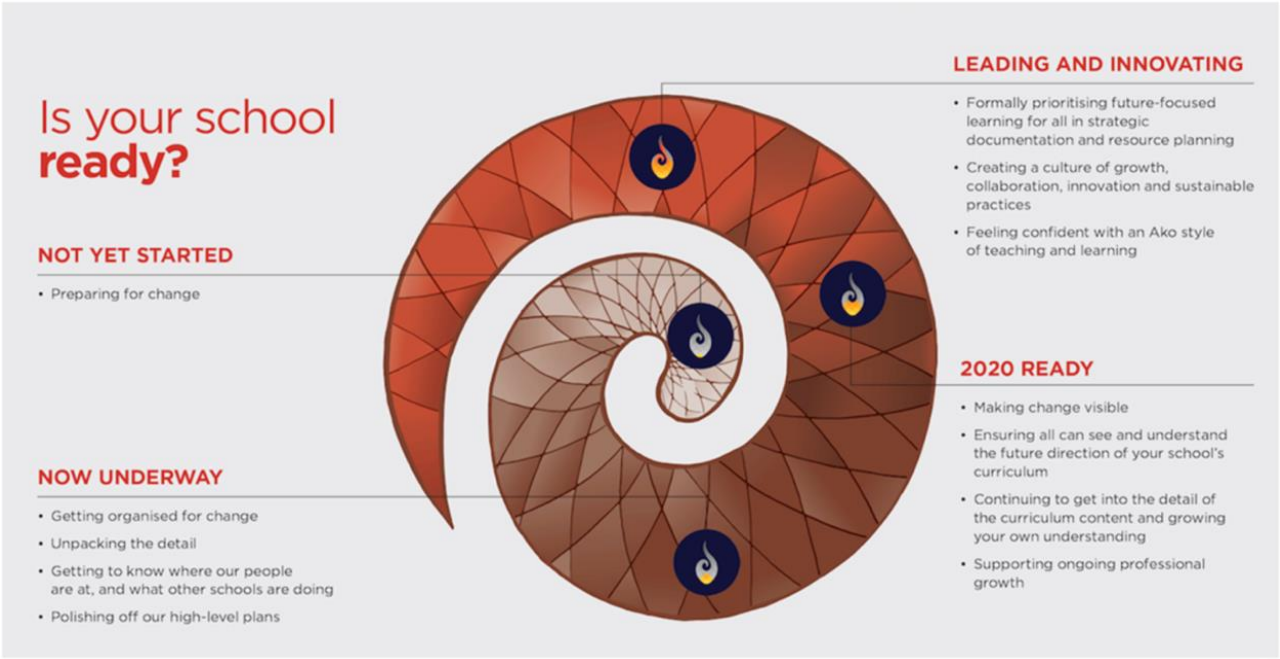
Note. From *Digital technologies in the revised technology learning area: Supporting your school's journey in 2020*, by Ministry of Education, 2019. (https://technology.tki.org.nz/content/download/38590/196830/file/DT%20implementation%20support%20tool%202020d.pdf). Used according to Crown Copyright legislation.

Digital Technologies Implementation Support Tool

In preparation for the implementation of the Digital Technologies content into the Technology Curriculum, the MoE disseminated a Digital Technologies Implementation Support Tool (DTIST) to leaders of New Zealand schools (MoE, n.d.-c), which included a Implementation Process Diagram derived from the Raranga Matihiko Kaiako Framework, shown in Figure 6 (MoE, 2019). The diagram and supporting documentation aimed to support schools to assess their readiness for the upcoming implementation of the DTC by outlining four distinct phases of the implementation process. These phases aligned strongly to the four phases in the Raranga Matihiko Kaiako Framework. They included the: not yet started, now underway, 2020 ready and leading and innovating phases. Each phase in the Digital Technologies Implementation Support Tool offered detailed guidance for schools, leaders and teachers on the characteristics and requirements of its corresponding phase.

Figure 6

The Digital Technologies Implementation Process Diagram



Note. From *Supporting your school's journey in 2020*, by Ministry of Education, 2019. (https://technology.tki.org.nz/content/download/38590/196830/file/DT%20implementation%20support%20tool%202020d.pdf). Used according to Crown Copyright legislation.

It seems reasonable to conclude that the MoE understood the value of prioritising strong leadership for the DTC rollout. Each phase of the Digital Technologies Implementation Support Tool outlined specific

next steps for leaders, including principles and practices such as: evaluating teacher knowledge, capacity and confidence; providing access to professional learning for teachers; and supporting innovative practices and ako. These principles and practices appear to have been included deliberately due to their empirical efficacy in New Zealand-based literature. The following section explores specific leadership practices in more detail.

Leadership Practices

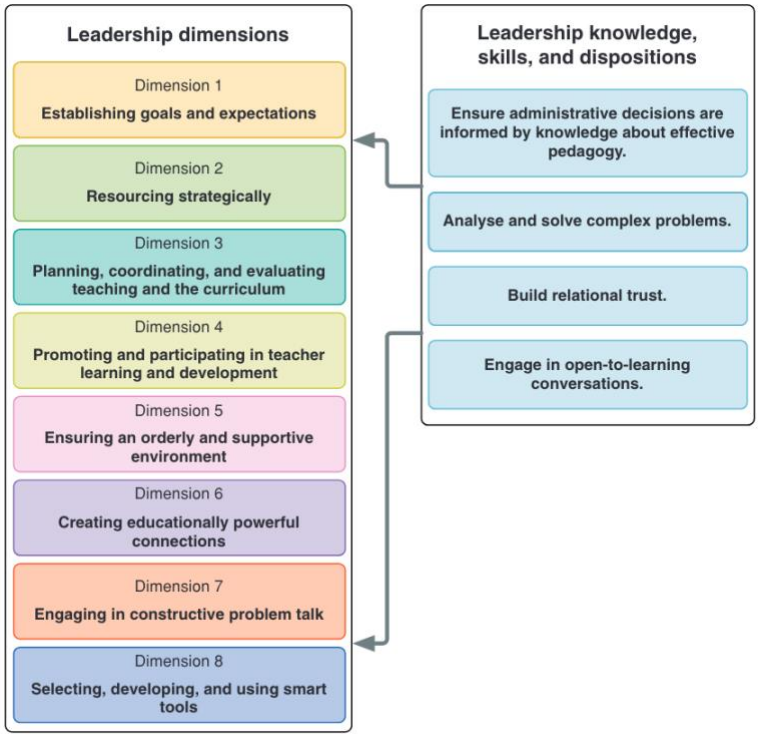
Effective leadership practices are essential when navigating and implementing organisational change. New Zealand has a collection of seminal literature on effective leadership practices, such as School leadership and student outcomes (Robinson et al., 2009), Leading from the middle: Educational leadership for middle and senior leaders (MoE, 2012) and the Leadership capability framework (LCF) (Education Council, 2018a). These documents collectively emphasise the criticality of leaders' qualities and actions to their organisations' success. While it is recognised that all the models and ideas in the literature may not be currently relevant, they offer valuable traits that are worth taking into consideration when it comes to the actions of leaders in the realm of digital technologies. These will be explored below.

Dimensions of Effective Leadership

A Best Evidence Synthesis iteration (BES) was developed in 2009 to explore how leaders can influence student outcomes. It "draws together bodies of research evidence to explain what works and why" (Robinson et al., 2009, p. ii) and emphasises its "crucial support for school leaders as they address our shared challenge of preparing all our children for the future" (Robinson et al., 2009, p. ii). Figure 7, below, illustrates the dimensions of effective leadership as established in the BES research (Robinson et al., 2009).

Figure 7

The dimensions of effective leadership, together with the associated knowledge, skills, and dispositions



Note. From *School leadership and student outcomes: Identifying what works and why*, by V. Robinson, M. Hohepa, C. Lloyd, 2009 (https://www.educationcounts.govt.nz/__data/assets/pdf_file/0015/60180/BES-Leadership-Web-updated-foreword-2015.pdf). Used according to Crown Copyright legislation.

The Leadership Capability Framework

The leadership Capability Framework (LCF) was developed to strengthen educational leadership in New Zealand. The document provides guidelines to support a shared understanding of what leadership may look like in an educational organisation. The LCF considers various spheres of influence in the framework by dividing the dimensions into organisational, middle, and teacher leadership. The authors explicitly state that the list is not exhaustive and that the capabilities will evolve over time (Education Council, 2018a).

The Education Council (2018a) identifies nine Educational Leadership Capabilities, including: building and sustaining high trust relationships; ensuring culturally responsive practice and understanding of Aotearoa New Zealand's cultural heritage, using Te Tiriti o Waitangi as the foundation; building and sustaining collective leadership and professional community; strategically thinking and planning;

evaluating practices in relation to outcomes; adept management of resources to achieve vision and goals; attending to their own learning as leaders and their own wellbeing; embodying the organisation's values and showing moral purpose, optimism, agency, and resilience; contributing to the development and wellbeing of education beyond their organisation.

The LCF provides a comprehensive framework for educational leaders to develop their leadership capabilities and enhance their performance. Its emphasis on building trust, fostering a sense of community, and promoting cultural responsiveness reflects the unique context of New Zealand's educational system. The document is a valuable resource for educational organisations seeking to improve their leadership practices and create positive community outcomes (Education Council, 2018a).

The New Zealand education sector has long emphasised the significance of effective leadership practices. Therefore, it is crucial for us to consider these practices when exploring the implementation of successful digital technology programmes in schools. Subsequent sections of this review will further examine the correlation between the models and practices outlined in this section and the proficient implementation of the DTC.

Here and Now – Te wā Nāinei

Our New Zealand Curriculum

The present structure of the New Zealand DTC has its foundation in the technological areas of Computational Thinking for Digital Technologies (CTDT) and Designing and Developing Digital Outcomes (DDDO). In CTDT, eight progress outcomes (POs) are distributed across the eight curriculum levels. Similarly, DDDO has six progress outcomes spread across the eight curriculum levels. As middle schools generally focus on levels 3 and 4 of the curriculum, they typically support two progress outcomes for CTDT and one progress outcome for DDDO. Notably, as illustrated in Figures 8 and 11, these are not aligned one-to-one with the curriculum levels (MoE, 2018b). The curriculum's current structure, thus, accounts for the varying time required for the achievement of each outcome (MoE, 2017a). The DTC's emphasis on CTDT and DDDO as the core components lays the foundation for imparting digital literacy and equipping students with the necessary skills to navigate the constantly evolving digital landscape (Chen, 2017).

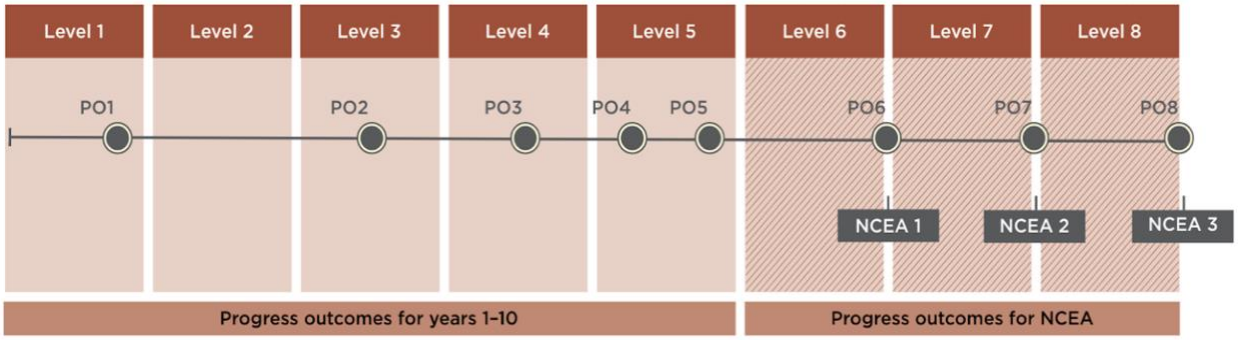
The current alignment between the New Zealand Curriculum (NZC) levels 1-5 and the digital technologies progress outcomes is considered provisional. This initial alignment is based on theory, not teacher

experience. The MoE (2017a) suggest that they expect to further refine the position of the POs once teachers have implemented the digital progressions in classrooms. Though, seven years after publication, there appears to be no evidence of this happening any time soon.

Computational Thinking for Digital Technologies

Figure 8

Computational Thinking (CTDT) for Digital Technologies



Note. From *Technology in the New Zealand curriculum*, by Ministry of Education, 2018, (https://nzcurriculum.tki.org.nz/content/download/168478/1244184/file/NZC-Technology%20in%20the%20New%20Zealand%20Curriculum-Insert%20Web.pdf). Used according to Crown Copyright legislation.

The MoE (2018a) states that CTDT is about "understanding the computer science principles that underlie all digital technologies and learning how to develop instructions, such as programming, to control these technologies" (p. 5). In a middle school, Progress Outcomes 2 and 3 are likely to be the focus of a DT programme; these are outlined below:

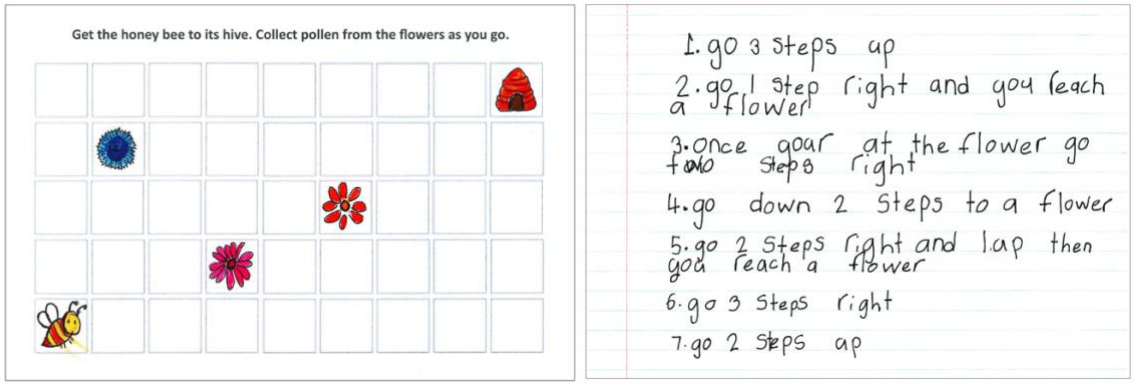
> Progress outcome 2: In authentic contexts and taking account of end-users, students give, follow and debug simple algorithms in computerised and non-computerised contexts. They use these algorithms to create simple programs involving outputs and sequencing (putting instructions one after the other) in age-appropriate programming environments.
>
> Progress outcome 3: In authentic contexts and taking account of end-users, students decompose problems into step-by-step instructions to create algorithms for computer programs. They use logical thinking to predict the behaviour of the programs, and they understand that there can be more than one algorithm for the

> same problem. They develop and debug simple programs that use inputs, outputs, sequence and iteration (repeating part of the algorithm with a loop). They understand that digital devices store data using just two states represented by binary digits (bits). (MoE, 2018b, p. 11)

Teachers can access exemplars of classroom activities to help students understand the CTDT outcomes at PO 2 and 3 (MoE, n.d.-a). These exemplars include information on student understanding, the task itself, the learning task's background, and student-teacher interactions during the task. These resources can assist teachers in identifying appropriate learning activities to facilitate in the classroom. One exemplar called 'Getting to the hive' covers Progress Outcome 2. In this task students write an algorithm (set of instructions) for a bee to follow, to collect pollen from flowers and get to the hive. This task is initially unplugged, which means it does not use a computer. This task and student response can be seen in Figure 9, below.

Figure 9

Getting to the hive task and student response



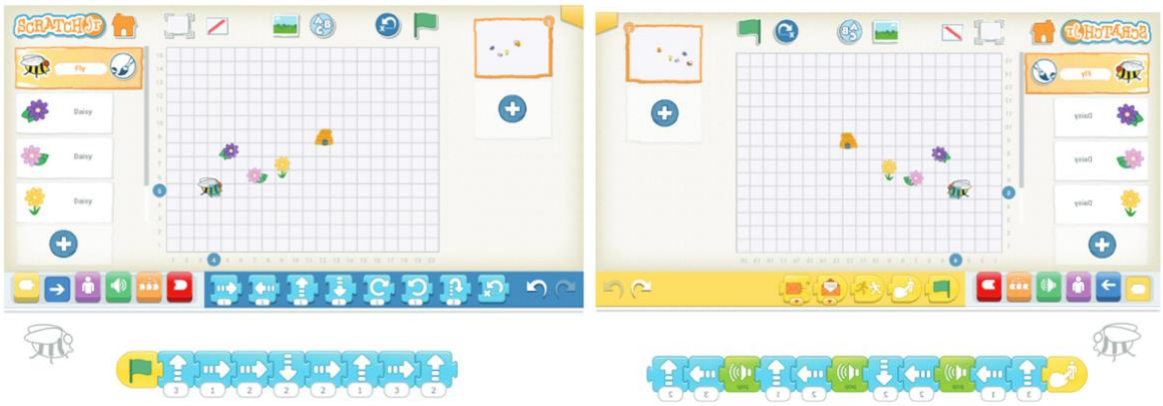
Note. From *Computational thinking for digital technologies: Exemplar 3*, by Ministry of Education, 2017. (https://technology.tki.org.nz/content/download/37491/188853/file/A0224_%20Ex%203_CT_Getting%20to%20the%20hive_008.pdf). Used according to Crown Copyright legislation.

From here, students are asked to put their algorithms into a programming environment called ScratchJr, which the teacher has put a template of the grid into. Students should then test the algorithm and make the program more interesting for the user. At the testing point, the student noted that they had made an error in their algorithm, using left instead of right. In locating and fixing this error, the student debugged their work. Figure 10 demonstrates what the program looks like after debugging, before and after

making the program more interesting for their user. The student was able to add sound outputs when the bee landed on the flower to represent taking the pollen.

Figure 10

ScratchJr Program before and after adding outputs



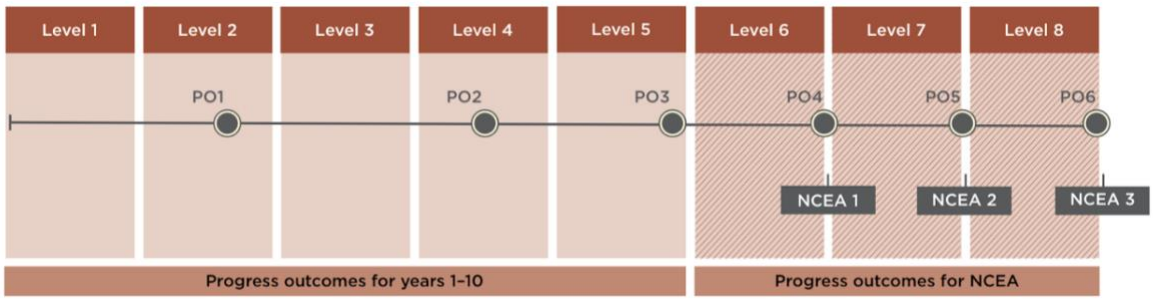
Note. From *Computational thinking for digital technologies: Exemplar 3*, by Ministry of Education, 2017. (https://technology.tki.org.nz/content/download/37491/188853/file/A0224_%20Ex%203_CT_Getting%20to%20the%20hive_008.pdf). Used according to Crown Copyright legislation.

This task is representative of the types of activities that students can do to achieve CTDT Progress Outcome 2, by demonstrating understanding of decomposition, algorithms, creating programs including sequence and output, and debugging, with consideration of end users. It also integrates well with English (instruction-giving and following) and Mathematics and Statistics – the positional language of Geometry (Kellow, 2018).

Designing and developing Digital Outcomes

Figure 11

Designing and Developing Digital Outcomes (DDDO)



Note. From *Technology in the New Zealand curriculum*, by Ministry of Education, 2018, (https://nzcurriculum.tki.org.nz/content/download/168478/1244184/file/NZC-Technology%20in%20the%20New%20Zealand%20Curriculum-Insert%20Web.pdf). Used according to Crown Copyright legislation.

The MoE (2018a) states that DDDO is about "understanding that digital systems and applications are created for humans by humans and developing knowledge and skills in using different digital technologies to create digital content across a range of digital media" (p. 5). In a middle school, Progress Outcome 2 is likely to be the focus of a DT programme. This is outlined below:

> Progress outcome 2: In authentic contexts and taking account of end-users, students make decisions about creating, manipulating, storing, retrieving, sharing and testing digital content for a specific purpose, given particular parameters, tools, and techniques. They understand that digital devices impact on humans and society and that both the devices and their impact change over time. Students identify the specific role of components in a simple input-process-output system and how they work together, and they recognise the "control role" that humans have in the system. They can select from an increasing range of applications and file types to develop outcomes for particular purposes. (MoE, 2018b, p. 13)

Teachers can access exemplars of classroom activities to help students understand the DDDO outcomes at Progress Outcome 2 (MoE, n.d.-b). These exemplars include information on student understanding, the learning task's background, the task itself, and student-teacher interactions during the task. These resources can assist teachers in identifying appropriate learning activities to facilitate in the classroom, including integration with other curriculum areas, such as music and English (Kellow, 2018). One exemplar 'Video of a system' covers Progress Outcome 2. In this task students write a script, film, edit and export their film to demonstrate their knowledge about the role of the central processing unit (CPU), which processes the data sent by instructions from computer programs. Images and an explanation of how students completed some of this task are shown below in Figure 12.

Figure 12

Video of a System Activity

Ruby writes a message and says, "Give the computer this as an input." Rhiannon puts it into the "computer" by handing it to Computer-Shakira.

A dial-up Internet sound effect plays while Computer-Shakira takes the piece of paper and pushes it into the box.

Computer-Shakira says, "Scanning ... scanning ... processing ... processing. The message says, 'Ruby is cool.'"

The students gasp in amazement.

Zoe asks Ruby to find some colouring-in pages online. She wants a picture of a cat. Ruby says, "I'll use the keyboard to input that. C–A–T, enter."

Note. From *Designing and developing digital outcomes: Exemplar 5*, by Ministry of Education, 2017. (https://technology.tki.org.nz/content/download/37512/188932/file/A0224_%20Ex%205_DDDO_Video%20of%20a%20system_004.pdf). Used according to Crown Copyright legislation.

This task covers a range of skills from Progress Outcome 2, including: independently make decisions about creating, manipulating, storing retrieving and sharing content that has been developed for a specific purpose; understand the particular roles of components in an input-process-output system and how they work together; understand that inputs are transformed into outputs within a system and the "control" role that humans have in this; and use a software application and a range of file types to meet a specific purpose (MoE, 2017b).

Even with the new progress outcomes, exemplars and online content designed to support the implementation of the DTC, introducing this revised curriculum to New Zealand classrooms has not been without challenges.

Challenges

The integration of the DTC into New Zealand schools, like any new initiative, has had challenges. These challenges, at times, have hindered successful implementation (Stringer et al., 2022). Jenkins (2017) established that "eighty-one percent of teachers agreed or strongly agreed that there would be significant challenges [in implementing the DTC]" (p. 30). Though literature identifies diverse challenges in implementing technologies in schools (Bower & Falkner, 2015; Chen, 2017; Duncan et al., 2017; Education Review Office, 2019; Ertmer & Ottenbreit-Leftwich, 2010; Inan & Lowther, 2010; Kellow, 2018; Levin & Wadmany, 2006; Stringer et al., 2022), the most recurring and pertinent for New Zealand middle schools centre around three interconnected factors: teacher confidence, skill, and pedagogy. This section delves into the complexities of these challenges, drawing upon empirical research to illuminate factors that facilitate successful implementation.

Confidence

Despite the intentions of the DTC, teacher concerns regarding their ability to effectively implement programmes pose a significant challenge to successful adoption. Confidence is a crucial attribute for educators, and those who lack confidence in utilising digital technologies themselves are unlikely to prioritise its integration into their classrooms (Inan & Lowther, 2010). Several New Zealand studies further underscore the prevalence of teacher anxiety and a lack of confidence in delivering the DTC (Chen, 2017; Duncan et al., 2017; Education Review Office, 2020). Jenkins' (2017) study found that there appeared to be enthusiasm for the curriculum, yet confidence in delivering the curriculum was low. Furthermore, the Education Review Office (ERO) (2019) researched the barriers schools face when implementing the DTC. This review found that teachers were "on a continuum of confidence when using

digital devices to enhance learning, let alone planning to teach computational thinking or designing and developing digital outcomes" (ERO, 2019, p. 5). These findings highlight the need for effective interventions that address teacher confidence in implementing the DTC.

Research suggests that dedicated professional learning and development (PLD) experiences can effectively address initial teacher anxieties and increase confidence in delivering the DTC. Several New Zealand studies have found that initially uncomfortable teaching DT, participants gained confidence over time through access to timely, needs-based PLD (Chen, 2017; Duncan et al., 2017; Rhodes & Calder, 2022; Mason, et al., 2021; Stringer et al., 2022). Moreover, the MoE commissioned a study prior to the publication of the DTC related to its consistency, connections, adaptability, clarity, future focus and implementation (Chen, 2017). In this study, confidence levels (rated from 1-5) were compared from the beginning of the workshops to the end, and the results showed that participants increased in confidence. Based on this finding, it was acknowledged that "appropriate resources and resourcing in general would be critical to successful implementation [of the DTC]" (Chen, 2017, p. 35). Conclusions can be drawn from this data that teacher confidence is a potential barrier to effective DTC implementation, yet it can be addressed through intentional and timely PLD.

Leadership is vital in supporting teacher confidence in the face of change. The ERO (2020) conducted a study that found that a culture and mindset of openness, learning and innovation nurtured schools implementing effective programmes. This supported teachers in trying components of the programme and growing in confidence. Additionally, they noted that when teachers felt their leadership teams had the curriculum's introduction under control, their anxiety lessened (ERO, 2020). It seems reasonable to conclude that leadership plays a crucial role in enabling teacher confidence and, in turn, supporting the implementation of the DTC.

Skill

Another challenge in implementing the DTC, and perhaps the most common one (ERO, 2019) has been the skill level or content knowledge of teachers. The rapid advancement of digital technology on a global scale has put significant pressure on technology programmes, resulting in challenges for teachers regarding their knowledge and skills. While the DTC has transformative potential, concerns have emerged about the expanding curriculum content (Fox-Turnbull, 2018; Munasinghe et al., 2021), ongoing requirements for upskilling (Crow et al., 2019; Fox-Turnbull, 2018; Kellow, 2018; Lindberg et al., 2017; Munasinghe et al., 2021) and the extra responsibilities placed on educators (Kellow, 2018; Rhodes & Calder, 2022; Schleicher, 2018). The implementation of DT is a gradual process that requires careful

attention to the development of skills to ensure success. As noted by Schleicher (2018), there is frequently a gap between the knowledge that must be acquired and what teachers teach. This requires teachers to navigate a balancing act: mastering new knowledge while keeping their primary focus on student learning (Newton, 2017). It is critical to address the gap and prioritise skill development to guarantee the successful implementation of the DTC.

Professional learning supports teachers' growth of digital technologies skills. The ERO (2020) conducted a study that found that schools implementing effective DT programmes worked closely with their PLD provider. In this capacity, PLD can be tailored to the individual context and requirements of skill acquisition. Additionally, schools with strong partnerships with the PLD providers were able to get support to plan units of work integrated into existing programmes. A study by Rhodes and Calder (2022) suggests that teacher knowledge and skill in the DTC improved with a professional learning and development session based on unplugged activities (learning experiences that do not require computer use). From this perspective, when teachers are supported with timely and relevant PLD based on their individualised needs, they are more likely to gain the skills required to implement the DTC.

Pedagogy

The third challenge for DT implementation is teacher pedagogy. There is no doubt that the beliefs and actions of a teacher, both about learning and teaching itself, significantly impact their ability to incorporate DT into their programmes of learning. Teachers whose pedagogies align with constructivist thinking can achieve higher efficacy in technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Vongkulluksn et al., 2018). In contrast, those with teacher-centric pedagogies are likely to resist changes that support the effective implementation of the DTC (Ertmer & Ottenbreit-Leftwich, 2010; Stringer et al., 2022).

One challenge for some teachers is that the pedagogical end goal keeps changing because pedagogy evolves as digital technologies evolve (Rhodes & Calder, 2022). This pedagogical shift requires a significant change for teachers (Newton, 2017). One perspective is that older or more experienced teachers may struggle to implement these pedagogies effectively (Bećirović, 2023; Prensky, 2001). However, some argue that age and experience are irrelevant, and mindset and willingness to engage with change determine the success of a teacher's pedagogical endeavours (Price & Kirkwood, 2014). Regardless of age, Bećirović (2023) affirms that some educators feel unprepared for the rapid pedagogical shift towards DT. Even high performing education systems struggle with the challenge of merging technology and effective pedagogy, according to Newton (2017).

Developing digital technology-based pedagogy is imperative in facilitating students' skill acquisition. However, teachers often lack a comprehensive understanding of this approach (Munasinghe et al., 2021; Stringer et al., 2022). Research has identified professional learning as crucial for strengthening teachers' pedagogical capabilities (Bower & Falkner, 2015). Moreover, Stringer et al. (2022) contend that addressing challenges and misconceptions through professional learning is the most efficient strategy to support teachers' implementation of digital technology-based pedagogy. In fact, part of New Zealand teacher's code of professional responsibilities is to "engage in professional learning and adaptively apply this learning in practice" (Education Council, 2017, p. 18).

Without an organisational culture of risk-taking and innovation, teachers may be less inclined to try new things; therefore, a leader's role is crucial. Research conducted by ERO (2020), found that in supportive environments, teachers were "more comfortable learning from, and alongside, students and allowing students to lead more of their own learning" (ERO, 2020, p. 9). Teachers willing to learn alongside their students and empower them to take the lead (Geldreich & Hubwieser, 2020; MoE, 2018a) are more likely to implement effective DT programmes successfully. This further confirms the importance of strong leadership in developing effective pedagogy for DT implementation.

Looking Forward – He Tirohanga Kōmua

Building on past and present insights, the following section explores the future of DTC implementation in middle schools. It epitomises the whakatauki laid out at the beginning of this review - *I walk backward into the future with my eyes fixed on my past* (Rameka, 2016, p. 387). Paving the way for effective DT programmes in New Zealand middle schools in 2025 and beyond requires fixing our eyes on the past to learn from what we have done well and to establish what we can do to improve outcomes for learners. In this section, the author aims to reintroduce key themes and models and frame them within a DTC context to examine the characteristics of effective DT programmes in New Zealand middle schools. Furthermore, leadership practices will be reintroduced and examined for efficacy in this field.

Framing effective DT programmes

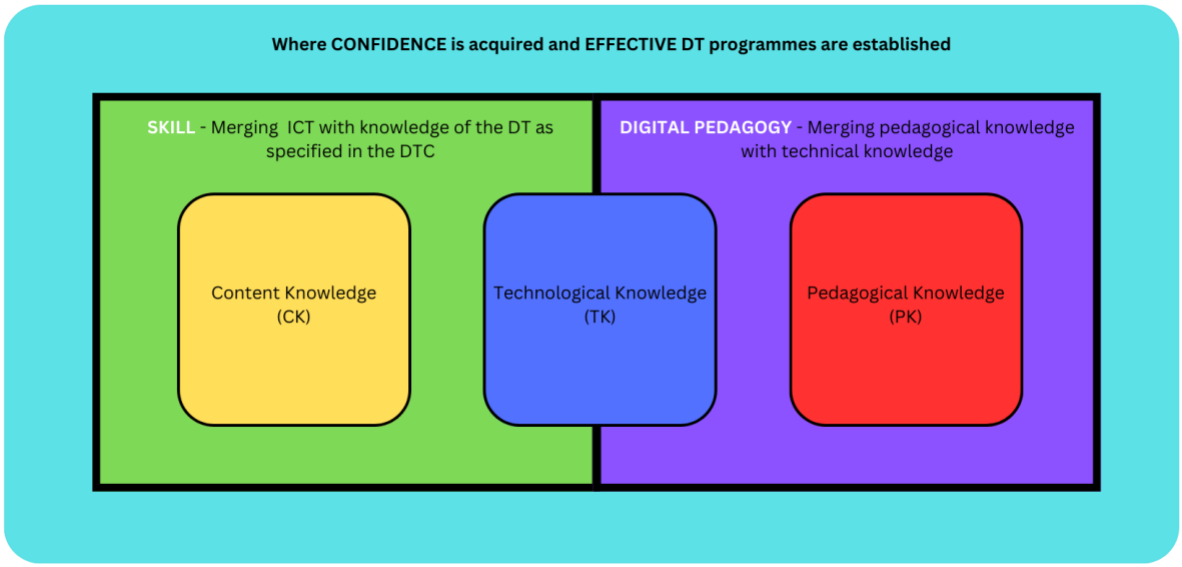
The TPACK model (Mishra & Koehler, 2006) is well-referenced by scholars for describing effective technological practice (Dilworth et al., 2012; Kushner Benson et al., 2015; Yeh et al., 2021). Conversely, the model may be misunderstood or misused when educators struggle to incorporate its principles into their practice (Dilworth et al., 2012; Saubern et al., 2020). One thing is clear, the TPACK framework

leaves room for teachers and leaders to fill in the blanks about the content, technological, and pedagogical knowledge required in their contexts.

To adopt a New Zealand context, I propose the Digital Technologies Content Implementation Tool (DTCIT), presented in Figure 13. This framework builds upon the TPACK model (Mishra & Koehler, 2006) and leverages insights from this literature review to suggest what effective digital technologies implementation may look like in New Zealand middle schools. It is further explained in the figure below and in subsequent sections.

Figure 13

Digital Technologies Content Implementation Tool (DTCIT)



Note. Adapted from Technological pedagogical content knowledge: A framework for teacher knowledge, by Mishra, P., & Koehler, M. J, 2006, Sage Publications. (https://doi.org/10.1111/j.1467-9620.2006.00684.x). Copyright 2013 by Teachers College, Columbia University.

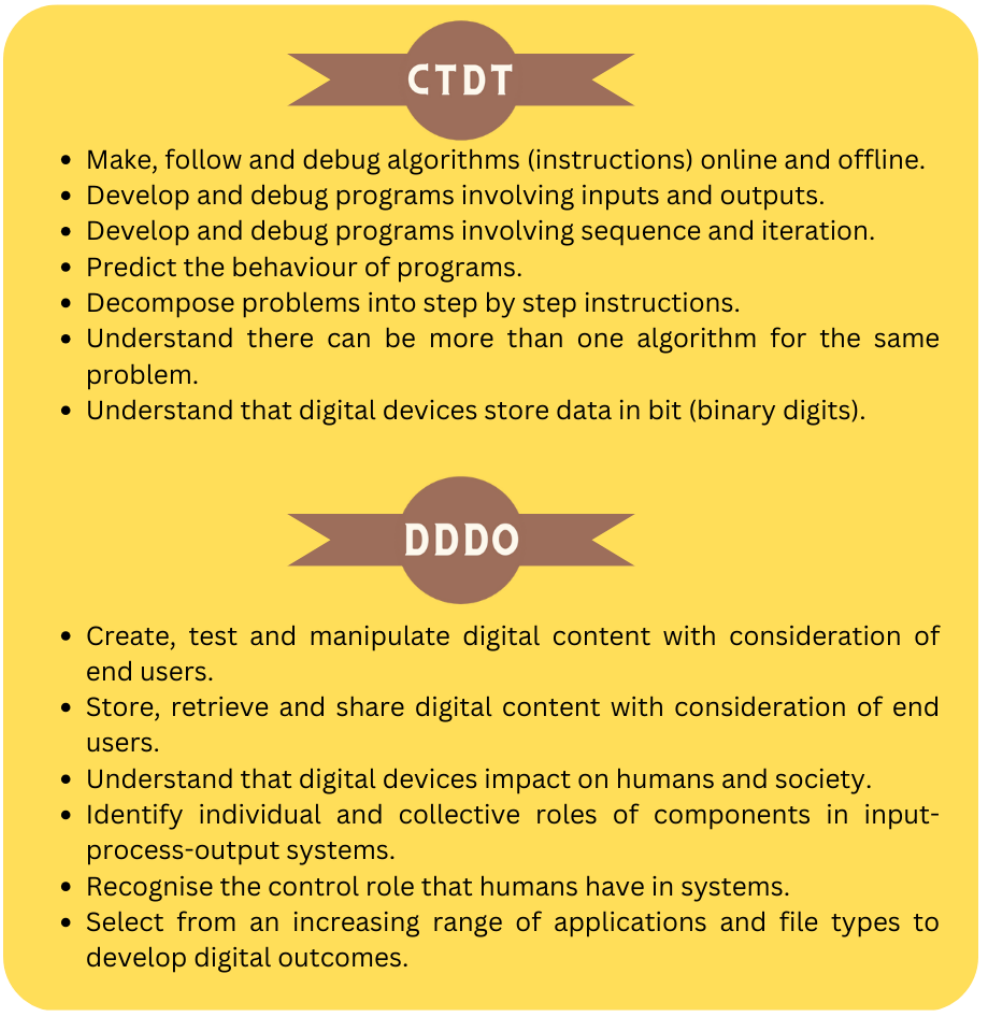
Content Knowledge for the Implementation of the DTC

In the Digital Technologies Content Implementation Tool (DTCIT), content knowledge refers to the specific digital technology content of the New Zealand Technology Curriculum. Information from the Progress Outcomes (MoE, n.d.-e, 2018b, n.d.g) has been synthesised to create the CK component of the DTCIT. This is also known as 'Technology Education'. Through this lens, New Zealand middle school

teachers implementing a digital technologies programme will hold the content knowledge as outlined in Figure 14, below.

Figure 14

DTCIT - Content Knowledge (or Technology Education) - Years 7-8



Note: Adapted from Technology in the New Zealand Curriculum, by Ministry of Education, 2018. (https://nzcurriculum.tki.org.nz/content/download/168478/1244184/file/NZC-Technology%20in%20the%20New%20Zealand%20Curriculum-Insert%20Web.pdf). Used according to Crown Copyright legislation.

Technological Knowledge for the Implementation of the DTC

In the Digital Technologies Content Implementation Tool (DTCIT), technological knowledge (TK) or 'Educational Technology' refers to the use of up-to-date technologies to support learning and engage

learners. Scholarship related to the DTC from the New Zealand Technology Curriculum (MoE, n.d.-e, 2018b, n.d.g) has been synthesised alongside documentation from MoE accredited DT PLD providers (Digital Kete, 2022b, 2022d, 2022c, 2022a; Impacted, n.d.-a, n.d.-b; OMG Tech!, n.d.-b, n.d.-a) to create the TK component of the DTCIT. This list is not exhaustive, but an indication of the technologies, apps and sites mentioned in available literature. Through this lens, New Zealand middle school teachers implementing a digital technologies programme may use tools such as those shown in Figure 15, below:

Figure 15

DTCIT - Technological Knowledge (or Educational Technology)

Note: This list will not remain current for long, as is the nature of digital technologies.

Pedagogical Knowledge for the Implementation of the DTC

In the Digital Technologies Content Implementation Tool (DTCIT), pedagogical knowledge refers to the employment of essential pedagogies (MoE, 2023) to support the teaching and learning of digital technologies. Scholarship related to Te Mātaiaho: The refreshed New Zealand Curriculum (MoE, 2023)

outlines five essential (cross-curricular) pedagogies under the pedagogical principle of responsive practice. This principle asserts that teachers who inquire into student progress and respond by adapting their practice will be more effective. Through this lens, New Zealand middle school teachers implementing a digital technologies programme utilise strategies as shown in Figure 16, below:

Figure 16

DTCIT – Pedagogical Knowledge

Note: Adapted from Te Maataiaho: The refreshed New Zealand curriculum, by Ministry of Education, 2023. (https://curriculumrefresh-live-assetstorages3bucket-l5w0dsj7zmbm.s3.amazonaws.com/s3fs-public/2023-04/PDF%20Te%20Mataiaho%20March%202023_0.pdf?VersionId=DGq6sIiLW5tA_59tWwTzHug08qP_cSUF). Used according to Crown Copyright legislation.

Skill for the Implementation of the DTC

The Digital Technologies Content Implementation Tool (DTCIT) illustrates the partnership of content knowledge and technological knowledge as 'skill'. For teachers to be **skill**ed facilitators of the DTC curriculum, they must first know and understand the required content and technological knowledge. Furthermore, when designing units of learning, they must make deliberate choices about the best

technologies to employ in the learning task to support student knowledge and understanding of the targeted progress outcomes.

It is essential to distinguish between content knowledge and technological knowledge regarding the DTC, as they are not interchangeable. A teacher with extensive understanding of the digital technologies progress outcomes may not necessarily be able to implement the DTC without support to understand the technology tools required, or vice versa. The Education Review ERO (2020) conducted a study in 2020 that found that schools solely engaged in professional learning related to digital fluency were insufficiently prepared to implement the DTC content. Conversely, schools that received customised professional learning services tailored to their specific context and focused on the DTC content were better equipped to implement it effectively. It seems reasonable to conclude, then, that professional learning and development across the DT content and technologies is imperative for teachers to maximise their efficacy for strong implementation of DT programmes.

Digital Pedagogy for the Implementation of the DTC

In contemporary classrooms digital technologies educators need to possess a diverse toolkit of pedagogical approaches that can cater to the varied contexts that arise (Newton, 2017). A need exists for various teaching methodologies that can adapt to the ever-changing digital landscape. The Education Council (2017) outlines within the standards for the teacher profession that teachers should use "an increasing repertoire of teaching strategies, approaches, learning activities, technologies and assessments for learning strategies and modify these in response to the needs of individuals and groups of learners" (p. 20). In this vein, digital pedagogy emerges as a concept explaining how educators can use digital technologies mindfully in teaching and learning (Bećirović, 2023).

Digital pedagogy is "as much about using digital tools thoughtfully as it is about deciding when not to use digital tools, and about paying attention to the impact of digital tools on learning" (Stommel & Rorabaugh, 2011, para. 1). The use of digital technologies can enhance educational opportunities for students (Google for Education, 2022). However, teachers must have the ability to discern when and how to use these technologies. They should look at the options available within the landscape of the learning outcomes (Morris, 2013) and ask questions such as what tools are available? Moreover, they ask how these tools can be used to enhance learning and promote a deeper understanding. As digital technologies continue to evolve, effective digital technologies programmes rely on contemporary digital

pedagogies. However, it is essential to clarify that digital pedagogy is an extension of pedagogical practices rather than a replacement for traditional pedagogy.

In the DTCIT, I propose that the partnership of pedagogical and technological knowledge is known as 'Digital Pedagogy'. When designing learning activities drawing on digital pedagogies, a teacher will question how digital technologies may be used to enhance learning, promote deeper understanding and cater to diverse learners. Therefore, by thoughtfully integrating their technological and pedagogical knowledge, educators can create engaging and effective learning experiences that cater to all learners and promote deeper understanding.

Confidence in the Implementation of the DTC

In the DTCIT, the confidence of teachers in using technology is enhanced when they merge the three aspects of TPACK (shown in teal). Teachers who understand these elements and how they relate to the DTC and students' learning can create effective digital technology programmes for their learners. Confidence has been identified as a challenge for New Zealand teachers. To build their confidence, teachers need to develop their skills and pedagogy, which can be achieved through professional learning and development and actions from leadership.

Leadership

Two change leadership models and two leadership practice documents were introduced in the Looking Back section. The Raranga Matihiko Kaiako Framework (MoE, 2019) and the Digital Technologies Implementation Support Tool (MoE, 2019) were created and employed by the MoE upon implementation of the DTC. The content of these documents outlines effective practices by leaders and teachers regarding the implementation and teaching of digital technologies programmes. School Leadership and Student Outcomes (Robinson et al., 2009) and the Leadership Capability Framework (Education Council, 2018a) outline effective leadership practices in schools. These documents outline dimensions and capabilities that leaders are encouraged to action to improve teaching and learning. This section explores the relationship between both sets of literature to ascertain the role of leadership in effective DTC implementation.

School Leadership and Student Outcomes

Robinson et al.'s (2009) work predates the current landscape by 16 years. Whilst it is prudent to conduct a critical analysis to discern the enduring relevance of their work, it would be imprudent to dismiss it wholesale. Taking this view, the author has leveraged the Best Evidence Synthesis (BES) framework

(Robinson et al., 2009) alongside the DT implementation support tool (DTIST) (MoE, 2019) to evaluate its ongoing validity for leaders implementing the digital technologies curriculum. This is shown in Table 1, below.

Table 1

Digital Technologies Implementation Support Tool with BES

Leadership Dimensions	Digital Technologies Support Tool Evidence
Dimension 1 **Establishing goals and expectations**	• Preparing to start your learning journey (NYS) • Recognise the new learning as part of the school's strategic plans and goals (NU) • DT learning is in strategic goals and planning (Ready)
Dimension 2 **Resourcing Strategically**	• Choose a person or group to lead the curriculum change (NYS) • Consider resources for implementation (NU) • Trialling the DTC in some classes (Ready) • Have a digital device resource plan (LAI)
Dimension 3 **Planning, coordinating, and evaluating teaching and the curriculum**	• Review the revised Technology Learning Area (NYS) • Review local curriculum to see the fit and are preparing to implement (NU) • Determine teachers' prior knowledge, capability and confidence (NU) • Do a stocktake/audit of DT teaching already occurring • Monitoring teaching and learning to gauge effectiveness (Ready)
Dimension 4 **Promoting and participating in teacher learning and development**	• Review current PLD practices in relation to DT (NU) • Look at professional support available and choose relevant ones (NU) • Participating in PLD and encouraging others to (Ready) • Continue to filter out information to all school staff (LAI)
Dimension 5 **Ensuring an orderly and supportive environment**	• Check how everyone is doing with implementation (Ready) • Encouraging teachers to use Teaching as Inquiry (TIC) to support their thinking • Teachers are encouraged to innovate and learn alongside their students (LAI)
Dimension 6 **Creating educationally powerful connections**	• Talk to other schools/local experts about what they are doing (NU) • Connecting with parents, whānau, industry, iwi and community contacts (Ready) • Structured meaningful school and community collaboration (LAI)
Dimension 7 **Engaging in constructive problem talk**	
Dimension 8 **Selecting, developing, and using smart tools**	

Note. This table aligns the Leadership Dimensions from the BES with the Digital Technologies Support Tool Evidence to ascertain its validity.

The table illustrates robust correlations between the leadership dimensions in the BES and the content of the DTIST. Despite Dimensions 7 and 8 not being explicitly articulated in the documentation, their implicit presence is evident. This underscores the enduring relevance and utility of the BES for leaders involved in the implementation of DT programmes.

The Leadership Capability Framework (LCF)

An analysis comparing the Educational Leadership Capabilities (Education Council, 2018a) with the DTIST (MoE, 2019) revealed a broad alignment, suggesting that the actions outlined in the latter document are crucial for leaders effectively implementing digital technologies in schools. This can be seen in Table 2.

Table 2

Digital Technologies Implementation Support Tool with Educational Leadership Capabilities

Leadership Capabilities	Digital Technologies Support Tool Evidence
Building and sustaining high trust relationships	• Teachers are encouraged to innovate and learn alongside their students (LAI)
Ensuring culturally responsive practice and understanding of Aotearoa New Zealand's cultural heritage using Te Tiriti o Waitangi as the foundation	• Connecting with parents, whānau, industry, iwi and community contacts (Ready) • Structured meaningful school and community collaboration (LAI)
Building and sustaining collective leadership and professional community	• Current specialist technology teachers have a leadership role to play (Ready) • Check how everyone is doing with implementation (Ready) • Encouraging teachers to use Teaching as Inquiry (TIC) to support their thinking
Strategically thinking and planning	• Review the revised Technology Learning Area (NYS) • Preparing to start your learning journey (NYS) • Review current PLD practices in relation to DT (NU) • Determine teachers' prior knowledge, capability and confidence (NU) • Review local curriculum to see the fit and are preparing to implement (NU) • Do a stocktake/audit of DT teaching already occurring (NU) • Recognise the new learning as part of the school's strategic plans and goals (NU) • DT learning is in strategic goals and planning (Ready)
Evaluating practice in relation to outcomes	• Monitoring teaching and learning to gauge effectiveness (Ready)
Adept management of resources to achieve vision and goals	• Choose a person or group to lead the curriculum change (NYS) • Consider resources for implementation (NU) • Trialling the DTC in some classes (Ready) • Have a digital device resource plan (LAI)
Attending to their own learning as leaders and their own wellbeing	• Look at professional support available and choose relevant ones (NU) • Participating in PLD and encouraging others to (Ready) • Continue to filter out information to all school staff (LAI)
Embodying the organisation's values and showing moral purpose, optimism, agency, and resilience	
Contributing to the development and wellbeing of education beyond their organisation	• Talk to other schools/local experts about what they are doing (NU)

Note. This table aligns the Leadership Capabilities from the LCF with the Digital Technologies Support Tool Evidence to ascertain its validity.

Comparing the actions expected of leaders in the DT Implementation Tool with the Educational Leadership Capabilities revealed a strong correlation. Some actions could have been placed under multiple capabilities; in these cases, the most fitting alignment was chosen. This analysis covered eight of the nine capabilities. However, the ninth capability can be met implicitly when leaders undertake other actions. This illustrates the criticality of the nine leadership capabilities in the implementation of the DTC.

Leaders play a critical role in ensuring the effectiveness of DT programmes. Their actions directly impact programme outcomes, as highlighted by Robinson et al., (2009) who emphasise the role of leadership in improving educational results. The Ministry of Education's Raranga Matihiko Kaiako Framework further emphasises this by outlining specific leader actions that influence successful DT implementation. Notably, these principles closely align with the dimensions and capabilities identified in the Best Evidence Synthesis Iteration and Leadership Capability Framework models. This convergence suggests a potential foundation for a comprehensive framework of leader actions in DT implementation. Further research across diverse educational settings is warranted to solidify this framework.

Conclusion

The DTC has an incredible potential to reshape education and empower learners like never before (MoE, 2017a). This literature review emphasises the critical importance of learning from past experiences to inform present and future practices with skill, effective pedagogy, and confidence. The TPACK framework, along with resources from the Ministry of Education (MoE) and their accredited Professional Learning and Development (PLD) providers, were instrumental in defining the characteristics of effective middle school digital technologies practices.

Building upon the TPACK framework's content knowledge, technological knowledge and pedagogical knowledge, this review suggests that teacher *skill, digital pedagogy, and confidence* are fundamental for effective DT programmes. Furthermore, based on the literature synthesis, the specific content, technological, and pedagogical knowledge relevant to New Zealand middle school teachers of digital technologies has been outlined in the Digital Technologies Content Implementation Framework (DTCIT).

Leadership literature overwhelmingly demonstrates the interconnection between leadership and the efficacy of educational programmes. From the inception of the DTC, the MoE developed a change leadership model that prominently featured the crucial role of leaders in its implementation. By analysing this model against the Best Evidence Synthesis Iteration and Leadership Capability Framework,

the theory that specific actions support the efficacy of DT programmes is further strengthened. While acknowledging the need for further research to solidify these claims, this review provides a strong foundation.

By drawing insights from past practices and current frameworks, this review has firmly established the successful implementation of the DTC in New Zealand middle schools. Equipping teachers with the necessary content, technological and pedagogical knowledge, along with fostering effective leadership practices, will be instrumental in empowering learners to thrive in the digital age.

Chapter Three: Methodology

Introduction

The previous chapter critically reviewed literature related to the implementation of effective digital technologies programmes. This chapter discusses my choice of research methodology in seeking to answer the three key questions of my study:

1. What are the rationales and purposes for digital technologies programmes in New Zealand middle schools?

2. How do teachers support the implementation of effective DT programmes?

3. What leadership actions are associated with effective digital technologies programmes?

This research investigates the implementation of the relatively new digital technologies content in the Technology Curriculum (DTC) in schools. By collaborating with teachers and leaders, the study aims to capture their perceptions of the DTC and inquire into how their interpretations of the curriculum guide their programme design. I seek to understand the sources of teachers' and leaders' knowledge regarding the DTC content, technologies, and pedagogies. Furthermore, I will explore how they leverage this knowledge to develop effective digital technologies programmes.

Qualitative research methodologies are particularly well-suited for this investigation as they allow for detailed descriptions and an in-depth understanding of the experiences of teachers and other stakeholders involved in DT programmes. Furthermore, focus groups, document analysis, classroom observation and interviews were the methods chosen for data collection. These differing methods support the triangulation of data and provide different perspectives on the research topic.

This chapter aims to ensure transparency and replicability by discussing the methodological choices made during the research. It includes an introduction to the research design, a discussion of the participant selection process, details about the data collection methods, an outline of the data analysis plan, and an emphasis on the strategies used to maintain data quality. The chapter concludes by critically examining the ethical considerations of the study.

Research Design

Grounding

This study is grounded in a qualitative interpretivist paradigm highlighting the importance of collaborative meaning-making with participants, specifically teachers and leaders, to gain a deeper understanding of their perspectives (Cohen et al., 2017; Grant, 2019). The research aims to investigate the social construction of meaning surrounding the implementation of digital technologies in schools, focusing on identifying the key characteristics that contribute to the efficacy of these programmes, and the actions of leaders in supporting them. The study is underpinned by a constructivist ontological view, which acknowledges the subjective nature of participants' realities and their unique experiences as socially constructed (Bryman, 2016). The research design is informed by the co-construction of meaning between the participants and the researcher using various methods of data collection, including focus groups, document analysis, observations, and interviews.

Collective Case Study

The research question, 'How do schools implement effective Digital Technologies programmes?' lends itself to a qualitative Case Study approach, specifically a collective Case Study. This methodology aims to discern both common and unique features within the cases studied (Ashley, 2021; Bell, 2005; Bryman, 2016) and to thoroughly examine their complexity (Ashley, 2021).

Despite the inherent diversity of schools (Denzin & Lincoln, 2000), there are clear advantages to comparing schools, or cases, selected due to their similarities. Bryman (2016) suggests that any differences found in phenomena are likely to reveal key factors as opposed to being related to their difference from the outset. The process of comparing and contrasting the cases enables the capture of a comprehensive range of data and facilitates the triangulation of findings (Stake, 2003). This approach allows for the testing and potential refutation of alternative explanations (Bryman, 2016; Suter, 2012). Through a comparative analysis of similarities and differences within the collective Case Study, the research seeks to identify overarching themes and establish generalisable phenomena (Stake, 2003).

Data Collection Methods

The Case Study approach embraces multiple data collection methods, thereby facilitating data triangulation to enhance the validity of research findings (Bryman, 2016; Denscombe, 2010). This approach encompasses four non-linear phases of data collection, including focus groups, document analysis, classroom observations and interviews. The purpose of triangulation is to clarify the meaning of

the phenomena under study (Stake, 2000) by understanding how it is perceived in public contexts (observations), in private contexts (interviews and focus groups) as well as exploring individuals' thoughts, feelings and beliefs (interviews, document analysis and focus groups) (Stewart-Withers et al., 2014). By employing these diverse methods, the researcher can gather comprehensive and multifaceted perspectives from various stakeholders regarding their experiences with the DTC.

The Case Study approach is deemed the most appropriate option for this research project due to its focus on gaining a comprehensive understanding, ability to integrate multiple data collection techniques, and flexibility for non-random case selection.

Participants and Sampling

Case Selection: Schools

The Case Study method allows for the facilitation of non-random selection of cases based on specific criteria, rather than random chance (Denscombe, 2010; Yin, 2018). As Stake (2000) emphasises, understanding how schools implement effective digital technologies programmes is contingent on selecting appropriate cases. Therefore, the cases chosen for inclusion in the study were based on their typicality as middle schools and their potential to offer insight into the phenomenon under investigation. This type of sampling, known as purposive sampling (Stake, 2000), ensured the cases provided valuable insights into the phenomenon of effective digital technologies programmes within a realistic school context.

Initially, two schools, Evergreen School and Oakhaven School (pseudonyms), located in the Waikato region and catering to students in Years 7-8, were selected as cases. The selection criteria were concordant with the research topic, which aims to explore effective digital technologies programmes from the perspectives of middle school teachers and leaders. Consequently, these schools were chosen due to their typicality as middle schools and their established DT programmes based on the New Zealand curriculum.

Regrettably, Evergreen School withdrew from the study after eight weeks due to scheduling conflicts and teacher workload. To maintain the integrity of the Case Study design, Willowbrook School (pseudonym), a comparable middle school in the Waikato region, was approached and agreed to participate.

Cases within the Cases Selection: Participants

The purposive sampling method was used to select participants from the schools based on specific attributes of interest, rather than for representativeness. This approach allowed for a diverse selection of participants to learn about their experiences. In contrast to random or probability sampling methods, purposive sampling does not provide an equal chance for all members of the population to be selected (Cohen et al., 2017).

After obtaining consent from the school principals for their schools to be included in the study (Appendices 1 & 2), teachers were recruited through a call for participants and an explanatory letter (Appendix 3). Purposive sampling, a key principle of Case Studies (Bryman, 2016), was beneficial for this study, as it facilitated deeper exploration by selecting participants with interest or expertise in digital technologies and enabled the deliberate selection of leaders and teachers (Lambert, 2012, p. 113).

Within each school (case), participants were invited to self-select based on specific criteria. They needed to express interest in digital technologies, be involved in teaching or leading digital technologies in the school and be willing to participate in a one-hour focus group. Furthermore, participants were informed additional phases of analysis included the ability to opt into providing documentation, participating in classroom observations, or engaging in one-on-one interviews. Although six teachers initially expressed interest, obtaining consent forms (Appendices 4-7) proved challenging, with one teacher ultimately not responding despite follow-up emails. Subsequently, when one school withdrew from the study, the recruitment process had to be repeated. Following the acquisition of informed consent from the participating teachers, data collection commenced. A detailed account of the data collection process will be provided in the subsequent section. Table 3 outlines details about the participants involved in the study.

Table 3

Participant Details

School	Name (Pseudonym)	Position in School			Additional Details
		Homeroom Teacher	Specialist Teacher	Middle /Senior Leader	
Evergreen School	*Participants/School withdrew from research*				
Oakhaven School	Sylvia		✓		Homeroom teacher in the past. Specialist - Digital Technologies
	Ruth	✓			Responsibilities for digital technologies across the school
Willowbrook School	Dudley		✓		Specialist - Digital Technologies
	Margaret	✓			
	Richard		✓		Specialist - Media
	Sam	✓			
	Nat			✓	

Note: Participant details and schools have had pseudonyms assigned.

Data Collection Methods

A key strength of the Case Study design is its ability to leverage triangulation, which involves using multiple data collection methods to support and enhance findings (Heck, 2011). Acknowledging that meaning can be subjective and open to interpretation, this study used a variety of methods to fully understand participants' real and espoused thoughts, feelings, and beliefs (Bell, 2005; Stewart-Withers et al., 2014). This is consistent with Yin's (2018) analysis, which showed that Case Studies using multiple data collection methods generally produce higher quality results than those using only one method. Based on this reasoning, four data collection methods were used: focus groups, document analysis, classroom observations, and one-to-one interviews. Although these were labelled as Phases 1 through 4 for logistical purposes, the order in which the data was collected was flexible. Each of these methods will be explained in more detail below.

Focus Groups

Focus groups are a data collection method designed to gain understanding from a group of participants simultaneously. Focus groups have variations across literature regarding the size of the groups, time frame, place, and structure of the sessions. However, the key advantages, limitations and logistics for implementing focus group sessions are described in this section.

One of the key advantages of focus groups is their ability to elicit information through the interaction of participants (Ashley, 2021; Bryman, 2016; Check & Schutt, 2012). This interactive format offers teachers a platform to exchange ideas, which can be instrumental in gauging their understanding of the characteristics of effective DT programmes and leadership actions associated with these. Additionally, focus groups can create an environment where participants can "talk about sensitive topics in a way in which they would not do in an individual interview, and they may gain strength from the energy of a group setting" (Ashley, 2021, p. 241).

In contrast, focus groups have limitations. Group dynamics may cause some members to monopolise the conversation and others to say very little (Cohen et al., 2017; Fontana & Frey, 2020). Additionally, over-recruitment may be necessary, to allow for some participants being unable to attend and a fine balance is required of the researcher, as both a moderator and an interviewer (Cohen et al., 2017; Fontana & Frey, 2020).

To ensure the successful execution of this phase, meticulous planning was undertaken. In addition to crafting questions (Appendix 12), selecting and creating appropriate resources (Appendix 13) and determining recording methods, I thoroughly considered logistical details. Punctuality, sign-in procedures, and an appropriate dress code were all carefully ruminated to establish a professional atmosphere (Lambert, 2012; Scheyvens et al., 2014). Refreshments were provided at the focus group sessions as a token of appreciation for the teachers' valuable time and participation.

Ideally, I had hoped to get between six and eight participants per focus group. For Oakhaven School two participants were recruited and for Willowbrook School four participants were recruited. The sessions went for under an hour and were held in a suitable space within the schools. I arrived at the schools prior to the meeting time with my audio recording devices, an iPhone and an iPod touch as back-up in case of technical error, some refreshments and documents relevant to the session, including a pen and clipboard with paper to write field notes on. Prior to commencing the session, the participants were offered refreshments and reminded about the audio recording. Upon starting the session, the

participants were advised that the discussion held within the focus group was to remain confidential. Throughout the focus group session, I remained conscious of interjecting only when necessary to allow the participants to think and discuss topics freely and negotiated the role of an interviewer and moderator, when necessary. However, I was also conscious of ensuring that the pace was conducive to completing the entirety of the interview guide.

Following the focus group sessions, the audio recordings were transcribed using Otter.ai and downloaded as a word document, ready for data analysis. Despite encountering challenges in recruiting the ideal number of participants and the loss of a 'case', focus groups as a method of collecting data was retained, due to the benefits it could bring to the research. The potential of this line of inquiry to converge with the other data collection methods (Yin, 2018) to corroborate findings and reduce the impact of potential biases (Bowen, 2009) far outweighed the challenges in retaining this phase.

Document Analysis

Document analysis differs from other approaches by centering on data selection, systematically reviewing and evaluating existing documents rather than gathering new information (Bowen, 2009). In selecting the data, Scott (1990, as cited in Bryman, 2016) advocates for four criteria: authenticity, credibility, representativeness and meaning. The documents collected from schools and teachers are likely to be authentic and meaningful, but their credibility and representativeness require thorough examination (Bryman, 2016). Additionally, they reveal aspirations, not necessarily reality (Bryman, 2016). Therefore, when analysing the documents from participants it is important to remain aware of and responsive to these things.

Document analysis has several advantages for a qualitative researcher. Morgan (2021) states that document analysis is an underused and valuable approach to qualitative research. It is argued that while methods such as interviews and observations have potential for the participants to be influenced by researchers, document analysis is unaffected (Bell, 2005; Merriam & Tisdell, 2016). Additionally, it is unobtrusive, cost-effective and provides opportunities to gain data that could otherwise be difficult to obtain (Bowen, 2009; Morgan, 2021). In contrast, the limitations of document analysis include the potential for biased selectivity, insufficient detail and documents being deliberately withheld (Bowen, 2009). Furthermore, Hodder (2000) argues that documents are only valuable within their socially embedded contexts and new and contradictory meaning can be made when documents are read.

Participants in the study were invited to share documentation pertaining to their planning and teaching of digital technologies in their school. Examples given included unit/lesson plans, schemes of work, scope and sequence documentation and/or other documents pertaining to the implementation of DT programmes in the school. The documents provided for this research were coded and used to support the themes found across other data collection methods. The document analysis phase of my data collection provided a unique perspective on how schools implement effective digital technologies programmes that at the convergence of the other phases of data collection, added to my overall findings.

Classroom Observation

This method of data collection was employed to reveal characteristics of the schools' programmes which may not have been present in their planning and documentation or raised in focus groups or interviews (Bell, 2005). Observation differs to other forms of data collection, as it can reveal what people actually do as opposed to what they say they do in their documents and discussions (Bell, 2005; Bryman, 2016).

Classroom observations, like any data collection method, offer both advantages and limitations. They are considered a reliable means of corroborating findings from other data sources (Angrosino & Mays de Pérez, 2000) and can provide insight into the extent of phenomenon implementation (Heck, 2011). However, observations can be perceived as intrusive (Angrosino & Mays de Pérez, 2000) and the researcher's presence may influence the data to be collected (Check & Schutt, 2012).

An observation framework (Appendix 14) was created based on event sampling (Lambert, 2012). In this type of framework, notes are recorded only when something relevant to the research topic occurs. Acknowledging that characteristics are not limited to those already recognised in curriculum content and digital tools, ample space was left on the observation framework for additional notes about characteristics or other noticings relevant to how schools implement effective digital technologies programmes.

Like the focus group phase, it was challenging to recruit participants for classroom observation. Consent was initially given for two teachers in Oakhaven School and then withdrawn. This was due to changes in the school structure and classes, following the MoE's mandate of an hour of reading, writing and maths. This left only one participant in total to participate in this phase of research from Evergreen School, which later withdrew from the study. When Willowbrook was later invited as a case, one participant was recruited for this phase.

Prior to completing the classroom observations, the observation framework was piloted in a classroom at my own school. The pilot session allowed me to identify weaknesses in the framework and make changes to it to improve its usability and therefore efficacy in the data collection phase (Bell, 2005; Lambert, 2012). The purpose of the framework was to collect field notes relevant to my research topic that could confirm, extend, or contradict data from the other three phases of research (Lambert, 2012; Yin, 2018). This, in turn, could support the understanding of how schools implement effective digital technologies programmes.

Interviews

Interviews are a "social, interpersonal encounter, not merely a data-collection exercise" (Cohen et al., 2017, p. 506). In one-to-one semi-structured interviews the researcher has a list of questions likely to be used (an interview guide). This guide is not rigid, but flexible (Bryman, 2016). The researcher may veer from the guide to explore an answer in depth or may miss questions as deemed necessary. The semi-structured interview style was chosen because it allows room for follow-up questions, when necessary, without being restricted (Bell, 2005), but also has a focus and purpose towards gathering the information valuable to the research question by confirming, extending, or contradicting other data (Lambert, 2012).

A strength of this method of data collection is that "the way in which a response is made; tone of voice, facial expression, hesitation etc, can provide information that a written response would conceal" (Bell, 2005, p. 157). Nuances such as these can support the convergence of data from other methods to add to the study's findings about how schools implement effective digital technologies programmes. Conversely, interviews have limitations as a method of data collection. According to Cohen et al. (2017), the use of an audio recorder could cause participants to become anxious and problems such as interruptions, distractions, and stage fright are possible.

The design of the interviews began by considering how I best answer the three critical questions of my research topic. The interview questions were designed to avoid leading questions, presuming questions, hypothetical questions, offensive questions, sensitive issues, vague questions, and closed questions (Bell, 2005; Bryman, 2016; Lambert, 2012). I chose a structure that utilised an introduction, simple start, meaty middle and rounding off (Lambert, 2012). In this structure, I started by introducing myself and the purpose of the research. I then moved into ice-breaker-type questions by asking the participant simple information about themselves, such as their name, role in the school and professional background. The meaty middle includes questions about how schools implement effective digital technologies

programmes and invites the participants to offer any additional information and thank them for their time.

Furthermore, after designing the interview guide, consideration was given to how to record the interviews. It was decided that audio recording would be preferable over written notes, as transcription can be achieved through Otter.ai and would leave me alert to consider responsive follow-up questions (Bryman, 2016; Lambert, 2012). Two recording devices were used in case of technical difficulties. One was placed in front of the participant and one in front of me. Otter.ai was used to transcribe the interview. The participants were given their transcripts after the interview and afforded two weeks to amend or confirm. The approved transcripts were then downloaded as Microsoft Word documents, ready to begin data analysis. The semi-structured interview as a method of data collection supported the growing convergence of data about how schools implement effective digital technologies programmes.

Coding of Data

Data from each phase was coded and organised into the table below (Table 4), which included the corresponding code and associated pseudonym for participants. This structured approach ensured participant confidentiality, facilitated data analysis and are referenced in the Findings and Discussion chapters.

Table 4

Codes and Pseudonyms for Research

School	Data	Code	Participant/s
Oakhaven School	Focus Group	OH-FG	Sylvia and Ruth
	Interview	OH-IV	Sylvia and Ruth
	Document - Term 2 2022 Unit Plan	OH-UP1	Ruth
	Document - Term 1 2023 Unit Plan	OH-UP2	Ruth
	Document - Term 2 Unit Plan	OH-UP3	Ruth
	Document - Term 3 Unit Plan	OH-UP4	Ruth
	Document - 2024 Unit Plan	OH-UP5	Ruth
	Document - Curriculum Overview 2023	OH-CO1	Ruth
	Document - Curriculum Overview 2024	OH-CO2	Ruth
Willowbrook School	Focus Group	WB-FG	Dudley, Sam, Margaret and Richard
	Interview	WB-IV	Dudley and Nat
	Document - 2023 Unit Plan	WB-UP1	Dudley
	Document - 2024 Unit Plan	WB-UP2	Dudley
	Document - 2024 Inquiry Plan	WB-OB-UP	Sam
	Classroom Observation notes	WB-OB-NT	Sam

Note: The table outlines the phases of research with codes and pseudonyms of participants. These will be analysed and reported on in the Findings and Discussion Chapters.

Data Analysis

Data collection across multiple phases of the case study had a goal of corroborating data to strengthen the validity of the findings (Yin, 2018). As such, data in this research could be triangulated to identify similarities from differing perspectives (Laws, 2003, as cited in Bell, 2005) and multiple measures of the same phenomenon (Yin, 2018) through analysing the data collected from focus groups, one to one interviews, classroom observations and documents.

According to Yin (2018) data analysis is about “examining, categorizing, tabulating, testing, or otherwise recombining evidence to produce empirically based findings” (p. 132). In this research, analysis was iterative; it began from the first phase of data collection and continued throughout the phases. This

process allowed me to cluster key phenomenon, search for patterns (Yin, 2018) and begin to draw conclusions about how schools implement effective digital technologies programmes.

Coding was a crucial aspect of my analysis. The development of codes arose from questioning the 'what' about a piece of information (Bryman, 2016). The judgements that were made about the data created the codes which acted as indexing tags (Ryan & Bernard, 2000). Initially NVIVO was considered and downloaded onto my device for data management. However, the logistics of the program were found to be time-consuming and arduous, and without the benefit of 'being in' the data. Therefore, I chose to use a simple table in a Microsoft Word document, instead. The benefits of this included being emersed in the data, through iteration. By creating the table, the codes as index tags soon supported the development of sub-themes and then themes. These are shown below in Table 5.

Table 5

Themes and Sub-Themes

Sub-Themes	Themes
Establish clear goals and expectations	**Leaders as catalysts for digital advancement**
Allocate resources strategically	
Attend to their own learning	
Support teachers to build their confidence and capacity in digital technologies	
Understand and are responsive to the rationale and purposes for digital technologies	**Teachers as digital technologies champions**
Demonstrate learning dispositions towards innovation and change	
Deliberately utilise a range of DT tools	
Leverage pedagogical strategies to enhance engagement and achievement	

Note: These themes and subthemes relate to how schools implement effective Digital Technologies programmes

Quality Assurance

Qualitative research, which explores subjective human experiences and interpretations, requires a unique approach to quality assurance (QA). Unlike quantitative research, which emphasises objective measurements, qualitative research focuses on understanding perceptions, emotions, and thoughts (Morse, 2018). Ensuring the validity and trustworthiness of findings necessitates a thorough evaluation of the research methodology and data collection processes (Riege, 2003).

According to Lincoln and Guba (1985) and Guba and Lincoln (1994), the quality of evidence obtained in a qualitative study can be assessed through their trustworthiness and their authenticity (as cited in Bryman, 2016). Stewart-Withers et al. (2014) argue a similar concept but prefer to use the term rigour to trustworthiness. Both sides agree on the criteria for judging the trustworthiness (or rigour) in qualitative research. These criteria include credibility, transferability, dependability and confirmability (Bryman, 2016; Stewart-Withers et al., 2014; Toma, 2011). These four criteria, along with authenticity are outlined below and then discussed within the context of my study.

Credibility

Credibility can be described as believability to those in the study and in the discipline. Credibility can be established in research through submitting transcripts of interviews to participants. This is known as member validation and may be the most crucial way to establish credibility (Seale, 2003). The triangulation of data also leads to credibility, by increasing scope, depth, and consistency (Seale, 2003).

Credibility, or the believability of my findings, was established through several strategies. Data triangulation, employing focus groups, interviews, observations, and document analysis, enhanced the depth and consistency of findings. Additionally, member checks, where participants reviewed and validated 1-to-1 interview transcripts, ensured that their perspectives were accurately represented.

Transferability

Transferability refers to “the degree to which findings can be generalized across social settings” (Bryman, 2016, p. 384).

Transferability in my research was addressed by providing thick descriptions of the research setting, participants, and the research process. This allows readers to assess the potential applicability of the findings to their own situations – across school types, year levels and classes.

Dependability

Dependability refers to how well the study can be replicated. Replication can be achieved through a detailed methodology, transparency of data collection and an audit trail (Mutch, 2013). Furthermore, pilot studies and use of an audio recorder support dependability (Riege, 2003).

Dependability, or the consistency and replicability of my research process, was ensured through a detailed audit trail documenting all research decisions, procedures and methodology. This trail includes interview transcripts, field notes, audio recordings and data analysis memos, allowing for an independent review of the research process.

Confirmability

Confirmability is the understanding that while complete objectivity is unachievable, the researcher has not "overtly allowed personal values or theoretical inclinations to sway the conduct of the research or the findings deriving from it" (Bryman, 2016, p. 386). Auditing is also a key criterion for confirmability. This is also an "exercise in reflexivity, which involves the provision of methodologically self-critical account of how the research was done" (Seale, 2003, p. 172).

Confirmability, or the objectivity of the findings, was addressed through reflexivity, where I critically examined my own biases and assumptions throughout the research process. I also sought out and analysed data that challenged initial interpretations to ensure a comprehensive understanding of the phenomenon.

Authenticity

Authenticity refers to the fairness, ontological authenticity, educative authenticity, catalytic authenticity and tactical authenticity of the research (Bryman, 2016).

Authenticity, or the fairness and trustworthiness of the research in representing participant perspectives, was considered by centering the research on participant voices and experiences. The findings are presented in a way that respects their realities and aims to contribute to a deeper understanding of the phenomenon from their perspective. I aim to add to the body of research about DTC programmes in New Zealand by addressing the perspectives of participants to support teachers' understanding of how to implement effective programmes. Furthermore, I hope for the research to support a positive change across New Zealand schools.

There is no doubt that it is crucial to ensure that data collection is conducted with rigour (Bell, 2010; Suter, 2012). Using the case study approach, I have ensured the trustworthiness and authenticity of my

research is strengthened through the methods outlined above. The quality of this research assures me that the data and outcomes of the study support an understanding of how schools implement effective digital technologies programmes.

Ethical Considerations

This section delves into the ethical considerations that were paramount in conducting this research. Key aspects explored include the ethical approval granted by the university's ethics committee, the procedures for gaining access to participants, the informed consent process obtained from each participant, the measures implemented to ensure anonymity and confidentiality, potential risks and harm to participants, and the safeguards established to uphold their rights and protections throughout the research process.

Ethical approval for this research was gained on February 8th 2024, by the University of Waikato Ethics Committee (FEDU003/24). Following approval, a memo was submitted and approved on the 19th of March 2024, due to difficulty recruiting participants. Amendments included:

• Modifying adherence to the phases of the research project outlined in the approved application so that focus groups, document analysis, classroom observations and one-to-one interviews will be conducted when appropriate and in no set order.

• Focus group participants will be given the alternative option of a one-to-one interview where participants numbers are low.

• Recruiting participants from a third school, if the above changes do not improve participant recruitment.

Access to participants

Permission was acquired from the principals for their schools to be engaged in the research (Appendix 1 & 2). The study's purpose and the time commitment that teachers who volunteer should expect from it along with the criteria for self-selection was outlined. Principals were asked to share this information with teachers via their in-school communication system and teachers who wished to volunteer were asked to email me directly to opt into the study. This process ensured that there was no opportunity for coercion by leaders to participate in the study. Additionally, if teachers emailed initially, but did not respond or send back consent forms, they were only contacted twice more, then it was presumed that they were no longer interested.

Informed consent

Informed consent is the principle that participants understand their rights within the research project and agree to take part in it (Lambert, 2012). Due to the differing methods of data collection, informed consent looked different in varying phases. These are outlined below.

Phases 1-3:

The teachers and leaders within the participating schools received a cover letter outlining their time commitment and the purpose of the study (Appendix 3) and an informed consent form (Appendices 4-6). If they chose to volunteer for the study, then they emailed me and filled out the relevant consent form/s. Additionally, Appendices 8-9 outline the information and consent forms that were distributed to parents whose children were part of the Phase 3 classroom observation. Appendix 10 outlines the assent statement that was read out to students before the classroom observation. Participants in Phases 1-3 did not have to engage in these phases, but once they did, there was no option to withdraw data later.

Phase 4:

The teachers and leaders in the participating schools for interviews received a cover letter outlining their time commitment and the purpose of the study (see Appendix 3) If they chose to volunteer for the study, then they emailed me and filled out the consent form (see Appendix 7). Once the interview was completed and the transcript shared, participants had two weeks to review and amend their transcripts.

Anonymity/Confidentiality

All information collected during the research was handled with strict confidentiality, and schools and participants were assigned pseudonyms to safeguard their identities. Every precaution was taken to prevent the identification of participants and schools through descriptions or titles, including the omission of any identifiable details. It is important to note that complete confidentiality cannot be guaranteed due to the nature of insider knowledge. When reporting data, details were anonymised to ensure the protection of participant identities. However, the focus groups were not conducted anonymously, as participants were acquainted with each other.

Potential harm to participants

Participation in the study was entirely voluntary and based on self-selection to minimise any potential pressure from senior leaders. Power imbalances can lead to feelings of intimidation or inadequacy among participants. As an external researcher with no authority within the schools, I aimed to reduce these dynamics. Within focus groups, I addressed potential power imbalances by emphasising the

confidentiality of discussions and requesting participants not to share group conversations outside the session. Additionally, to avoid any sense of coercion in subsequent research phases, I carefully chose my language, framing involvement as an invitation rather than urging or encouraging participation.

Participants' right to decline to participate and right to withdraw/withdraw data

Phases 1-3

Participants had the right to withhold any information they wanted, including refraining from contributing to the discussions. They did not have to engage in phases 1-3, but once they did, there was no option to withdraw data at a later date. Individuals did not get the chance to review and amend the transcript of the focus group session, as it contains the collective group's contributions. In the case of the classroom observations, parents received a letter and consent form.

Phase 4

Participants of the 1-to-1 interviews had time to review and amend their transcripts. These were emailed to participants, and they were asked to amend and/or confirm or withdraw within two weeks by return email.

Conclusion

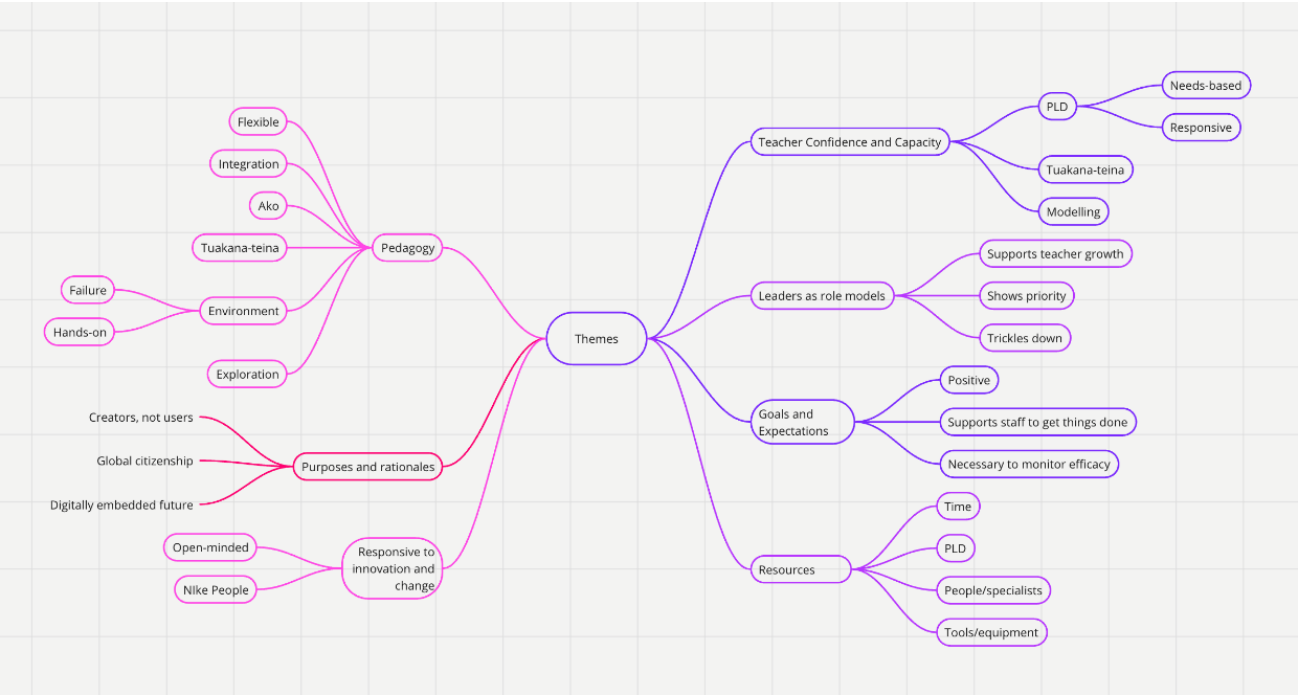
This methodology chapter has reviewed the research design and its rationale, demonstrating why this approach was best suited to achieve the research aims. A qualitative (collective) Case Study approach explored how schools implement effective digital technologies programmes. This aligns with the study's foundation in interpretivism and constructivism, which acknowledge participants' subjective perspectives and multiple realities. Triangulation was a crucial design principle to ensure data validity (trustworthiness), implemented in data collection methods and by examining multiple similar cases. The chapter concludes by acknowledging the ethical considerations applied throughout the research process.

Chapter Four: Findings

This section articulates the findings from the research conducted across two middle schools, Oakhaven School and Willowbrook School. Thematic analysis of the data gathered across the two schools and four phases led to the development of codes and nodes. These initial codes and nodes were collected in a mindmap, as shown below.

Figure 17

How Schools Implement Effective Digital Technologies Programmes



Note. Mindmap of codes and nodes based on data analysis

Through the comprehensive analysis of data obtained from focus groups, documents, classroom observations, and interviews, the codes and nodes represented in the mindmap above made way for two central themes and eight sub-themes. The first theme, Leaders as Catalysts for Digital Advancement, underscores the pivotal role of leadership in facilitating digital technology initiatives in their school. This overarching theme encompasses four sub-themes. The second theme, Teachers as Digital Technologies Champions, highlights the essential role of educators in overcoming obstacles, pursuing excellence and inspiring others. It is supported by four sub-themes. Subsequent sections in this chapter will provide an in-depth exploration of each theme and sub-theme. A key feature of these sections is the use of

participant voice and verbatim quotes. These offer unique and rich perspectives on the successful implementation of digital technologies programmes in educational settings.

Table 6

How schools implement effective Digital Technologies Programmes

Themes	Sub-Themes	Through:
Leaders as Catalysts for Digital Advancement	Establish clear goals and expectations	• An integrated Approach • A specialist Approach
	Allocate resources strategically	• People • Tools and equipment • Professional Learning and Development • Time
	Attend to their own learning	• Modelling a strong learning orientation • Understanding that confidence and competence filters down

	Support teachers to build their confidence and competence in digital technologies	• Acknowledgement of confidence and competence as barriers to DT implementation
		• Professional learning and development
		  ○ Continuous
		  ○ Gradual
		  ○ Targeted
		• Sandpit time
		• Organisational culture

Teachers as Digital Technologies Champions	Understand and are responsive to the rationale and purposes for digital technologies	• Equipping students with essential skills for the future • Fostering digital citizenship • Enhancing teaching and learning
	Demonstrate learning dispositions towards innovation and change	• Embracing learning opportunities • Igniting a passion for DT • Learning on the go
	Deliberately utilise a range of DT tools	• CTDT • DDDO
	Leverage pedagogical strategies to enhance engagement and achievement	• Exploration, creativity and agency • Practical, hands-on learning experiences • Ako • Learning across the curriculum • Resilience

Note. Table of themes and subthemes extracted from data analysis.

Leaders as Catalysts for Digital Advancement

Participants from both schools emphasised the pivotal role of leadership in effectively facilitating digital technologies (DT) initiatives. Leaders, they stressed, should establish clear goals and expectations, allocate resources strategically, attend to their own learning, and support teachers in building their confidence and competence in DT. These key aspects of leadership were identified as critical factors in creating and sustaining effective digital technologies programmes.

Establish Clear Goals and Expectations

The analysis revealed that establishing clear goals and expectations for DT use in the classroom provides a framework for success for those responsible for implementing DT programmes. While both schools acknowledged the importance of establishing clear goals and expectations for DT, their approaches to implementation differed. Oakhaven School approached their digital technologies programme through both integration and specialisation. Conversely, Willowbrook School adopted a model that prioritised DT as a specialist subject, with less perceived expectation on integration within homerooms.

Oakhaven School

Teachers at Oakhaven School reported that there were clear expectations from senior leaders that DT be integrated into classroom programmes. As Sylvia noted, "there is definitely an expectation that it is in the planning. That's first and foremost...their deans should be making sure that it is happening" (OH-IV). This approach is evident in the DT leader's development of school-wide plans that incorporate digital technology components across various subjects (OH-UP1-5). Ruth, the DT leader at Oakhaven, explains their approach: "Integration is a big thing here, right? To cover it all...we try not to do 'standalone' because...[teachers] should be able to apply [DT] throughout more" (OH-IV). This integrated approach is further reinforced by Sylvia, who observes that the teachers "always look at our inquiry topic and frame our digital literacy around that" (OH-IV). When asked if all the teachers were on board with this approach to integrating DT, Ruth responded "Yeah!" (OH-IV).

Willowbrook School

Conversely, Willowbrook School adopted a model that prioritises DT as a specialist subject, with dedicated DT and Media teachers and designated learning spaces for these specialisations. This approach is reflected in Dudley's statement: "there's not the expectation around seeing it within your unit plans or your classroom programme" (WB-FG). Instead, he says, "the [Board of Trustees] and the management see it as important to have [DT] as a separate subject" (WB-IV). This specialist model may allow for a more focused exploration of DT concepts. This is evidenced in Dudley's approach to planning where he

combines ‘Computational Thinking’ and ‘Designing and Developing Digital Outcomes’ progress outcomes in each unit ensuring students are exposed to both components of the curriculum (WB-UP1-2). Furthermore, Dudley explains, "So that's why I've got a ‘Year A’ and a ‘Year B’...by running ‘Year A’ and ‘Year B’, you're hitting the same learning intentions, but in a different context. And so...they're getting a broad range" (WB-IV). This approach was believed to facilitate a deeper dive into DT for students. However, specialisation also raises concerns about the potential for siloed learning and teacher reliance on the specialist teacher. This concern was evident in a focus group discussion at Willowbrook School, where one classroom teacher admitted, "I don't really unpack the [DT] curriculum as such" (WB-FG-Margaret) and another said "I use technologies where it fits, but I’m not hugely aware of the curriculum that goes with it. So I wing it" (WB-FG-Sam). Furthermore, there was a belief that integration of DT was less of a necessity in a middle school setting, as demonstrated by Sam's comment,

> I used a whole lot more digital technologies when I was a primary school teacher than at intermediate. And I think part of it is because there's a specialist area that takes care of that for me and allows me to focus on other things...I guess in an intermediate school, it's different...because I know [Dudley] does it. (WB-FG)

Integrated vs. Specialist Approaches

The contrasting approaches at Oakhaven and Willowbrook have resulted in distinct experiences for both teachers and students. At Oakhaven, teachers report appreciating the integrated approach, stating that this model allows students to experience DT as a "flow of learning" (OH-IV-Sylvia) and recognise its relevance across multiple contexts. Ruth explains,

> we did Gamefroot as part of storytelling last year and then those teachers should be able to use it again for...telling a myth...they've got that confidence from doing it with the school plan, to do it...every day in their class if they want to. (OH-IV)

Ruth continues to assert that once teachers see how much students enjoy working with digital tools, teachers “like teaching [DT]” (OH-IV). This suggests that Oakhaven's integrated approach fosters a degree of teacher confidence and student engagement in and familiarity with DT. Furthermore, the expectations from leaders to integrate has led to an increase in teacher confidence and competence.

At Willowbrook School, participants reported no clear expectations for the integration of DT into classroom programmes, but rather, clear expectations for prioritising DT within the specialist spaces. Sam reported ‘winging’ DT in her classroom and stated that she wasn’t familiar with the curriculum (WB-

FG). Despite this lack of confidence, she offered to participate in the classroom observation phase of my research. The observed Artificial Intelligence (AI) writing lesson, while not intentionally designed to target specific Digital Technologies progress outcomes, demonstrates how the use of digital tools in authentic learning contexts across the curriculum can incidentally meet these outcomes (WB-OB-NT). The lesson focused on using AI to generate images for fantasy stories based on student-written prompts (WB-OB-UP). This activity aligned with Progress Outcome 2 for Designing and Developing Digital Outcomes, which states that students should be able to "make decisions about creating, manipulating, storing, retrieving, sharing and testing digital content for a specific purpose, given particular parameters, tools, and techniques" (MOE, 2018b, p. 13). Although the lesson's primary focus was on improving writing skills in the context of a fantasy story unit, students engaged with AI tools to create and refine digital content, demonstrating an understanding of how these tools can be used to achieve specific outcomes. This unintentional alignment with the progress outcomes highlights how the integration of digital technologies can occur organically within other learning areas, regardless of teacher knowledge of the DTC and without clear expectations from leadership. This further illustrates the distinct roles of leaders as catalysts, who can speed up and facilitate digital advancement and teachers, who are at the chalk face and act as digital technologies champions.

Allocate Resources Strategically

Participants suggested that strategic resource allocation, which encompassed financial investment in people, tools and equipment, professional learning and development, and time, was a crucial factor in supporting effective DT programmes. This perspective is encapsulated by Dudley's statement, "you can establish a goal, but if you don't have the resources for it, then that's a waste of time" (WB-FG). The following section looks at the different ways that participants felt that Senior Leaders allocated resources strategically to support effective digital technologies programmes.

People as a Resource

Participants across both schools identified specialists as invaluable resources, emphasising the importance of their expertise and dedicated classroom spaces. Dudley's observation that the Board and management at Willowbrook School saw the value in "having [DT] as a separate subject" (WB-FG) and were willing to invest "time and energy and dollars into actually getting it up and running effectively as a programme" (WB-FG) exemplifies this perspective. Furthermore, while Oakhaven School strongly emphasises integration, it maintains a separate, dedicated DT programme led by a specialist teacher, Sylvia. This programme, however, aims to complement rather than replace the integrated approach.

Sylvia explained that when the school was in the process of “choosing a tech” (OH-FG), that many subjects were considered, but digital technologies was chosen as it was thought to be “actually more important” (OH-FG) than other subjects. Dudley suggests that if leaders “focus that way, on a space where you have the resources and you have the person that knows the knowledge, and you can target [DT] really well” (WB-IV). Nat’s support for this sentiment was clear, in her statement that “teacher knowledge and experience and enthusiasm" (WB-IV) is the most significant factor in creating successful DT programmes. She asserts, "it's the individual, every time" (WB-IV-Nat).

Tools and Equipment as Resources

Access to appropriate tools and equipment was also deemed essential for robust DT programmes. Participants across both schools acknowledged that having a range of devices, such as Chromebooks, and engaging tools, such as robots and programs like Minecraft EDU, supported student engagement and enhanced learning experiences. For example, Ruth noted that while "unplugged stuff" (OH-IV) was possible, "it's not as engaging" (OH-IV) as having access to "cool hands-on robotty stuff" (OH-IV) and Margaret stated that “we’ve got more devices in our classrooms that we’ve ever had. That willingness from leadership to go ‘yes this is important’, is important” (WB-FG). Furthermore, Sylvia described the investment of money on tools and resources as a high priority in her school, saying “resourcing is massive. My school has been very generous in the money they've spent on my resources” (OH-IV). These quotes highlight the teachers’ perception that purchasing and utilising a variety of tools and equipment enhances student motivation and supports the success of digital technologies programmes.

Interestingly, while both schools recognised the importance of adequate device access, they differed in their beliefs about the ideal device-to-student ratio and ‘bring your own device’ (BYOD) policies. Oakhaven School embraced a BYOD philosophy, leading to a close to 1:1 device ratio combining school-owned and personally owned devices. In contrast, Willowbrook School participants emphasised their schools’ belief in not requiring the community to provide devices, leading to a 1:2 device ratio. Teacher participants across both schools strongly advocated for a 1:1 device ratio, as communicated by Dudley, “it would be nice one to one” (WB-FG). Margaret’s response to this was “Oh my god, yes” (WB-FG). The differing school perspectives on device ratios and BYOD policies, influenced by factors such as school culture, community demographics, and leadership philosophies, highlight the complex considerations involved in resource allocation decisions.

Professional Learning and Development as a Resource

Beyond financial investment, participants highlighted the importance of professional learning and development (PLD) as a crucial resource for supporting teachers in effectively implementing DT initiatives. They stressed that PLD should provide teachers with the opportunity to develop both their confidence and competence in using digital technologies. The need for PLD to be viewed as a valuable use of time and resources is evident in Margaret's statement: "I think if we're expected to help kids move forward, then time and energy has to be put into us too, for our development" (WB-FG). Recognising and addressing the time constraints faced by teachers and providing dedicated time for them to engage in meaningful PLD suggests the importance of digital technologies to Senior Leaders, “we’ve set aside a time during our staff meeting time...we are doing this and it takes priority” (OH-IV-Sylvia). This resourcing stood out as a crucial factor in effective DT implementation. The concept of PLD features across themes and sub-themes within this research and will be unpacked in more depth in the final subtheme of this section, as a way in which leaders support teachers to build their confidence and capacity in DT.

Time as a Resource

The analysis of data suggested that time itself is a critical resource in the context of DT implementation. Participants acknowledged the challenges associated with finding the time to integrate new learning, particularly given the demands of an already "jam-packed teaching space" (WB-FG-Margaret). Sam's comment, "As a practitioner, you need time to go and plan these things and look at them. And think ‘how do I use this?’" (WB-FG) emphasises this challenge. Furthermore, Sylvia suggested that without the time, “if you have any hesitancy about teaching [DT], you are not going to use that as your first option" (OH-IV). The curriculum refresh underway in New Zealand schools was also referenced by participants as adding another barrier to an already pressurised middle school curriculum. Margaret and Dudley discussed the “narrow timetable” (WB-FG-Dudley) that middle schools are faced with and the limited time available within a single lesson, underlining the pressure to address multiple learning objectives. Margaret said “you’ve only got an hour a quarter and then you have to do this and this…”(WB-FG). Dudley elaborated that “you can't roll stuff over like you do at a primary school” (WB-FG).

Recognising that ‘time as a resource’ extends beyond the classroom, a participant at Willowbrook School highlighted their school's commitment to providing a staff member with dedicated time to develop their expertise in DT and lead professional learning for their colleagues, through a Community of Learning

(COL) role (WB-IV-Nat). This dedicated allocation of time for leadership and development demonstrates a strategic approach to building capacity and supporting sustainable change.

Attend to Their Own Learning

Teachers believed that leaders who demonstrated some proficiency and willingness to engage in digital technologies were better equipped to inspire and guide staff, fostering a culture of innovation and continuous improvement. This perspective is encapsulated in Ruth's statement, "if they [leaders] can do it, we [teachers] can do it" (OH-IV). The perception was that leaders who themselves lacked confidence or competence in this area could inadvertently hinder school-wide DT initiatives.

At Oakhaven School, participants spoke positively about their Senior Leadership team's willingness to learn and develop their digital literacy, even though they were not deemed to be particularly proficient. This observation underscores that leaders do not need to be experts but rather active learners who model a strong learning orientation. The positive impact of this approach was evident in Ruth's comment: "Just seeing them problem-solve was quite cool. Like, they weren't just doing their own thing. They were actually actively involved" (OH-IV). Sylvia also discussed the power of this moment, saying “they modelled that beautifully” (OH-IV). Witnessing their leaders' willingness to learn alongside them likely empowered teachers to embrace new technologies and approaches. Additionally, as DT leaders, Sylvia and Ruth had opportunities to advance their professional learning through programs like the Mindlab Postgraduate Certificate in Digital Technologies, working with Using Technology Better (UTB) facilitators, and attending DT-based conferences such as INTERFACEXpo (OH-FG-Ruth, OH-FG-Sylvia). These opportunities for professional growth were seen as valuable in their contexts, as it enabled them to “pass [the knowledge] onto staff” (OH-FG-Ruth).

By comparison, participants at Willowbrook School reported that they believed the Senior Leader’s lack of competence and confidence in using digital technologies directly impacted on teachers at a classroom level. Margaret said that “their level of expertise and what they’re comfortable and confident doing filters down” (WB-FG). The “old school thinking” (WB-FG-Margaret) was mentioned as impacting on systems like “the number of devices, whether you're a BYOD school [and] whether you have to print all your planning or not” (WB-FG-Sam). This was further confirmed by Margaret, who perplexingly reported that “all my planning is online and I **still** have to print it out on paper” (WB-FG). Sam suggested that at other schools she had been at where leaders were “very digitally orientated” (WB-FG), there were higher expectations and therefore, her perspective was that “there's a huge correlation...between...capabilities

in senior leadership in a school, and what your school produces in the way of digital technologies" (WB-FG).

Support Teachers to Build Their Confidence and Competence in DT

The data revealed that participants believed leaders act as catalysts for digital advancement by building teachers' confidence and competence in using DT. Participants acknowledged the importance of teacher confidence and competence when implementing effective DT programmes and suggested ideas for supporting teachers' growth in this area.

The importance of confidence

Across both schools, a lack of teacher confidence was identified as a significant barrier to the successful integration of digital technologies. Sylvia's statement that "[DT's] actually...one of those scary subjects...it can be actually quite daunting for a lot of people" (OH-FG) was supported by Ruth, who acknowledged that "the confidence to do [DT] will be the biggest barrier" (OH-IV). Sylvia also noted that "there are some teachers in the school that are really scared [of DT]" (OH-FG). These statements emphasise the importance of addressing teacher anxieties and providing targeted support to build their confidence and skills. Furthermore, Sylvia's observation that "when a teacher is reluctant in an area, that absolutely feeds through to the kids" (OH-FG) highlights the wider impact that teacher confidence, or lack thereof, can have on student learning experiences.

The importance of competence

Teachers across both schools also referenced teacher competence as being impactful on DT programmes. Sylvia's statement encapsulated this idea:

> if you only teach a digital technology once, and then swipe it out for the rest of the year, not only does your confidence have to be rebuilt next time you try to teach it, but your physical capabilities are going to be fluttered away in the wind. (OH-IV)

At Willowbrook School, Dudley and Margaret specifically mentioned 'knowledge' when asked what they believe are the biggest barriers to teachers integrating DT in their classrooms. Ruth explained that at Oakhaven School, the "teaching staff are at very different levels of understanding and capability" (OH-FG) when using digital technologies. Sylvia elaborated on this, stating that leaders are actively working to support teacher knowledge and understanding of the DTC.

How can teacher confidence and competence be supported?

Participants identified continuous, deliberate and purposeful professional learning and development (PLD), tailored to the varying needs of teachers, as essential for building both confidence and competence. At Oakhaven School, where teachers reported feeling more confident in their use of digital technologies, PLD was a key factor in their success. Sylvia's comment that the external facilitator who supported their PLD "helped shape the programme for me, because I didn't previously have much experience in the digital world" (OH-IV) demonstrates the transformative impact that well-designed and facilitated PLD can have. However, the participants also highlight potential pitfalls in PLD provision. At Willowbrook School, where teachers expressed lower levels of confidence and competence in DT, participants felt that PLD opportunities were limited and not always effective. Sam's comment, "I've had very little professional development here. But ... when it does happen, it's usually a broad sweep of one thing" (WB-FG), suggests a lack of consistency and a potential misalignment between the PLD provided and the specific needs of teachers.

Furthermore, participants raised concerns about the efficacy of large group PLD sessions, highlighting the need for more differentiated approaches that cater to the diverse skill levels and learning preferences of teachers. The need for differentiated PLD is evident in comments such as Margaret's: "When in a group of 40 you don't always get that time because there's other people like ‘oh, I already know how to do that’" (WB-FG), and Sam's observation that "someone's still trying to log in" (WB-FG) while others are ready to move on. The need for modelling and 'snippets’ of learning was a recurring theme, with participants emphasising the importance of manageable steps and ongoing support. Ruth's advice to "give them small bites, like don't overload them" (OH-FG) encapsulates this approach. Furthermore, the opportunity to observe teachers who are competent users of digital tools was mentioned as a PLD strategy at Willowbrook, where Dudley stated that he “always [sends] people to [Margaret] because...[she] does Hapara really well” (WB-FG). He suggested that allowing others to observe competent users of specific digital tools was a good way for teachers to see the tool in use by teachers and students and support their own confidence and competence at using the tool/s in their own context. Sam affirmed this by stating “Because some people are visual learners, they want to see someone else do it in their class, and then they'll go ‘Oh, yeah, I could do that. That's not that difficult’” (WB-FG). Providing teachers with opportunities to observe effective practice, receive targeted guidance, and gradually build their skills in a supportive environment emerged as crucial for fostering confidence and competence in DT.

The concept of "sandpit time"—time for exploratory and playful learning—was identified as valuable for both teachers and students at Willowbrook School. This dedicated time for experimentation and discovery was seen as crucial for building confidence and fostering a deeper understanding of digital tools and concepts. Sam's reflection, "The more time you have as a teacher to play with things, the more confident you are" (WB-FG) underscores the importance of providing opportunities for teachers to engage in this type of unstructured exploration to build competence, which in turn, builds confidence. Nat suggested that “permission [from leaders] to try” (WB-IV) is an important part of building teacher confidence and competence. Sam built on this, saying that the organisational culture was a critical factor in teachers developing confidence and competence, explaining that:

> if mistakes are accepted, not just for kids, but for teachers as well...then people will be more resilient when it comes to having a go at something and not feeling like they're an idiot as an adult, not knowing. (WB-FG)

At Oakhaven School, Sylvia and Ruth both recognised a supportive environment as being “massively” (OH-FG-Sylvia) important to teachers implementing DT programmes. This culture of experimentation, making mistakes, and reflecting on the outcomes was seen as crucial for teachers to develop confidence and competence and discover effective pedagogical applications of DT.

This section has highlighted the crucial role of leaders as catalysts for digital advancement within their schools. By establishing clear goals and expectations, strategically allocating resources, actively engaging in their own learning, and providing ongoing support to build teacher confidence and capacity, leaders break down many barriers for teachers and create a fertile ground for the successful implementation of digital technologies programmes.

Teachers as Digital Technologies Champions

In addition to the imperative role of school leaders in catalysing digital advancement, this section highlights the essential role of educators in championing digital technologies initiatives. The research found that this can be done when teachers: understand and are responsive to the rationale and purposes for digital technologies, demonstrate a learning disposition towards innovation and change, deliberately utilise a range of DT tools and leverage pedagogical strategies to enhance engagement and achievement.

Understand and are responsive to the rationales and purposes for DT.

The data reflected the importance of teachers understanding the rationales and purposes behind digital technologies programmes. Participants felt that effective programmes should equip students with essential skills for the future, foster digital citizenship and enhance teaching and learning. This is in line with Sylvia's statement, "if you don't know where something comes from, you can't understand where it's going to go" (OH-IV-Sylvia).

Equipping Students with Essential Skills for the Future

One prominent rationale centres on the perceived importance of digital technologies for students' future employment prospects. The participants recognised that proficiency in digital skills is becoming increasingly essential for success in the modern workforce. As Ruth states, "there are lots of jobs in the digital world" (OH-IV), highlighting the career-oriented benefits of digital literacy. This perspective is echoed by Sylvia, who emphasised that "the world is computerised these days" (OH-IV) and that students need a strong foundation in digital technologies to succeed in this environment. Similarly, Ruth highlighted the relevance of digital technologies to students' lives, stating that their world "is phones and computers and gaming" (OH-IV) and that this curriculum helps them "use that safely and...effectively" (OH-IV). At Willowbrook School, Margaret believed that digital technologies are "where the world's heading" (WB-FG) and therefore it is important that teachers are responsive to this in the programme design.

Beyond future employment, the participants also emphasised the role of digital technologies in fostering digital literacy and computational thinking. Dudley, for instance, compared digital technologies to a new language, stating that it is "another way of talking...and writing and understanding" (WB-IV). Sam supported this statement by discussing the necessity for students to be digitally literate, stating "it's critical for kids to have that literacy that goes with [DT], and...the language that goes with it" (WB-FG). This perspective highlights the cognitive benefits of engaging with digital tools and concepts, framing them as essential literacies for a digitally immersed future. Similarly, Dudley sees value in teaching students about technology beyond just its applications, emphasising that students should understand the "important background stuff" (WB-FG) and learn to "utilise technology properly" (WB-FG). Margaret supports this, suggesting that our role as teachers is to introduce DT as "more of a work tool, rather than just a social entertainment tool" (WB-FG).

Fostering Digital Citizenship

The participants also express a strong belief in the need to educate students about responsible technology use and online safety. They acknowledge the potential risks associated with internet access, particularly for young people, and advocate for incorporating digital citizenship and online safety into the curriculum. Dudley, for example, highlighted the need for explicit instruction on online safety, arguing that teaching students how to "utilise [technology] properly" (WB-FG) can help them "keep themselves safer" (WB-FG). Ruth also emphasised that digital technologies education teaches students "how to use [technology] safely" (OH-IV) and "how to navigate the online world" (OH-IV) responsibly. Furthermore, Sylvia provides more detail about Oakhaven School's approach to digital citizenship, mentioning topics like 'digital footprints', 'password protection' and 'online safety'. She also mentions explicit teaching of these topics during dedicated digital literacy lessons (OH-IV, OH-UP2, OH-UP5). This focus on responsible technology use underscores the participants' understanding of digital technologies as powerful tools that require careful navigation.

In addition to practical skills and safety considerations, the participants also recognise the broader social and cultural implications of living in a digital age. They highlight the need for students to develop critical thinking skills to engage with online content thoughtfully and responsibly. Sylvia stressed the importance of teaching students to think critically about the information they encounter online, questioning "where this information is going. Where it's coming from. Who's making it?" (OH-IV). This emphasis on media literacy and critical thinking reflects a broader understanding of digital technologies as shaping not only individual lives but also social norms and values. Nat's example of using ChatGPT with her students to write a script further illustrates this approach. When students expressed concerns about whether this was cheating, Nat capitalised on the "teachable moment" (WB-IV) to discuss the ethics of AI. By doing so, she helped students develop a more nuanced understanding of technology's capabilities and limitations.

Enhancing Teaching and Learning

Participants felt that DT has the potential to enhance teaching and learning by promoting student engagement and facilitating personalised learning and differentiation.

Participants at Oakhaven School observed that DT can significantly enhance student engagement and motivation. This was often attributed to the interactive nature of many digital tools and their relevance in students' lives. Both Sylvia and Ruth pointed out that students are immersed in a digital world and leveraging this inherent interest can enhance learning. Sylvia stated "when you've got a fantastic Minecraft Education world to work with...it's so engaging" (OH-FG) and Ruth added "you never really

have disengagement in digital technologies" (OH-IV). Syliva also emphasised the importance of keeping DT relevant and enjoyable, noting that "I think the key to being effective is keeping it relatable, but also the fun element, which is not hard to do in digital. There's just so much out there" (OH-FG).

The research suggests that DT can support personalised learning and differentiation by providing students with more choice and control over their learning pathways. Online platforms in particular offer opportunities for students to learn at their own pace and receive tailored feedback. Margaret and Sam explained that Education Perfect and Prototec are used at Willowbrook School. These tools, if used effectively, can personalise or differentiate student learning. Furthermore, Sam explained that she uses AI in her writing programme, where her students "did some writing that they put into AI and...took the feedback and upgraded it" (WB-FG). Margaret explained that while she hasn't used AI with her students for personalised learning, she was able to differentiate a text that she found, using AI, by requesting it to adapt the text for three different curriculum levels. These texts were then able to be utilised and engaged with by three different groups of learners, at their specific levels.

The examples from Oakhaven School and Willowbrook School demonstrate the significant potential of DT to enhance teaching and learning. By fostering engagement, providing personalised feedback, and supporting differentiation, DT can create more meaningful and effective learning experiences for students. As technology continues to evolve, it is essential for educators to explore innovative ways to leverage these tools to enhance teaching and learning.

Participants felt that effective DT programmes equip students with essential skills for the future, foster digital citizenship and enhance teaching and learning. By understanding and responding to these rationales and purposes of the DTC, teachers act as DT champions, supporting the implementation of effective digital technologies programmes.

Demonstrate learning dispositions towards innovation and change.

This section examines the significance of learning dispositions in the context of digital technologies education. The participants argued that this is not simply a desirable quality for educators in this field, but rather a fundamental prerequisite for creating effective DT programmes. Ruth stated that "the biggest thing is a teacher being on board to teach [digital technologies], the...open mindset" (OH-IV). This section will explore three key dimensions of the learning dispositions identified through analysis of the data: embracing learning opportunities, igniting a passion for DT and learning on the go.

Embracing Learning Opportunities

A recurrent theme across the participants was the importance of teachers being active learners themselves, constantly seeking to develop their own knowledge and skills in the ever-changing landscape of digital technologies. This goes beyond simply attending mandatory professional development courses; it is about developing a mindset of continuous learning and a willingness to explore new ideas and approaches.

The participants offered compelling examples of how they have embraced learning opportunities to support their understanding of DT. Ruth's decision to undertake the Mindlab course, even though it was not a requirement for her role at the time, demonstrates a clear commitment to personal and professional growth in this area (OH-IV). This proactive approach equipped her with both the knowledge and the enthusiasm to take on a leadership role in digital technologies at her school (OH-IV). Dudley actively seeks opportunities to expand his expertise. He attends conferences like INTERFACEXpo to stay abreast of new developments and engage with industry professionals. He also ventured beyond his comfort zone to learn a new programming language - Python, despite acknowledging his limited initial knowledge, “my Python knowledge is about like an nth of a percent” (WB-IV-Dudley). Similarly, Ruth actively seeks out professional development opportunities, such as the Minecraft Student Academy and Google certifications, to further enhance her skills and knowledge. Ruth's dedication to ongoing learning is also evident in her willingness to share her expertise with colleagues through structured professional development sessions and an open-door policy for support (OH-FG-Ruth). Nat observes that successful DT teachers are characterised by their openness to learning and their willingness to "put energy into learning something new" (WB-IV). This willingness to venture outside of one's comfort zone and embrace new challenges is indispensable in a field that is constantly evolving.

Igniting a Passion for Digital Technologies

Participants highlight the significance of genuine enthusiasm and energy in effective digital technologies teaching. This passion for the subject matter is evident in the way these teachers discuss their work and, in their desire to share their knowledge and excitement with their students (OH-IV-Ruth, WB-IV-Nat). Ruth's comment that "you never really have disengagement" (OH-IV) in digital technologies speaks to the captivating nature of the subject when taught with energy and zeal. This enthusiasm can create a positive feedback loop: enthusiastic teachers are more likely to inspire and motivate their students, leading to increased engagement and deeper learning (OH-IV-Ruth). Nat goes so far as to identify "enthusiasm" (WB-IV) as a defining characteristic of effective digital technologies teachers. A genuine

passion for the subject is a key driver of a teacher's effectiveness. When teachers are genuinely excited about what they are teaching, this translates into more engaging and meaningful learning experiences for students.

Learning on the Go

The rapid pace of technological advancements demands that digital technologies teachers embrace uncertainty and adopt a learning-on-the-go approach. This involves a willingness to experiment, learn from setbacks, and continually adapt and adjust their teaching practice in response to new developments and unforeseen challenges. Margaret suggested that this may even lead to greater learning outcomes (WB-FG). Dudley highlights the need for teachers to "keep learning, keep knowing that you're always probably behind the eight ball a little bit" (WB-IV), acknowledging the constantly changing nature of digital technologies as an "ever-evolving, ever-moving beast" (WB-IV) and suggesting that teachers are required "to roll with it" (WB-IV). Furthermore, Sylvia exemplifies flexibility by describing how she has had to adapt her teaching in response to unforeseen circumstances like internet outages and students with limited prior experience with technology. Her willingness to "completely reframe" (OH-IV) her lessons and find ways to make them work offline to differentiate for "those kids had a lot of fear around computers" (OH-IV-Sylvia) demonstrates a high degree of flexibility. Sam refers to teachers who have this strong learning orientation as "Nike people" (WB-FG), these people, she says "just do it...they'll just take the risk and they'll have a go" (WB-FG).

Learning dispositions towards innovation and change, as characterised by the three key dimensions discussed above, were seen to be a crucial foundation for effective digital technologies programmes by participants in the study. By embracing learning opportunities, igniting a passion for DT and being prepared to learn on the go, teachers can champion digital technologies and create engaging and relevant learning programmes that equip students with the skills and mindsets they need to thrive in a technology-driven world.

Deliberately utilise a range of DT tools

The use of DT tools (including programs) arose organically throughout the research phases. Teachers mentioned in passing some of the tools that they use or have used in their programmes to scaffold student understanding. While tools and equipment as resources has already been discussed as a sub-theme in Leaders as Catalysts for Digital Advancement, this sub-theme focusses not on the purchasing of

the tools, but the deliberate use of the tools in classroom programmes to support DT progress outcomes or student enhance learning outcomes.

The table below (Table 7), lists the DT tools identified by teacher participants as key components of their current or recent programmes.

Table 7

DT Tools in Programmes

	Ruth	Sylvia	Dudley	Sam	Margaret	Richard	Nat
AI			✓	✓			✓
Animation	✓					✓	
Book Creator	✓						
Blooket	✓						
Bloxels	✓						
Canva	✓			✓		✓	✓
Chromebooks	✓	✓	✓	✓	✓		✓
Code.org	✓		✓				
Drones	✓						
Education Perfect				✓			
Gamefroot	✓		✓				
Gimkit	✓						
Google Workspace	✓	✓	✓	✓	✓		✓
Grok Academy			✓				
Hapara					✓		
iPads			✓	✓	✓		
Kahoot	✓						
MaKey MaKey	✓	✓					
Micro:bits		✓	✓				
Minecraft EE	✓	✓	✓				
Photoshop						✓	
Procreate						✓	
Prototec				✓			

Robots	✓	✓	✓				
Scratch		✓	✓				
Sphero		✓					
Stop Motion						✓	
Tinkercad	✓	✓	✓				
3D Printer	✓	✓	✓				

Note: Table of tools mentioned in programmes by participants in the Case Study.

Leverage pedagogical strategies to enhance engagement and achievement

Participants strongly supported the assertion that teachers who implement effective digital technologies programmes leverage pedagogical strategies to enhance engagement and achievement. This was not simply about using technology in the classroom, but rather about utilising tools and concepts to enhance learning. The strategies that participants noted were: exploration, creativity and agency; practical, hands-on learning experiences; ako; learning across the curriculum; relevance, real-world application and transferability; and resilience-building.

One prominent theme across schools was the importance of a student-centred pedagogy where teachers create learning environments that prioritise student exploration, creativity, and agency. Sylvia emphasised the need for a "learning based teaching style" (OH-IV) that encourages students to "show me the things that they find" (OH-IV). This approach, she argued, is essential given the vastness of the digital world and the need for students to develop their own pathways of inquiry and discovery. Other participants echoed similar sentiments around exploration, creativity and agency. Nat noted that we “need to teach kids to be thinkers and...tinkerers...and think about the impact that technology has, and what would be the advantages and disadvantages of using technology in this moment” (WB-IV). Furthermore, Richard emphasised the need for teachers to scaffold programmes for kids to be creators “and not just users” (WB-FG). Sylvia reinforced this by stating that “room for agency is vital” (OH-IV). One way Dudley demonstrates allowing room for agency in his programme is by differentiating based on student needs. He described offering different coding languages to students based on their prior experience and interests, allowing them to direct their learning experience within the framework of his programme (WB-IV).

In effective digital technologies programmes teachers recognise the value of practical, hands-on learning experiences. Sylvia argued that "it is a technology subject, they should be able to be getting involved

with their hands and their bodies, you know, talking, discussing working on things together, not just sitting at a computer" (OH-IV). Her decision to incorporate 3D printing into her programme exemplifies this commitment to providing students with tangible, engaging learning experiences that connect digital concepts to real-world applications. David emphasised the value of unplugged activities – learning experiences that don't rely on computers – as a foundation for understanding digital concepts. He describes this approach as "a sandbox place...it's where they're learning to do things" (WB-IV).

Ako was also identified as a key pedagogical strategy in effective digital technologies programmes. Ako is a Māori word, intertwining both teaching and learning. Te Kete Ipurangi (TKI) state that it “affirms the value of the pair and group learning approaches in which students interact with their peers, teacher, tasks, and resources” (n.d.-b, para. 2). Recognising that technology can sometimes lead to isolation, teachers who value the pedagogical strategy of ako prioritise opportunities for students to collaborate, work together, share ideas, and learn from one another. Sylvia's emphasis on group work reflects a commitment to fostering a collaborative learning environment where students can support and challenge one another's thinking. “I would expect there to be a lot of group work...a computer is a really easy way for us to stay isolated...it's a very one on one situation. So I try to...combat that” (OH-IV-Sylvia).

Furthermore, the data also suggests that effective collaborative pedagogy in digital technologies often involves embracing tuakana-teina. In te ao Māori, tuakana-teina is a philosophy where a “more expert tuakana...helps and guides a...less less expert...teina” (TKI, n.d.-a, para. 1). An important part of this philosophy is that a child who was the tuakana yesterday, may be the teina today (TKI, n.d.-a). Sam, Margaret and Sylvia highlighted the importance of tuakana-teina in their programmes. Sam describes how she leverages the expertise of students who are more confident with technology, asking them to "go and teach [other] kids" (WB-FG) who might be struggling. She believes this has a "trickle-down effect" (WB-FG), where knowledge is shared and disseminated throughout the class. Additionally, she feels "it's empowering for our kids when they know that the teacher doesn't know how to do something and they step into the responsibility of being the teacher" (WB-FG). Margaret suggests that “kids learn sometimes better from each other than they do from us” (WB-FG). Dudley adds that he often uses a collaborative strategy to find solutions to unknown problems that arise in his class by asking the kids to “work it out together” (WB-FG). He suggests that by using this strategy, kids switch on and think "Ah, I'm not dumb” (WB-FG-Dudley). This data suggests that teachers who are comfortable with not having all the answers and are willing to learn alongside their students as co-constructors of knowledge are more likely to be effective.

Rather than treating digital technologies as a stand-alone subject, the teachers at Oakhaven School see it as a versatile tool that can enhance and enrich learning across the curriculum. This approach is particularly evident in the school's use of inquiry learning, where digital technologies play an integral role in supporting students' exploration of a specific theme or concept through “a lot of integration” (OH-IV-Sylvia). Ruth elaborated on this, stating “school wide, we always integrate into the term inquiry...a digital element's gonna be...a Minecraft outcome. Then...we're going to be looking at Edison robots” (OH-FG). This integration of digital technologies into inquiry learning provides students with opportunities to develop their digital skills and helps them see the connections between different learning areas. Teachers at Oakhaven School described how digital technologies naturally fit within various subjects, such as mathematics and social studies. Sylvia explained that "lots of mathematics" (OH-FG), such as working with coordinates, "is hugely linked into those basic coding skills" (OH-FG). Similarly, Ruth pointed out that "algorithms can be done through writing" (OH-FG) and that there are numerous opportunities to incorporate digital technologies into existing teaching practices. Lots, she said “you do without actually knowing it's digital” (OH-FG-Ruth). However, Sylvia asserted that “if you don’t know how to integrate, you don’t know how to integrate” (OH-FG).

Participants across both schools emphasised the importance of relevance, real-world application, and transferability in DT programmes. This emphasis on relevance and real-world application is evident in the participants' calls for digital technologies programmes to be grounded in “meaningful context” (WB-FG-Sam) and fit “within a context of learning, so it's not standalone” (WB-FG-Margaret). This focus on context, they argue, helps students to see the connections between different subjects and understand how digital technologies can be used to solve problems and enhance learning across a range of areas. The importance of ‘transferable skills’ is further evidenced by Ruth, who stated that digital fluency involves "being able to...cross-apply the skills"(OH-IV) and Margaret, who suggested that students should understand that any skill learnt “crosses over... [its] not just one dimensional” (WB-FG) and students should automatically ask themselves "can [this] be used somewhere else?” (WB-FG-Margaret). The consistent emphasis on ‘context’ in these discussions reveals a shared understanding among participants that digital technologies should not be taught in isolation. Instead, they believe that by situating digital technologies learning within meaningful and relevant contexts, and by highlighting the real-world applications of these skills, teachers can create more effective learning experiences for students.

Finally, participants emphasise the importance of resilience in digital technologies programmes. When recognising the importance of resilience, teachers make room to scaffold students’ acceptance of failure

when designing learning experiences. Sylvia's emphasis on expecting "to see that being encouraged" (OH-IV) in DT programmes exemplifies this commitment to building resilience in digital learning. She continues to explain that “I told them, you're going to write a code, and it's going to be wrong, and you're going to have to fix it 100 times” (OH-IV). She also suggests that DT “is not a subject for those who are not persistent” (OH-IV) and she “would expect to see this being built upon...opportunities for them to make mistakes intentionally” (OH-IV-Sylvia). Furthermore, Dudley's comment that DT teaches students to analyse "why isn't this working?" and to systematically "go through the process" (WB-IV) to identify and address errors, highlights the problem-solving nature of this subject and the importance of scaffolding resilience.

The participants present a compelling argument that pedagogical choices are paramount in creating strong and effective digital technologies programmes. Teachers employing these strategies are not simply delivering content but are actively shaping the learning environment to scaffold essential skills, foster creativity, and empower students to become confident and responsible users and creators of digital technologies solutions.

This research identified two key themes: Leaders as Catalysts for Digital Advancement and Teachers as Digital Technologies Champions, highlighting the crucial roles both school leadership and teachers play in the effective implementation of digital technologies programmes. School leaders catalyse effective DT programmes by establishing clear goals and expectations for digital technology use, strategically allocating resources, engaging in their own digital learning to inspire staff, and providing ongoing, relevant professional development to build teacher confidence and capability. Furthermore, teachers are champions for digital technologies when they understand and are responsive to the rationales and purposes for digital technologies, demonstrate learning dispositions towards innovation and change, deliberately utilise a range of DT tools and leverage pedagogical strategies to enhance engagement and achievement. This two-pronged approach, encompassing strong leadership actions and enthusiastic, informed teaching, creates a powerful synergy that drives the effective implementation of digital technologies programmes in schools, ultimately leading to more engaging and effective learning experiences for students.

Chapter Five: Discussion

The introduction of digital technologies to the New Zealand Technology Curriculum (DTC) has necessitated a shift in teacher practice, requiring teachers to develop the necessary knowledge, skills, and confidence to effectively teach digital technologies. Moreover, school leaders have been tasked with guiding and facilitating this curricular implementation, regardless of their prior experience or personal inclinations.

This study aimed to investigate how schools implement effective digital technologies programmes. The research explored the following questions:

1. What are the rationales and purposes for digital technologies programmes in New Zealand middle schools?
2. How do teachers support the implementation of effective digital technologies programmes?
3. What leadership actions are associated with effective digital technologies programmes?

Through a collective Case Study approach, this research sought to gain insights into the key factors that contribute to the effective DT programmes in New Zealand middle schools. By examining participants' perceptions of the DTC and exploring how their interpretations guide programme design, this study aimed to make meaning of how teachers and leaders in middle schools implement effective digital technologies programmes. The findings of this study have important implications for teachers, leaders and policymakers seeking to enhance the efficacy of digital technologies programmes.

This chapter extends the analysis of the data presented in the findings chapter, connecting it to relevant literature to gain a more comprehensive understanding of its critical implications. Two key themes were identified in this analysis: ‘Teachers as Digital Technologies Champions’ and ‘Leaders as Catalysts for Digital Advancement’.

While teachers and leaders have distinct roles in implementing the DTC, their actions are interconnected and often overlap. Common themes can be identified from their collaborative efforts (as shown in Table 8, below). However, to better understand the specific contributions of each, the roles of teachers and leaders have been deliberately separated in this synthesis. This does not imply that these roles are mutually exclusive, but rather, recognises the unique roles and responsibilities of each. This approach

also further highlights the complex nature of digital technologies, where boundaries between different dimensions often blur.

Table 8

Similarities Between Leaders and Teachers

	Leaders	**Teachers**
Clarity of purpose	Establish clear goals and expectations.	Understand and are responsive to the rationale and purposes for digital technologies.
Learning	Attend to their own learning. Allocate PLD	Demonstrate a learning orientation towards innovation and change.
Resources	Allocate resources strategically, including people, tools and equipment, PLD and time.	Deliberately utilise a range of DT tools.
Building pedagogical capability	Support teachers to build their confidence and competence in DT.	Employ a range of pedagogical strategies.

Note. The table illustrates the relationship between leaders and teachers when implementing digital technologies programmes.

This Discussion chapter is organised around the three research questions, with subheadings guiding readers through the sub-themes identified in the research, as indicated in Table 9.

Table 9

Areas for Discussion

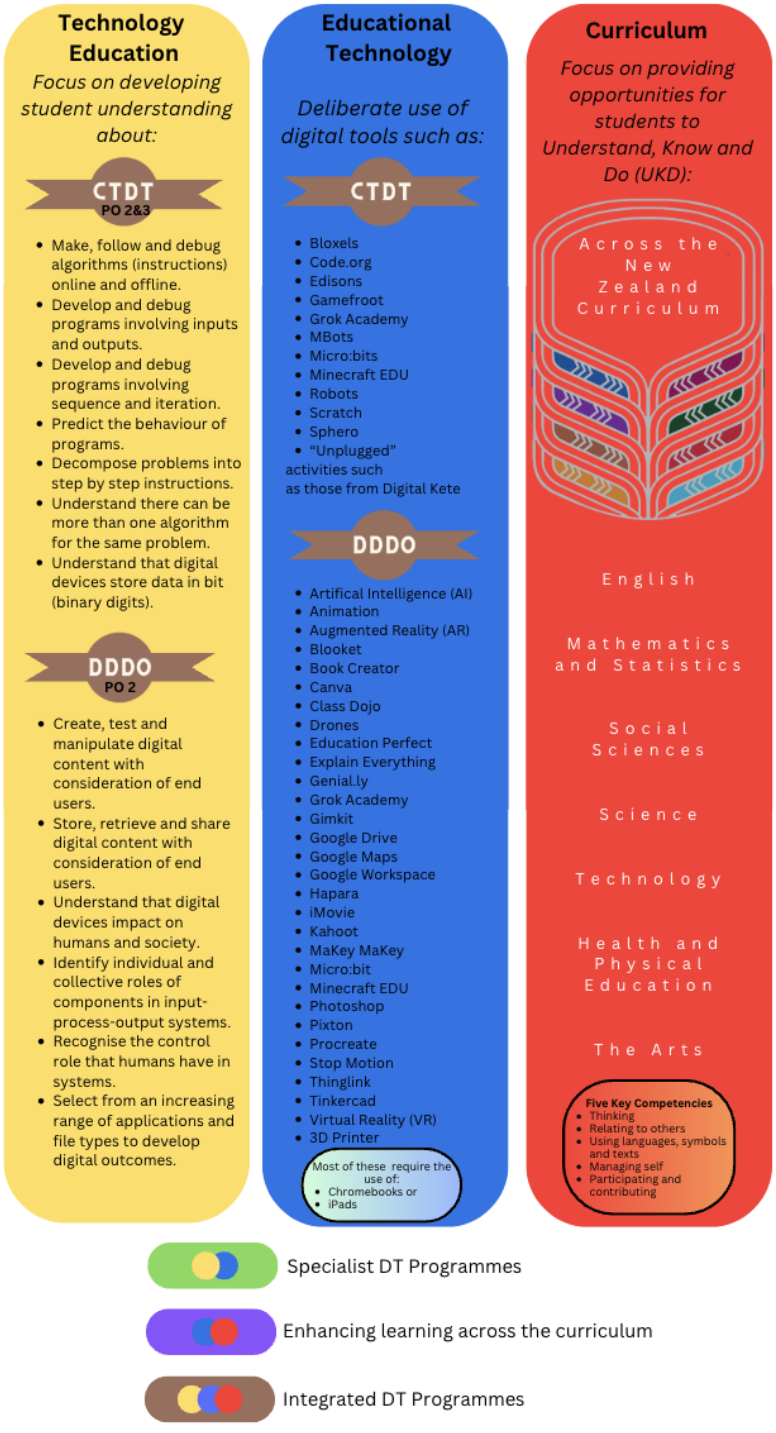
How do schools implement effective digital technologies programmes?		
What are the rationales and purposes for digital technologies programmes in New Zealand middle schools?	How do teachers support the implementation of effective DT programmes?	What leadership actions are associated with effective digital technologies programmes?
• Equip students with essential skills for the future • Foster digital citizenship • Enhance teaching and learning	• Demonstrate learning dispositions towards innovation and change • Leverage pedagogical strategies to enhance engagement and achievement • Deliberately utilise a range of DT tools	• Establish clear goals and expectations • Allocate resources strategically • Attend to their own learning • Support teachers to build their confidence and competence in DT

Note. The table illustrates the structure and relationship of the research questions and associated sub-themes presented in the Findings chapter.

In the literature review a Digital Technologies Content Implementation Tool (DTCIT) was presented. It was based on my reading, research and professional experience. This framework has been further synthesised into version 2 (DTCIT V2). This second version of the framework is a research-informed redevelopment (Digital Kete, 2022b, 2022d, 2022c, 2022a; Impacted, n.d.-a, n.d.-b; MoE, n.d.-e, 2018b, 2023; Mishra & Koehler, 2006; OMG Tech!, n.d.-b, n.d.-a), its literature base has been extended to complement key findings from my empirical study. The DTCIT V2 is shown below, in Figure 18. The tool's purpose is to provide guidance for teachers and leaders when implementing digital technologies programmes. Being a single page document, it is not designed to be exhaustive, but something that can sit alongside teachers and leaders in the planning process, as food for thought, inspiration and motivation to integrate DT into their already full curriculum. This tool will be used as a lens through which to view the findings and will be referenced throughout this discussion document.

Figure 18

Digital Technologies Content Implementation Tool Version 2 (DTCIT V2)



Note. The tool is coloured to illustrate how partnering one column with another impacts on learning. This version is based on a Year 7-8 programme.

The utility of the DTCIT V2 lies in its ability to visually define technology education and educational technology as separate, yet interconnected concepts. It clearly illustrates the key differences between specialist and integrated DT programmes and how learning across the curriculum can be enhanced through utilising digital technologies.

In the DTCIT V2, specialist DT programmes (green) are shown through blending Technology Education (yellow) with Educational Technology (blue). Specialists in the study identified time limitations in their programmes (often with 8-10 hours per student per year), and therefore integrating across the curriculum in a specialist capacity was not often a priority. Teachers in this field felt that they could teach students how to use the tools (Educational Technology), so that homeroom teachers were better positioned to integrate them into their programmes.

Enhancing learning (purple) can be achieved through blending Educational Technology (blue) and Curriculum (red). This can be seen when there are no particular DTC learning outcomes, but digital tools have been used to support student learning and engagement in other curriculum areas. An example of this from the research is the use of Education Perfect (EP) at Willowbrook School. Here, an Educational Technology has been used to support and enhance learning across curriculum areas such as Maths and English, with no specific link to Technology Education. This has strong links to Digital Learning (Forbes, 2019; Rennie & Smyth, 2019).

Integrated DT programmes (brown) are shown in the DTCIT V2 through blending Technology Education (yellow), Educational Technology (blue) and Curriculum (red). Teachers working across these three domains are deliberately implementing the DTC into other learning areas, and using digital tools to support student knowledge and understanding. An example of this from the research is where Oakhaven School had students demonstrating their understanding of Social Science principles through the use of robots, Minecraft EDU and Google Workspace.

Each of these three types of programmes are somewhat interdependent. While an integrated programme (brown) is the end goal (Education Review Office, 2019, 2020), observations from the research suggest that each of these methods of programming have benefits for student achievement and therefore, a combination of the three approaches may be truly representative of effective DT implementation. This discussion chapter will critically analyse my research findings using relevant literature and the DTCIT V2 framework. The goal is to understand how schools effectively implement digital technologies programmes.

What are the rationales and purposes for digital technologies programmes in New Zealand schools?

Three subthemes are presented to address the question 'what are the rationales and purposes for digital technologies programmes in New Zealand middle schools?': equipping students with essential skills for the future, fostering digital citizenship, and enhancing teaching and learning. These sub-themes are underpinned by the belief that understanding the purpose of DT and the benefits for students, supports teachers in implementing the DTC (Kellow, 2018).

Equipping students with essential skills and dispositions for the future

21st Century Skills are widely acknowledged as a crucial part of education (Dishon & Gilead, 2021; Hodges, 2020; Varas et al., 2023). However, despite being 25 years into the 21st century, there is no definitive list of skills that will adequately prepare students for the future workforce and society (Kennedy & Sundberg, 2020). This ambiguity may stem from the rapid evolution of our increasingly digital world. As introduced in Chapter 2, the New Zealand Curriculum emphasises the development of Key Competencies, which include thinking, relating to others, using language, symbols and texts, managing self and participating and contributing. Globally, a '4 Cs' approach focuses on collaboration, communication, creativity and critical thinking (Varas et al., 2023). In the following section, the skills and dispositions that can be scaffolded by DT programmes identified through my analysis are discussed.

Participants consistently emphasised the importance of relational dispositions (how students interact with others) within DT programmes. This finding is supported by Duncan et al. (2017) whose study suggested that the DTC scaffolded social skills. These social skills directly align with the Key Competencies' focus on relating to others and participating and contributing, and resonate with the 4 Cs' emphasis on collaboration and communication.

Relational skills were deemed crucial for students' future success in both societal and the professional contexts. Participants acknowledged the potential of educational technology to cultivate these skills, citing examples such as Minecraft EDU, robotics, and Google Workspace. However, they also raised concerns about the potential for individual device use such as headphones and one-to-one devices, to isolate students. Without proactive strategies to mitigate this risk, DT environments could inadvertently become counter-relational, hindering the development of these essential social skills.

Thinking skills were also mentioned regularly by participants. Bloom's Digital Taxonomy (Churches, 2008), as introduced in the literature review specifically supports the acquisition of essential skills for

the future, known in the taxonomy as higher order thinking skills. The taxonomy is underpinned by the belief that "before we can create, we must have remembered, understood, applied, analysed and evaluated" (Churches, 2008, p. 5). These skills can be linked directly to the digital technologies progress outcomes (POs) in the Technology Curriculum (MoE, 2018b) and explicitly taught through authentic contexts as shown in Table 10, below.

Table 10

Bloom's Digital Taxonomy in the DTC

Bloom's Digital Taxonomy	**Technology Education**	**Educational Technology Across the NZ Curriculum**
Students…	**When they…**	**They can do this by…**
Create	Create digital content.	Filming, animating, blogging, publishing, podcasting, directing, producing, designing, developing, inventing, making, planning, solving, devising (content)
	Manipulate digital content.	modifying, adapting (content)
	Give simple algorithms.	designing, making (a process or set of rules)
	Use algorithms to create simple programs, including outputs and sequencing.	building, constructing, designing, planning, producing and programming (programs)
Evaluate	Test digital content.	Assessing, critiquing, reviewing (content)
	Recognise the control role that humans have in the system.	assessing, checking, conclusion, debugging, experimenting, predicting and validating (different systems)
	Use logical thinking to predict the behaviour of programs.	predicting, reflecting, hypothesising, assessing (the behaviour of programs)
	Understand that there can be more than one algorithm for the same problem.	critiquing, assessing, detecting, reflecting, reviewing and validating (algorithms)
Analyse	Decompose problems into step-by-step instructions to create algorithms for computer programs.	Breaking down, deconstructing (problems)
Apply	Share digital content.	Sharing (content)
	Follow simple algorithms.	carrying out, executing (algorithms)
Understand	Understand that digital devices impact on humans and society.	Explaining, describing, discussing (device's impact on humans and society)
	Understand that both devices and their impact change over time.	describing, discussing, discovering, explaining, identifying (how devices and their impact change)
	Identify the specific role of components in a simple input-process-output system and how they work together.	predict, interpret, discover, infer, indicate, compare (the specific roles of components and their interdependence)
	Understand that digital devices store data using just two states represented by binary digits (bits).	classify, comment, identify, discover, express (binary digits)
	Store digital content.	group, classify, tag, gather (content)
Remember	Retrieve digital content.	find, locate, recall, retrieve (content)
	Select from an increasing range of applications and file types.	Recall, select (applications and files)

Note. Aligning Bloom's Digital Taxonomy with the New Zealand Technology Curriculum.

As demonstrated in the table above, by teaching the DTC, teachers support students in building essential future-focused skills. For example, when students decompose problems into step-by-step instructions (CTDT Progress Outcome), they engage in 'analysing' (analytical thinking). Similarly, when they create, test and manipulate digital content (DDDO Progress Outcome), they practice 'evaluating' (critical thinking and analysis) and 'creating' (creativity and originality).

It is acknowledged that there is an economic benefit to the implementation of the DTC. The rapid adoption of technology across industries, as highlighted by the World Economic Forum (2020), necessitates a shift in educational approaches. Equipping students with adaptable digital skills and a foundation for lifelong learning is crucial, as the skills required for jobs evolve rapidly. Employers increasingly expect employees to acquire new skills on the job, reinforcing the importance of digital technology programmes that foster not only technical skills but also adaptability, problem-solving, critical thinking, and self-management abilities (World Economic Forum, 2020).

The participants in the study perceived digital technologies as instrumental in enhancing students' future employment prospects. They acknowledged the increasing significance of digital skills in the contemporary workforce and emphasised the cultivation of digital literacy and computational thinking. This aligns with the MoE's (2019) rationale for implementing the change to the New Zealand Technology Curriculum, stating:

> We want to ensure that all of our tamariki and young people have the learning opportunities to gain new specific technological skills and capabilities required for the future of work – an estimated 85% of jobs that will exist in 2030 haven't been invented yet. (Ministry of Education, 2019, p. 1)

The World Economic Forum (2020, as cited in GFE, 2022) suggest that there will be five top in-demand skills among employers by 2025, these include: analytical thinking and innovation; active learning and learning strategies; complex problem solving; critical thinking and analysis; and creativity, originality and initiative. Many of these skills are the basis of the New Zealand Technology Curriculum, with the introductory paragraph of the curriculum stating "Technology is intervention by design. It uses intellectual and practical resources to create technological outcomes, which expand human possibilities by addressing needs and realising opportunities" (MoE, 2018b, p. 1). Further reading of the curriculum gives numerous additional examples of analytical thinking, innovation, analysis, creativity, originality and initiative.

Equipping students with essential skills and dispositions for their societal and professional future is a key purpose of implementing digital technologies programmes in New Zealand schools. Therefore, it is important that teachers act as champions for digital advancement by understanding this rationale and explicitly teaching these future-focused skills and dispositions in their programmes.

Fostering digital citizenship

American middle school students are spending, on average, 5-8 hours per day on screens for entertainment (Common Sense Media, 2022). New Zealand youth, among the highest in the world, spend around 42 hours a week on screens (Cullen et al., 2024). Therefore, teachers have a responsibility to ensure students are equipped to navigate this digital landscape safely and responsibly. The participants in the study expressed a strong conviction that students should be educated about responsible technology use and online safety. They acknowledged the potential risks associated with internet access, especially for young people, and advocated for integrating digital citizenship and online safety into learning programmes, including curriculum links to Health and Physical Education. Oakhaven School provided documentation (OH-UP3) that demonstrated their commitment to minimising online risks for students. These included the explicit teaching of digital technologies expectations, internet user agreements, the impact of cyberbullying and integration with their school-wide values programme.

The need for digital citizenship education is further underscored by the increasing permeation of digital technologies in all aspects of life. This pervasive nature of technology necessitates moving beyond a purely technical focus on digital skills and embracing a broader perspective that encompasses the social, ethical, and civic dimensions of technology use (Lee & Lee, 2024). There was widespread participant acknowledgement of the ubiquity of DT, with one participant in particular noting, “we’re trying to integrate it into...different parts, because I don't think any curriculum area should sit in a silo. That would be a terrible design” (WB-IV-Nat). This statement underscores the need for a holistic and integrated approach to digital citizenship education, reflecting the interconnectedness of digital technologies with all aspects of learning and life. This thinking aligns with the MoE’s (2019) rationale for the curriculum change, which states:

> we want to support children and young people to develop a strong sense of digital citizenship as people relate to one another in a way unlike before. This is why we need to focus digital technologies learning around the wellbeing of ourselves and others. (Ministry of Education, 2019, p. 1)

The idea that the world doesn't have distinct separations between subject areas or between the digital and physical realms, aligns with a postdigital view (Örtegren, 2024). This perspective challenges traditional views of digital citizenship, ie. those that prioritised access to digital technologies, inclusion in the digital world, and the communication rights and liberties of individuals online (Pangrazio & Sefton-Green, 2021), by recognising that digital technologies are integrated into all aspects of life, blurring the lines between online and offline experiences. It rejects the idea of separate online and offline spheres and highlights the entanglement of technology with social practices (Örtegren, 2024). Employing a postdigital lens, therefore, encourages us to view digital citizenship not merely as a set of skills or rules for online behaviour but as a way of being in the world, a way of understanding and navigating the complex interplay between technology and society. This perspective permeates not only the educational landscape, but the broader societal context.

Applying a postdigital lens to education requires a shift in pedagogical strategies. Taking this view, teachers must create learning experiences that address the social, ethical, and civic dimensions of technology use, going beyond teaching technical skills to fostering critical thinking, ethical decision-making, and responsible online behaviour (Lee & Lee, 2024). This could involve modelling responsible technology use, facilitating discussions about online ethics, and empowering students to critically evaluate online information and its potential impact. Oakhaven School demonstrated their understanding of the entanglement between online and offline practices by producing DT programmes that aligned with and explicitly taught their values, particularly manākitanga (kindness/respect) and whanaungatanga (relationship/kinship) (OH-UP2, UP5).

Ultimately, fostering digital citizenship in a postdigital age is not just about protecting students from online risks; it is about empowering them to leverage the transformative potential of digital technologies for good (Lee & Lee, 2024). Schools have a responsibility to prepare young people to be effective digital citizens, capable of shaping a more equitable and just digital world. Equipping students with these skills not only promotes their well-being but also empowers them to become active, engaged, and successful learners in the digital age.

In the DTCIT V2, teachers who are integrating DT programmes will consider how they will best implement digital citizenship within their school context. By integrating the DTC with Health and Physical Education and Social Sciences, teachers can meet the varying needs of their learners and address holistic digital citizenship considerations. Furthermore, teachers seeking to scaffold students' essential skills and

dispositions will be encouraging critical thinking when online, ethical decision-making and responsible online behaviour as part of their programmes.

Enhancing teaching and learning

Participants perceived DT as having the power to enhance teaching and learning. This was often attributed to the interactive nature of many digital tools (Educational Technology) and their relevance to students' lives. Furthermore, participants suggested that DT can facilitate personalised learning and differentiation by providing students with greater choice and control over their learning pathways. In the DTCIT V2, this is illustrated through blending Educational Technology (blue) with Curriculum (red).

Using digital technologies in the learning process can be particularly engaging for learners. Programmes designed to allow learners to work at their own pace, with the support of digital technologies can be liberating and motivational (Rennie & Smyth, 2019). The correlation between digital technologies and student engagement has been widely researched and supported (Duncan et al., 2017; Hawkins et al., 2017; Newton, 2017; Schuetz et al., 2018). In contrast, studies have also found that technology can be counter-productive when used frivolously (Ditzler et al., 2016; Meates, 2021; Oppenheimer, 2003; Perry & Cox, 2017). Despite these challenges, within the context of my research, teacher participants were unanimous about the affordances that DT can bring to learning programmes for students.

One positive aspect discussed by participants was the engagement found in the use of specific learning tools. Technologies such as augmented reality (AR) and virtual reality (VR) have the potential to transform the learning landscape and enable experiences that would be impossible to achieve otherwise (Google for Education, 2022; Newton, 2017). Within VR contexts students can be immersed in computer-generated 3D environments, offering many opportunities for learning and exploration. Within AR contexts students view digital information overlayed in the real-world, transforming traditional learning materials into dynamic and interactive experiences (Google for Education, 2022). Teachers in the study referenced the degree of engagement brought about from DT. Ruth, a teacher participant from Oakhaven School shared that she rarely saw disengagement from her students when using digital technologies. Ruth's programmes included the strong integration of DT into inquiry using tools such as Minecraft EDU, robots and coding, as well as digital citizenship content relevant to what students are currently facing (OH-UP1-5, OH-CO1-2).

Pedagogies such as gamification and game-based learning are being used by teachers to maintain engagement in learning activities through competition and collaboration. Digital gamification involves incorporating game elements into existing activities, while game-based learning uses gaming characteristics to engage learners in a self-directed manner (Google for Education, 2022). Class Dojo is an example of gamification that is suggested to increase student engagement (Brown, 2021). Using this classroom management tool, learners are given immediate feedback for positive behaviours, actions and work habits in the form of points. Teachers set parameters so that when a student reaches a certain number of points, they receive a reward. Rennie and Smyth (2019) agree that increased motivation, engagement and the enjoyment of learning activities are generally associated with a gamified approach. However, they do warn that there is a risk of trivialising learning and teachers should be wary of this.

Teacher participants acknowledged the ability of DT to support strong personalised or differentiated programmes of learning. Online platforms, in particular, were said to offer opportunities for students to learn at their own pace and receive individualised feedback. Willowbrook School reported using an online tool called Education Perfect (EP). EP "is a comprehensive digital learning platform that provides a full suite of instructional materials and resources for primary and secondary school teachers" (John Hopkins University centre for Research and Reform in Education, 2022, p. 2). There are eight areas of emphasis in the EP digital learning platform, these are: explicit instruction, differentiation, adaptive practice, gamification, timely and specific feedback, mastery-based progression, formative assessment and spaced repetition (Education Perfect, n.d.). Each of these areas of emphasis relate directly to enhanced teaching and learning. Other DPL platforms such as IXL provide similar user experiences, with the aim of engaging students through digital pedagogies such as gamification. Schuetz's (2018) research found that a strength of IXL was its ability to adapt the questions to individual student levels, including the ability for students to listen to instructions instead of reading them, when necessary.

In the DTCIT V2, enhancing learning becomes evident when teachers intentionally combine the Educational Technology (blue) and the Curriculum (red) columns. When used deliberately with a clear pedagogical purpose, digital technologies tools can effectively engage and motivate learners. Drawing context from the TPACK model (Mishra & Koehler, 2006), the DTCIT V2 is underpinned by the belief that "teaching is a highly complex activity that draws on many kinds of knowledge" (Mishra & Koehler, 2006, p. 1020). Taking this view, the DTCIT V2 illustrates that in instances where research suggests a weak link between digital technologies use and enhanced learning, poor pedagogical knowledge has been considered. For example, while Minecraft EDU can be engaging, 'free play' scenarios may lack a clear

learning objective. In contrast, when teachers use Minecraft EDU to challenge students to collaboratively express their understanding of specific curriculum outcomes, the potential for deep learning is significantly increased. Students engage in discussion, negotiation, analysis, and creative problem-solving, developing essential skills valued by employers. This example highlights the power of DT as a tool to enhance teaching and learning when used in a pedagogically sound manner, that is, when teachers draw on Technological Knowledge (TK) and Pedagogical Knowledge (PK) to enhance learning across the curriculum (the DTC and other learning areas of the NZC).

Teachers act as digital technologies champions when they have a clear understanding of the rationales and purposes for digital technologies programmes. These support teachers to equip students with the essential skills and dispositions for the future, foster digital citizenship and enhance teaching and learning.

How do teachers support the implementation of effective DT programmes?

Three subthemes are presented to address the second research question, 'How do teachers support the implementation of effective digital technologies programmes?': demonstrating learning dispositions towards innovation and change, leveraging pedagogical strategies to enhance engagement and achievement, and deliberately utilising a range of DT tools. The DTCIT V2 introduced in the first section will continue to be used as a lens through which to view this section, alongside relevant literature.

Demonstrate learning dispositions towards innovation and change

The findings demonstrate that learning dispositions towards innovation and change are a fundamental prerequisite for the creation of effective DT programmes. As Stumbrienė et al. (2024) state, "the conceptual change in the use of digital technologies in teaching practice requires teachers' and schools' readiness for the new normal of constant adoption of innovation" (p. 1720). Teachers in this study embraced learning opportunities, demonstrated the ability to learn on the go and ignited a passion for learning. These dispositions provided the grounding on which to build effective DT programmes.

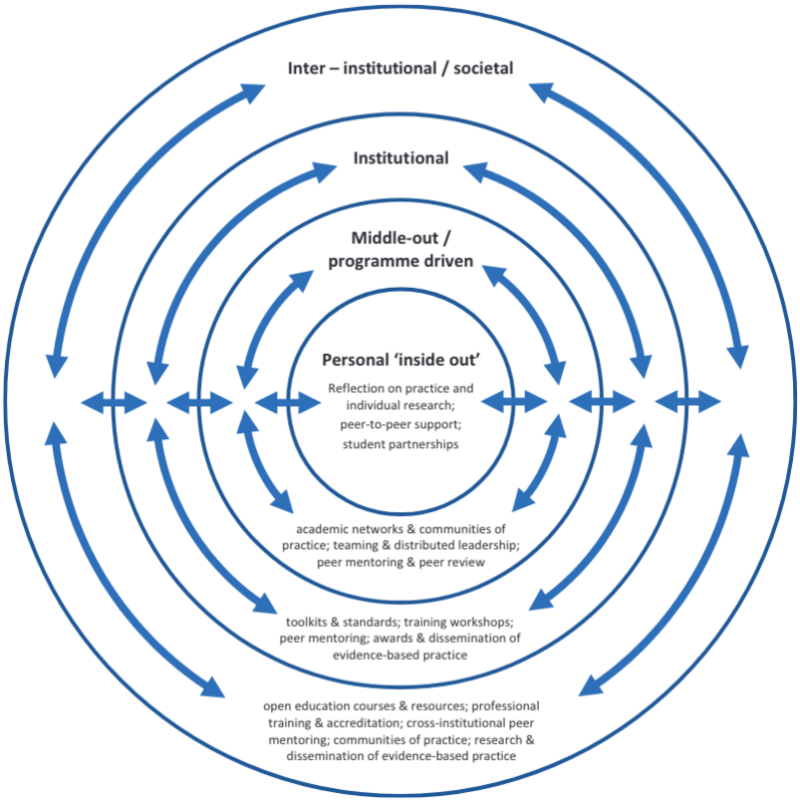
Embracing Learning Opportunities

Teachers who embrace learning opportunities are active learners who consistently seek to refine their knowledge and skills. In their study of NZ schools undergoing DTC implementation, the ERO (2020) state that 'effective' teachers "actively sought out and took advantage of the support that leaders offered" (p. 20). These teachers did not wait for PLD to come their way, they embraced the idea of innovation and actively sought out ways to develop their knowledge and understanding in this area.

In their literature, Walker and Forbes (2022) discuss an adaptable, diverse, sustained and ongoing development process for teachers called continuous professional learning and development (CPLD). They present a CPLD ecological support model, shown in Figure 19, which outlines four levels of "opportunities for reflection on teaching practice using technology" (Walker & Forbes, 2022). This model provides a useful framework for understanding the different levels at which CPLD can be provided and the interconnected nature of professional learning and development. It highlights the importance of teachers engaging with a range of opportunities for professional growth, both within and outside of their institution. The model also emphasises the role of individual agency and the importance of teachers taking ownership of their own professional learning and development.

Figure 19

CPLD Ecological Support Model for Online Teaching



Note. From *Introduction: A continuous professional learning and development (CPLD) framework for online teaching*, by R. Walker and D. Forbes, 2022, Springer Nature. (https://doi.org/10.1007/978-981-19-5587-7_1). Copyright 2022 by Springer Nature Singapore Pte Ltd.

This model supports our understanding of how teachers may embrace learning opportunities by actively seeking out opportunities for growth, rather than waiting for PLD to come to them. This idea will be further developed in the next section.

Implementing the DTC is a significant task for teachers, requiring the ability to deliver Technology Education and use Educational Technology. The DTCIT V2 was designed to support teachers in this endeavour. However, its effectiveness relies on teachers' content knowledge (CK), Technological Knowledge (TK), and the ability to apply these across contexts. To this end, the document must be underpinned by a process of continuous reflection and professional growth in teaching with and about digital technologies. This ongoing development is critical for teachers to act as champions for digital advancement, ensuring they have a deep understanding of the curriculum content and the associated tools and pedagogies required for effective implementation.

Learning on the Go

The innovative use of digital technologies as proposed in the DTC (Stumbrienė et al., 2024) demands an ongoing learning approach from teachers (Munasinghe et al., 2021; Stringer et al., 2022; Stumbrienė et al., 2024). Innovation involves introducing something new (Collins English Dictionary, 2005). As such, teachers implementing the DTC into learning programmes must be prepared to continuously acquire new skills and knowledge. This perpetual state of change was echoed by the teacher participants in my research, who emphasised the need for a willingness to experiment, learn from failures, and adapt their teaching practices to emerging trends and unforeseen challenges.

Teachers who embrace uncertainty and are committed to lifelong learning are better equipped to navigate the challenges of innovation and change (Hill-Jackson et al., 2019). Described as "Nike people" (Sam-WB-FG) who embody a 'just do it' attitude, those who embrace the uncertainty of implementing the DTC, are digital technologies champions. This sentiment was also discussed by the ERO (2020), when addressing the dispositions of teachers who they considered as successful in implementing the DTC. They state that a teachers' "growth mindset helped [them] be comfortable with uncertainty and accept ako, allowing capable students to lead the learning" (p. 23).

Timperley (2008) proposes that learning is cyclical as opposed to linear. This further supports the CPLD model proposed by Walker and Forbes (2022). In the model, teachers move between and across levels to support their professional growth and understanding. As they navigate these levels, teachers revisit ideas and concepts they may have misunderstood or only partially grasped. They apply these concepts in the classroom, reflect on their practice, and then seek further knowledge to refine and deepen their

implementation (Timperley, 2008). This iterative process supports sustained and effective professional learning.

My research suggests effective teachers not only embrace learning opportunities but deliberately take action to embed this new learning into their classroom programmes. This is supported by the work of Stumrienė et al. (2024), who found that confident technology users were more motivated than reserved technology users to transfer their new learning into the classroom. This exemplifies the link between teacher confidence and effective DT programmes. Furthermore, it demonstrates that teachers with learning dispositions towards innovation and change are able to seek out personal growth and embed their new learning to act as a catalyst for digital advancement.

The DTCIT V2 was created as a tool to support teachers who are learning on the go. It clearly outlines the skillset required by teachers in regard to content knowledge (Technology Education) and technological knowledge (Educational Technology). Furthermore, it prompts teachers to ensure their ongoing growth and development of teaching about and with digital technologies across the curriculum.

Igniting a Passion for Digital Technologies

Passion, defined as a "strong affection or enthusiasm" (Collins English Dictionary, 2005, p. 1189), is an essential attribute for effective teaching. The teachers involved in the research demonstrated a genuine enthusiasm for digital technologies, which was evident in their discussions and eagerness to share knowledge with their students. Participants in my study talked about their love for DT, but more so, it was their non-verbal communication that expressed their passion for this area; their smile, their tone, the way they sped up or emphasised dialogue in their conversation. This passion significantly contributes to their effectiveness by fostering more engaging and meaningful learning experiences (Maiers & Sandvold, 2017).

As Day (2004) emphasises, "teachers with a passion for teaching are those who are committed, enthusiastic, and intellectually and emotionally energetic in their work with children, young people, and adults alike" (p. 2). This passion is not just a desirable quality; it is an essential component of high-quality teaching (Day, 2004). Passionately committed teachers, as described by Kottler et al. (2005) love their work, constantly seek improvement, and feel a personal mission to help others learn. Therefore, passion is not a luxury but a fundamental requirement for all effective DT teachers and programmes (Day, 2004).

In demonstrating a learning disposition towards innovation and change, teachers who embrace learning opportunities, are willing to learn on the go and ignite a passion for DT, are digital technologies

champions. These teachers seek out the content, technological and pedagogical knowledge required for teaching digital technologies. Moving between levels of the CPLD, filling gaps and striving to learn more about the nature of digital technologies, these teachers develop the skill, digital pedagogy and overall confidence to create and sustain effective digital technologies programmes.

Leverage pedagogical strategies to enhance engagement and achievement

The second way that teachers support the implementation of effective digital technologies programmes is through the leveraging pedagogical strategies to enhance engagement and achievement. Today's teachers are tasked with using "an increasing repertoire of teaching strategies, approaches, learning activities, technologies and assessments for learning strategies and modify these in response to the needs of individuals and groups of learners" (Education Council, 2017, p. 20). Furthermore, they are required to possess a diverse toolkit of pedagogical approaches that can cater to the varied contexts that arise (Newton, 2017). In my research, recurring pedagogical themes of 'how' to teach DT included: fostering exploration, creativity, and student agency; providing practical, hands-on learning experiences; employing the Māori concept of *ako* (reciprocal teaching and learning); and integrating learning across the curriculum. My analysis of data identified the leveraging of these pedagogical strategies to underpin the teaching of the DTC.

The ERO (2019) suggest that schools seeking to review their implementation of the DTC shift to "more student-centred pedagogy, promoting student agency" (p. 19). This aligns with the MoE's (2023) assertion of power-sharing partnerships, where meaningful choices are given to students within their learning and that scaffolding is provided for students to develop self-regulation. Furthermore, Fox-Turnbull (2018) emphasises the importance of students being "given opportunities to explore, to collaborate, and to be creative and resilient within purposeful learning" (p. 7). Sylvia discussed these ideas, stating that:

> room for agency is vital, like they can use this equipment if they want to, they don't have to…it is a technology subject, they should be able to be getting involved with their hands and their bodies, you know, talking, discussing working on things together, not just sitting at a computer. (OH-IV)

Practical, hands-on learning is another pedagogy associated with implementing the DTC. This approach is strongly emphasised in the Technology Curriculum, woven throughout the curriculum's structure and evident across all three strands, Technological Practice, Technological Knowledge and The Nature of

Technology. In these areas, students are expected to apply their knowledge and create 'output'. Teacher participants exemplified this with their commitment to collaborative work, 'unplugged' activities and the use of 3D printing. Oakhaven School had an expectation in their 'Tech' classes that students would take something tangible home with them.

Ako was a pedagogical approach that came through very strongly from participants. Teachers in the focus group at Willowbrook School discussed this at length, with Sam stating "a lot of teachers…are quite happy for the kids to be the experts in the classroom" (WB-FG). Other participants qualified this statement through numerous examples of how they do this in the classroom. The ERO (2020) suggest that schools implementing the DTC should utilise ako, a pedagogy that empowers students to actively lead the learning process. This aligns with the MoE's (2019) emphasis on teachers "feeling confident with an Ako style of teaching and learning" (p. 2). Research further suggests that teachers who are willing to learn alongside their students and empower them to take the lead (Geldreich & Hubwieser, 2020; MoE, 2018a) are more likely to implement effective DT programmes. By embracing an ako approach, teachers are digital technologies champions.

Lastly, integration with other learning areas is crucial for the successful implementation of the DTC (Education Review Office, 2020). Incorporating digital technologies into various curriculum areas not only enhances learning experiences but helps students understand digital skills in a meaningful context. The ERO (2019) recommend that schools aiming to improve their DTC implementation should focus on cross-curricular integration, enabling students to use digital technologies in learning areas such as science, mathematics and the arts. This approach creates stronger connections between the learning areas, providing an authentic context for learning and equipping students to transfer digital skills across subjects. Participants at both schools referenced the importance of this, with both schools stating that "standalone" (Ruth-OH-IV, Sam-WB-FG) teaching was ineffective. Participants unanimously agreed on the importance of integrating DT across learning areas. In the DTCIT V2 this integration is shown by blending the three columns together (brown). While the three different types of programmes (green, purple and brown) all have their merit, it is through integration that truly effective digital technologies programmes are implemented.

Deliberately utilise a range of Digital Tools

The final sub-theme about how teachers support the implementation of effective digital technologies programmes is through the deliberate use of a range of DT tools. Participants across both schools

acknowledged that having a range of devices, such as Chromebooks, engaging tools and programs like Minecraft EDU, supported student engagement and enhanced learning experiences. Teacher participants organically mentioned tools that they use in programmes throughout the phases of data collection. Many of these were able to be verified through document analysis. This was collected in Table 7, in the findings chapter. This data has been synthesised in a word cloud to illustrate the most frequently mentioned tools, and illustrated in Figure 20, below:

Figure 20

Digital Tool Word Cloud

Note: Word cloud demonstrating tools mentioned by participants proportionately. Created in www.wordart.com.

Possessing digital tools in the school is vastly different from deliberately using them in the classroom. Developing technological knowledge (TK) is essential for teachers to implement effective digital technologies programmes. The Educational Technology column (in blue) of the DTCIT V2 includes the tools, resources and websites identified both through the literature review and in my research. While this list was current at the time of data collection, it is acknowledged that it will neither remain current nor exhaustive within 12 months, due to the rapidly evolving nature of technology. Nevertheless, the Educational Technology column serves as a valuable resource for teachers seeking to embed new tools, resources and websites into their programmes. Importantly, while the column primarily lists technologies, the 'K' in TK emphasises the importance of knowledge - teachers must understand how to

effectively use a range of these tools to support their teaching practices (Mishra & Koehler, 2006). They can do this through CPLD and learning on the go, as discussed in previous sections of this chapter.

This section has addressed the sub-themes identified in relation to the research question: 'how do teachers support the implementation of effective DT programmes?'. In addressing this question, it is clear that teachers support the implementation of effective DT programmes by demonstrating learning dispositions towards innovation and change, leveraging pedagogical strategies to enhance engagement and achievement and deliberately utilise a range of digital technologies tools.

What leadership actions are associated with effective digital technologies programmes?

Four subthemes are presented to address the question 'what leadership actions are associated with effective digital technologies programmes?': establish clear goals and expectations, allocate resources strategically, attend to their own learning and support teachers to build confidence and competence in digital technologies. The following sections will examine the participant perspectives and literature relevant to the research question.

Establishing clear goals and expectations

The analysis revealed that when leaders establish clear goals and expectations for DT use in the classroom, teachers are more likely to act as digital technologies champions. It was evident across the two schools that leaders had different expectations of how to implement digital technologies programmes. Teacher participants were clear about the expectations that their leaders had set and systems and programmes were in place that reflected these expectations. At Oakhaven School this looked like a rigorous specialist programme and digital technologies integrated heavily into classroom programmes. At Willowbrook School rigorous specialist programmes were prioritised, and little deliberate integration was happening within classrooms.

In the Best Evidence Synthesis Iteration (BES), Robinson et al. (2009) state that a goal only motivates teachers when its importance is understood. Furthermore, a goal's importance is tethered to its wider purpose. This perspective highlights the interconnected nature of teachers and leaders and their roles in implementing effective digital technologies programmes. Referring back to Table 8, clarity of purpose is seen when leaders establish clear goals and expectations and teachers understand and are responsive to the rationales and purposes for digital technologies. This relationship is highlighted here to illustrate the

partnership required for digital advancement. Acts are required from both leaders and teachers in order for schools to implement effective digital technologies programmes.

Simon Sinek's (2009) book 'Start with Why' provides a powerful framework for leaders to establish clear goals and expectations by aligning their actions with a strong sense of purpose. The book emphasises the importance of starting with 'why' – the core belief or purpose that drives an organisation or individual. He argues this 'why' serves as the foundation upon which clear goals and expectations can be built. Osborne (2014) corroborates this idea, stating that successful leaders avoid situations where change is 'done to' teachers, instead seeking to empower teachers to contribute to the change.

Seminal New Zealand leadership literature, including the Best Evidence Synthesis Iteration (BES) and Leadership Capability Framework (LCF), as discussed in the literature review, highlight the importance of leaders setting goals and expectations in their organisations (Education Council, 2018a; Robinson et al., 2009). Establishing goals and expectations "includes the setting, communicating, and monitoring of learning goals, standards, and expectations and the involvement of staff and others in the process so that there is clarity and consensus about goals" (Robinson et al., 2009, p. 95). This further illustrates the entangled nature of 'Leaders as catalysts for digital advancement' and 'Teachers as digital technologies champions'.

Allocate resources strategically

Leaders act as catalysts for digital advancement when they allocate resources strategically. Research participants were unanimous in advocating for the importance of strategic resourcing. Resources in my research were defined as the financial investment in people, tools and equipment, professional learning and development and time. Seminal New Zealand leadership literature, including the BES and LCF, highlight the importance of resource allocation by leaders (Education Council, 2018a; Robinson et al., 2009). Specifically:

> leaders understand the information they have in order to make decisions on how best to use resources of money, time, and space and gain support for their learners and staff. They ensure they have the right information in making financial, human resource and property decisions, and they seek specialist advice to assist their decision-making if needed. They prioritise seeking and allocating resources that match the organisation's strategic plan. (Education Council, 2018b)

In this sense, resources implemented by leaders as catalysts for digital advancement are considered thoroughly to achieve effective programmes and are chosen to support the school's goals. PLD should also be prioritised for teachers to use the resources effectively to improve teaching and learning. This is supported by numerous New Zealand studies (Crow et al., 2019; Fox-Turnbull, 2018; Kellow, 2018; Timperley, 2008) and unpacked in more depth in a future section. Furthermore, time for 'playing with' Educational Technology was identified by participants as being a crucial part of the learning curve. Participants were unanimous in citing time to embed PLD as part of the learning process, with Sam stating "The more time you have as a teacher to play with things, the more confident you are" (WB-FG). Timperley (2008) corroborates this view, by stating that "teachers need multiple opportunities to absorb new information and translate it into practice" (p. 15) and Stringer et al. (2022) assert the importance of teachers requiring additional time to plan, develop and deliver the DTC.

Attend to their own learning

Leaders as digital technologies champions need to attend to their own learning. The Best Evidence Synthesis Iteration (BES) and Leadership Capability Framework (LCF) highlight the importance of leaders engaging in their own professional development (Education Council, 2018a; Robinson et al., 2009). In the BES research, promoting and participating in teacher learning and development was found to have the largest significant effect on student outcomes (Robinson et al., 2009). Furthermore, teachers watch and learn from their role models (Osborne, 2014). Ruth, a research participant mentioned the power in having her Senior Leadership team actively engage in a PLD session, stating that "if they [leaders] can do it, we [teachers] can do it" (OH-IV). This was in contrast to Sam's statement about her Senior Leadership team and her belief that their lack of digital literacy trickled down:

> it is interesting, because I can compare to other schools where the senior leadership team has been very digitally orientated and the expectations around it are quite different… it flows to everything, the number of devices, whether you're a BYOD school, whether you have to print all your planning or not, you know. I think there's a huge correlation actually, between your own capabilities in senior leadership in a school, and what your school produces in the way of digital technologies. (WB-FG)

Both the literature and my research highlight the importance of leaders attending to their own learning in digital technologies to be catalysts for digital advancement in their school.

Support teachers to build their confidence and competence in DT

Leaders act as catalysts for digital advancement by supporting teachers to build confidence and competence in using digital technologies. In the literature review, three challenges were identified as being detrimental to the integration of the DTC into NZ schools. These were teacher confidence, skill (competence) and pedagogy.

The importance of confidence and competence

Several New Zealand studies highlight how a teacher's lack of confidence impacts on their delivery of the DTC (Chen, 2017; Duncan et al., 2017; Education Review Office, 2020). Furthermore, the rapid pace of change in the area of digital technologies puts significant pressure on technologies programmes, resulting in challenges for teachers regarding their skill level and therefore competence (Education Review Office, 2019).

There was as consensus amongst teacher participants that teacher knowledge, a component of competence, was a barrier to the implementation of the DTC at their schools. Sylvia's statement encapsulated this idea, "if you only teach a digital technology once, and then swipe it out for the rest of the year, not only does your confidence have to be rebuilt next time you try to teach it, but your physical capabilities are going to be fluttered away in the wind" (OH-IV).

How can teacher confidence and competence be supported?

Leaders have a key role in supporting the confidence and competence of teachers of digital technologies. One way this can be done is through the deliberate use of professional learning. Another way that leaders support teacher confidence and competence is through providing an organisational culture that fosters innovation.

Numerous New Zealand studies have highlighted the significant role of professional learning and development (PLD) in mitigating initial teacher anxieties and boosting confidence in delivering the DTC (Chen, 2017; Duncan et al., 2017; Rhodes & Calder, 2022; Rich, Larsen, et al., 2021; Stringer et al., 2022). Participants who initially felt uneasy about teaching DT often reported increased confidence over time, particularly when provided with timely, tailored PLD. A Ministry of Education study preceding the DTC's publication underscored the importance of adequate resources and support for successful implementation (Chen, 2017). By comparing pre and post workshop confidence levels (rated 1-5), the study revealed a notable increase in teacher confidence. This finding underscores the potential of well-

designed PLD to overcome initial barriers and facilitate effective DTC implementation. While teacher confidence can hinder the successful rollout of the DTC, intentional and timely PLD can serve as a powerful tool to address these concerns and empower educators to deliver high-quality digital technologies education.

Teacher participants at Oakhaven School expressed satisfaction with the PLD provided by external providers like UTB and from teacher-leaders, attributing it to increased confidence and competence. A key strategy employed was delivering small, digestible chunks of information to support staff knowledge and understanding. In contrast, teachers at Willowbrook School felt less confident and competent, perceiving a misalignment between their individual learning needs and the content of PLD sessions. Concerns were also raised about the efficacy of whole-school PLD, particularly in diverse settings.

Research underscores the importance of effective PLD in enhancing teachers' digital technologies skills. The ERO (2020) found that schools implementing successful digital technologies programmes had collaborated closely with PLD providers to tailor learning to specific needs and contexts. Furthermore, a study by Rhodes and Calder (2022) suggests that PLD can significantly improve teacher knowledge and skills. By providing timely, relevant, and individualised PLD, schools can empower teachers to acquire the necessary skills to effectively implement digital technologies in the classroom.

Outside of PLD, a supportive organisational culture that encourages risk-taking and innovation was identified as a crucial factor in building teacher confidence and competence. This view is widely supported within New Zealand and global literature (Education Review Office, 2020; Kirkland & Sutch, 2009; Stringer et al., 2022) The concept of ‘sandpit time’, dedicated to exploratory and playful learning, was seen as valuable for both teachers and students at Willowbrook School. This time for experimentation and discovery was crucial for building confidence and fostering a deeper understanding of digital tools and concepts. As Sam reflected, "The more time you have as a teacher to play with things, the more confident you are" (WB-FG), highlighting the importance of unstructured exploration. Nat suggested that "permission [from leaders] to try" (WB-IV) is essential for building teacher confidence and competence. Sam further emphasised the role of organisational culture, explaining that accepting mistakes for both teachers and students fosters resilience and encourages experimentation.

At Oakhaven School, Sylvia and Ruth recognised a supportive environment as "massively" (OH-FG-Sylvia) important for implementing DT programmes. This culture of experimentation, making mistakes, and reflecting on outcomes was seen as crucial for developing teacher confidence and competence and

discovering effective pedagogical applications of DT. Without a supportive organisational culture, teachers may be less inclined to try new things, underscoring the importance of leadership. ERO's research (2020) found that in supportive environments, teachers were "more comfortable learning from, and alongside, students and allowing students to lead more of their own learning" (Education Review Office, 2020, p. 9).

This section has highlighted the crucial role of leaders as catalysts for digital advancement within their schools. By establishing clear goals and expectations, strategically allocating resources, actively engaging in their own learning, and providing ongoing support to build teacher confidence and capacity, leaders create a fertile ground for the successful implementation of digital technologies programmes.

So What?

This chapter has explored how New Zealand middle schools implement effective digital technology (DT) programmes, focusing on the roles of teachers and leaders. The research identifies two key themes: 'Teachers as Digital Technologies Champions' and 'Leaders as Catalysts for Digital Advancement'. I have presented a Digital Technologies Content Implementation Tool (DTCIT V2) to differentiate between specialist, integrated, and enhanced learning approaches to DT programmes. Teachers support DT implementation by demonstrating learning dispositions, using effective pedagogical strategies, and using a range of DT tools. Leaders are essential, by setting clear goals, allocating resources, engaging in their own learning, and supporting teacher confidence and competence. The research highlights that both teacher and leader actions are interconnected and crucial for successful DT programmes.

Chapter Six: Conclusion and Implications

This research concludes that the successful implementation of digital technologies programmes in New Zealand middle schools is fundamentally underpinned by the synergistic roles of visionary leaders, who act as catalysts for digital advancement, and proactive teachers, who champion the integration of digital technologies within their practice. Effective implementation necessitates collaborative effort, a clearly articulated vision that permeates the school culture, strategic allocation of diverse resources (including financial, time, and professional development), and a sustained commitment to robust professional learning and development (PLD).

Leaders are pivotal in establishing and consistently communicating a compelling vision and clear objectives for the purposeful use of digital technologies, thereby cultivating a shared understanding and sense of direction among teachers. Strategic resource allocation, encompassing financial investment, dedicated time for planning and experimentation, and targeted training opportunities, is crucial for the long-term viability and impact of these initiatives. Furthermore, leaders must embody a strong commitment to digital technologies by actively engaging in their own professional growth and demonstrating a continuous learning orientation. Critically, leaders play a key role in nurturing teacher confidence and competence in teaching digital technologies. This can be achieved by proactively identifying and addressing barriers to implementation, providing relevant and timely PLD, fostering opportunities for exploratory "sandpit" time, and cultivating an organisational culture that values innovation, risk-taking, and collaborative learning.

Teachers, in turn, must internalise and respond thoughtfully to the rationale underpinning DT programmes, recognising their vital role in equipping students with essential future-focused skills and enriching their overall learning experiences. Embracing learning dispositions towards innovation and change is paramount, characterised by a willingness to "build the plane while flying," actively seeking out learning opportunities, and cultivating a genuine enthusiasm for the subject matter. Effective teachers deliberately and thoughtfully integrate a diverse range of educational technology (EdTech) tools, coupled with innovative pedagogical strategies, to enhance student engagement, deepen understanding, and improve learning outcomes.

This study introduces the Digital Technologies Content Implementation Tool Version 2 (DTCIT V2) as a practical and adaptable framework for the systematic planning and implementation of effective DT programmes. The tool provides a nuanced understanding of specialist, integrated, and enhanced

learning approaches, underscoring the significance of effectively blending technological, pedagogical, and content knowledge (TPACK). It offers a structured methodology for engaging with the core curriculum concepts of Computational Thinking (CTDT) and Designing and Developing Digital Outcomes (DDDO), promoting the purposeful application of technological tools across various learning contexts to elevate student engagement and achievement. By facilitating a pedagogical shift from basic technology use towards the creation of meaningful and deeply integrated programmes, the DTCIT V2 aims to equip students with the necessary skills and dispositions to thrive in an increasingly digital world where technology is seamlessly woven into life and learning.

The findings of this research carry significant implications for teachers, school leaders, and policymakers alike. For teachers, it is imperative to actively pursue continuous professional development opportunities to enhance their confidence and pedagogical expertise in digital technologies. Embracing innovation and adaptability is crucial, enabling them to design purposeful and engaging learning experiences that are strategically aligned with the specific goals of their DT programmes, whether delivered through specialist, integrated, or enhanced approaches. By thoughtfully leveraging diverse pedagogical strategies and integrating digital technologies across the curriculum, teachers can inspire students, model enthusiasm for digital learning, and ultimately foster digitally capable learners.

For leaders, this research underscores the critical need to articulate a clear and compelling vision for DT programmes, supported by well-defined goals and expectations that are consistently communicated across the school community. Strategic resource allocation, aligned with the school's overarching strategic objectives, is essential to provide sustained support for teacher growth and programme development. Leaders must also actively participate in professional learning related to digital technologies and model their effective use, thereby cultivating a school-wide culture of continuous learning and digital fluency. Furthermore, fostering a supportive environment that encourages experimentation, collaboration, and the sharing of best practices is paramount for empowering teachers and ensuring the successful and sustainable implementation of DT initiatives.

For policymakers, this study highlights the importance of ensuring equitable access for all schools to adequate resources, including dedicated funding, specialist support personnel, and high-quality professional development opportunities focused on both DT content and its associated pedagogies. Developing clear and comprehensive frameworks that provide practical guidance for leaders and teachers is crucial for the effective and consistent implementation of DT programmes across the nation.

Policymakers should also prioritise the seamless integration of digital citizenship education within the curriculum, actively encourage collaboration and the dissemination of successful practices among schools and recognise the interdependent roles of teachers and leaders as key drivers of successful DT initiatives.

The limitations of this research primarily relate to its scale and participant selection. While the collective case study of two schools allowed for valuable data triangulation, the small sample size of seven participants necessitates caution regarding the broad generalisability of the findings. The geographical focus on the Waikato region of New Zealand, coupled with the selection of only middle schools recognised for their high-performing DT departments, may not fully represent the diverse landscape of DT implementation across different regions and school types within New Zealand. Furthermore, the New Zealand context may present unique characteristics that limit direct transferability to international settings. These factors suggest that the findings offer valuable insights within a specific context but should be interpreted with awareness of these limitations.

This study has identified two key areas that warrant further scholarly inquiry:

- The application and effectiveness of established theoretical frameworks and models, such as TPACK (Technological Pedagogical Content Knowledge) and Bloom's Digital Taxonomy, in supporting New Zealand teachers and leaders with the implementation of the Digital Technologies Curriculum (DTC).
- The systematic incorporation of student voice to gain deeper insights into the characteristics of effective digital technologies programmes from the learners' perspectives.

Both of these areas represent significant gaps in current New Zealand-based research, likely due to the relatively recent introduction of the DTC. Further investigation in these domains would provide valuable evidence to support teachers, leaders, and policymakers, ultimately contributing to the enhanced efficacy and impact of DT programmes in New Zealand schools.

By reflecting on the evolution of digital technologies in education and understanding current implementation practices, this research offers insights to guide future advancements. "Kia whakatōmuri te haere whakamua – I walk backward into the future with my eyes fixed on the past" (Rameka, 2016, p. 387).

In conclusion, this research underscores the critical importance of collaborative and distributed leadership in fostering engaging and effective digital technologies programmes in New Zealand middle schools. By thoughtfully considering the findings and strategically leveraging frameworks such as the DTCIT V2, schools can better equip their students to not only navigate but also thrive in an increasingly digital world where technology is seamlessly integrated into their learning journeys and everyday lives. It is my sincere hope that this research contributes to the successful and equitable implementation of digital technologies across all New Zealand schools, empowering the next generation to become "digitally capable thinkers, producers, and creators of innovative digital solutions" (Ministry of Education, 2020, p. 10).

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Please Note: *Much of the NZ curriculum-based content in this thesis has been migrated from the original TKI and Technology Online sites accessed in 2023/2024, to the new Tahurangi site. Therefore, these links provided in the Figures, Tables and references section will be redirected to Tahurangi.*

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Appendices

Appendix 1 – Letter for Schools

9 February 2024

Re: **Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders**

Dear XXXX,

My name is Shannon Buckle. I am pursuing a Master of Educational Leadership at the University of Waikato. As part of this qualification, I am conducting research for my thesis. This research will be supervised by Dr Andrew Doyle and Dr Dianne Forbes. I am also a teacher at Berkley Normal Middle School, specialising in digital technologies.

My research will be in the form of Case Studies from two schools. I am interested in gaining knowledge and understanding about how schools implement effective digital technologies programmes. Alongside the overarching question, I am looking at teachers' perceptions of why strong digital technologies programmes are crucial, what the characteristics of strong digital technologies programmes are and the leadership actions that are associated with strong digital technologies programmes. The results of this research may be beneficial to teachers of digital technology as the analysis of the information gained and synthesised may provide insights which may assist teachers and leaders in providing effective digital technologies programmes in their schools.

I would like to invite your school to be one case in my Case Study and am seeking your permission to invite teachers to participate in my research. The research is split into four phases, which teachers may participate in none, some or all of.

Phase 1: Focus Groups Session (4-8 teachers)

- Teachers would participate in a discussion around my research question - 'how do schools implement effective digital technologies programmes?'
- One hour timeframe
- This session will be audio-recorded

Phase 2: Providing documentation for analysis (x2 teachers/leaders)

- Teachers would provide me with access to any planning, scope and sequence documents or other documents relevant to the teaching and learning of DT at your school.
- This is likely to take under 30 minutes to locate, gain necessary permissions and send to me.

Phase 3: Classroom observation (x2 teachers/leaders)

- At a time convenient to the teachers.
- Lesson duration between 30-60 minutes.
- My focus would be on observing the teaching of digital technologies during this lesson.
- This session will be audio recorded and field notes will be taken.

Phase 4: 1 to 1 interviews. (x2 teachers/leaders)

- At a time convenient to the teachers.
- Around 1 hour interview and 30 minutes to check and amend the transcript.
- The session will be audio recorded.

This research has been approved by the Division of Education Human Research Ethics Sub-committee of the University of Waikato. The study's outcomes may be presented in academic journals, at conferences and in school PLD. Care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms. However, while every effort will be made to maintain anonymity this cannot be guaranteed. After the research has been examined, a succinct summary of my findings will be sent to the participants. I would appreciate your support and approval by consenting to allow your teachers to assist with this research. Should you have any questions or issues, please do not hesitate to contact me on 0220376440 or email skh11@students.waikato.ac.nz. Or you may contact my chief supervisor at the University of Waikato: Dr Andrew Doyle at andrew.doyle@waikato.ac.nz

Thank you in advance for your time and consideration.

Yours faithfully,

Shannon Buckle

Appendix 2 – Consent Form for participation for a school

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I have read and understood the information given about the nature and purpose of this research.
- I consent for any teacher volunteers to participate in this study.
- I understand that audio-recording will be used during Phases 1, 3 and 4.
- I understand that care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms.
- I understand that while every effort will be made to maintain anonymity this cannot be guaranteed.

Name of principal: [Participant name]
Name of School: [School Name]

Signature: _____ Date: [Date]

This research has been approved by the University of Waikato Division of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 3: Letter to Teachers

Te Kura Toi Tangata
Division of Education
The University of Waikato
Private Bag 3105
Hamilton, New Zealand,3240

0800 WAIKATO (924 528)
skh11@students.waikato.ac.nz
www.waikato.ac.nz

9 February 2024

Re: **Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders**

My name is Shannon Buckle. I am pursuing a Master of Educational Leadership at the University of Waikato. As part of this qualification, I am conducting research for my thesis. This research will be supervised by Dr Andrew Doyle and Dr Dianne Forbes. I am also a teacher at Berkley Normal Middle School, specialising in digital technologies.

My research will be in the form of Case Studies from two schools. I am interested in gaining knowledge and understanding about how schools implement effective digital technologies programmes. Alongside the overarching question, I am looking at teachers' perceptions of why strong digital technologies programmes are crucial, what the characteristics of strong digital technologies programmes are and the leadership actions that are associated with strong digital technologies programmes. The results of this research may be beneficial to teachers of digital technology as the analysis of the information gained and synthesised may provide insights which may assist teachers and leaders in providing effective digital technologies programmes in their schools.

Your school has been selected to form one of the cases in my research, and I invite you to consider participating in my research if you meet any or all of the following criteria:

- You have an interest in digital technologies
- You teach and/or lead digital technologies in some capacity in the school
- You are prepared to take part in a **one-hour focus group**, where you will discuss the characteristics of effective digital programmes and the actions that leaders take in supporting this.
- You are prepared to take part in any or all of these phases of my research: providing documentation for analysis, classroom observations and/or 1 to 1 interviews.

Phase 1: Focus Groups Session (4-8 teachers)

- Teachers would participate in a discussion around my research question - 'how do schools implement effective digital technologies programmes?'
- One hour timeframe

Phase 2: Providing documentation for analysis (x2 teachers/leaders)

- Teachers would provide me with access to any planning, scope and sequence documents or other documents relevant to the teaching and learning of DT at your school.
- This is likely to take under 30 minutes to locate, gain necessary permissions and send to me.

Phase 3: Classroom observation (x2 teachers/leaders)

- At a time convenient to the teachers.
- Lesson duration between 30-60 minutes.
- My focus would be on observing the teaching of digital technologies during this lesson.
- This session will be audio recorded and field notes will be taken.

Phase 4: 1 to 1 interviews. (x2 teachers/leaders)

- At a time convenient to the teachers.
- Around 1 hour interview and 30 minutes to check and amend the transcript.
- The session will be audio recorded.

This research has been approved by the Division of Education Human Research Ethics Sub-committee of the University of Waikato. The study's outcomes may be presented in academic journals, at conferences and in school PLD. Care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms. However, while every effort will be made to maintain anonymity this cannot be guaranteed. After the research has been examined, a succinct summary of my findings will be sent to participants. I would appreciate your assistance with this research. Should you have any questions or issues, please do not hesitate to contact me on 0220376440 or email skh11@students.waikato.ac.nz. Or you may contact my chief supervisor at the University of Waikato: Dr Andrew Doyle at andrew.doyle@waikato.ac.nz

Thank you in advance for your time and consideration.

Yours faithfully,
Shannon Buckle

Appendix 4 – Consent Information for Teachers for Phase 1: Focus Group Session

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I have read and understood the information given about the nature and purpose of this research.
- I volunteer to participate in this study.
- I understand that I am volunteering to participate in a focus group session, with the ability to opt into further phases of the research if I wish, at a later date.
- I understand that this session will be audio recorded.
- I understand that I do not have to engage in this phase, but once I do engage, there is no option to withdraw the data shared. This is due to the nature of focus groups, where meaning is made from the interaction between participants and the omission of one participant's data impacts upon the entirety of the data gained.
- I understand that care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms.
- I understand that while every effort will be made to maintain anonymity this cannot be guaranteed.

Name of Participant: _____

Name of School: _____

Signature: _____ Date: [Date]

This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 5 – Consent Form for Teachers for Phase 2: Document Analysis

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I have read and understood the information given about the nature and purpose of this research.
- I volunteer to participate in this study.
- I understand that I do not have to engage in this phase, but once I do engage, there is no option to withdraw the data shared.
- I understand that care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms.
- I understand that while every effort will be made to maintain anonymity this cannot be guaranteed.

Name of Participant: _____

Name of School: _____

Signature: _____ Date: [Date]

This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 6 – Consent Form for Teachers for Phase 3: Classroom Observation

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I have read and understood the information given about the nature and purpose of this research.
- I volunteer to participate in this study.
- I understand that I do not have to engage in this phase, but once I do engage, there is no option to withdraw.
- I understand that care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms.
- I understand that while every effort will be made to maintain anonymity this cannot be guaranteed.

Name of Participant: _____

Name of School: _____

Signature: _____ Date: [Date]

This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 7 – Consent Form for Teachers for Phase 4: 1 to 1 Interviews

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I have read and understood the information given about the nature and purpose of this research.
- I volunteer to participate in this study.
- I understand that the transcript will be emailed to me, and I may amend and/or confirm or withdraw within two weeks by return email.
- I understand that If I have not responded within this timeframe, it will be assumed that the transcripts are approved.
- I understand that care will be taken to safeguard the school and individuals by stripping identifying information at the time of analysis, including through the use of pseudonyms.
- I understand that while every effort will be made to maintain anonymity this cannot be guaranteed.

Name of Participant: _____

Name of School: _____

Signature: _____ Date: [Date]

This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 8: Information Letter for Parents

Te Kura Toi Tangata
Division of Education
The University of Waikato
Private Bag 3105
Hamilton, New Zealand,3240

0800 WAIKATO (924 528)
skh11@students.waikato.ac.nz
www.waikato.ac.nz

9 February 2024

Re: **Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders**

Dear Parents/Caregivers,

My name is Shannon Buckle. I am pursuing a Master of Educational Leadership at the University of Waikato. As part of this qualification, I am conducting research for my thesis. This research will be supervised by Dr Andrew Doyle and Dr Dianne Forbes. I am also a teacher at Berkley Normal Middle School, specialising in digital technologies.

I am writing to inform you that I will be conducting a one-off classroom observation in your child's classroom, where I will be looking at the digital technologies programmes implemented and delivered by your child's teacher. The lesson will be audio recorded and some photos of student work may be taken. The work that the students do during this lesson will be part of the New Zealand Curriculum and their usual classroom programme. The results of this research may be beneficial to teachers of digital technology as the analysis of the information gained and synthesised may provide insights which may assist teachers and leaders in providing effective digital technologies programmes in their schools.

Should you have any questions or issues, please do not hesitate to contact me on 0220376440 or email skh11@students.waikato.ac.nz.

Thank you in advance.

Yours faithfully,

Shannon Buckle

Appendix 9 – Consent Form for Parents

CONSENT FORM

Project Title: Exploring effective digital technologies programmes: Perspectives of middle school teachers and leaders.

Researcher's Name: Shannon Buckle

- I am aware that a researcher will be collecting data in the classroom while my child's teacher is teaching.
- I understand that the classroom observation will be audio recorded for the purpose of keeping a backup record of the teacher's teaching, but this recording will not be shared with any other parties.
- I have had the opportunity to ask questions of the teacher and researcher.
- I understand that if my child feels uncomfortable whilst the researcher is in the room, they can distance themselves.

Name of student: _____

Name of Parent: _____

Name of School: _____

Signature: _____ Date: _____

This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 8/2/24. Approval Number: FEDU003/24

Appendix 10 – Information and Assent statement for Students

To be read out to the students by the teacher or myself prior to observation:

Kia ora!

My name is Shannon Buckle and I teach Digital Technologies at Berkley Normal Middle School. I am working with teachers in your school on a research project. I am interested in exploring a range of teachers' perspectives on what makes an effective digital technologies programme. I am excited to observe a lesson here today because it will help me learn a little bit about what your teacher believes about teaching digital technologies. During the lesson, I will be

- audio recording the lesson
- watching what your teacher does
- looking at some of your learning activities

I look forward to working alongside you during this lesson.

Appendix 11 – 1-to-1 Semi-Structured Interview Questions

My literature review seeks to craft a document entitled Characteristics of an effective DT programme, based on seminal and current literature about leadership and digital technologies programmes. Additionally, a Strategic Actions of Leaders Framework will be established. These documents will play a vital role in my research and are referred to in the questions below.

- Can you tell me about yourself, professionally?
- What are your key responsibilities in this role, in relation to the Digital Technologies programme at your school?
- What can you tell me about the Digital Technologies programme at your school?
- What do you consider to be strengths within your current DT programme?
- What areas of development do you have in mind for your DT programme?
- What characteristics do you consider a vital component of a Year 7-8 digital technologies programme in 2024?
- What has influenced the development of your school's DT programme?
- What have you/other leaders done to support DT programmes in terms of:
    - The Strategic Actions of Leaders Framework? *This question will identify which framework elements are relevant to the participant/school.*
    - Characteristics of an effective DT programme?
    - *Further lines of questioning are likely to arise from these questions.*
- Tell me more about the introduction of… (depending on observation) and its purpose in the programme.
- Do you have anything else you would like to add, regarding the DT programme at your school?

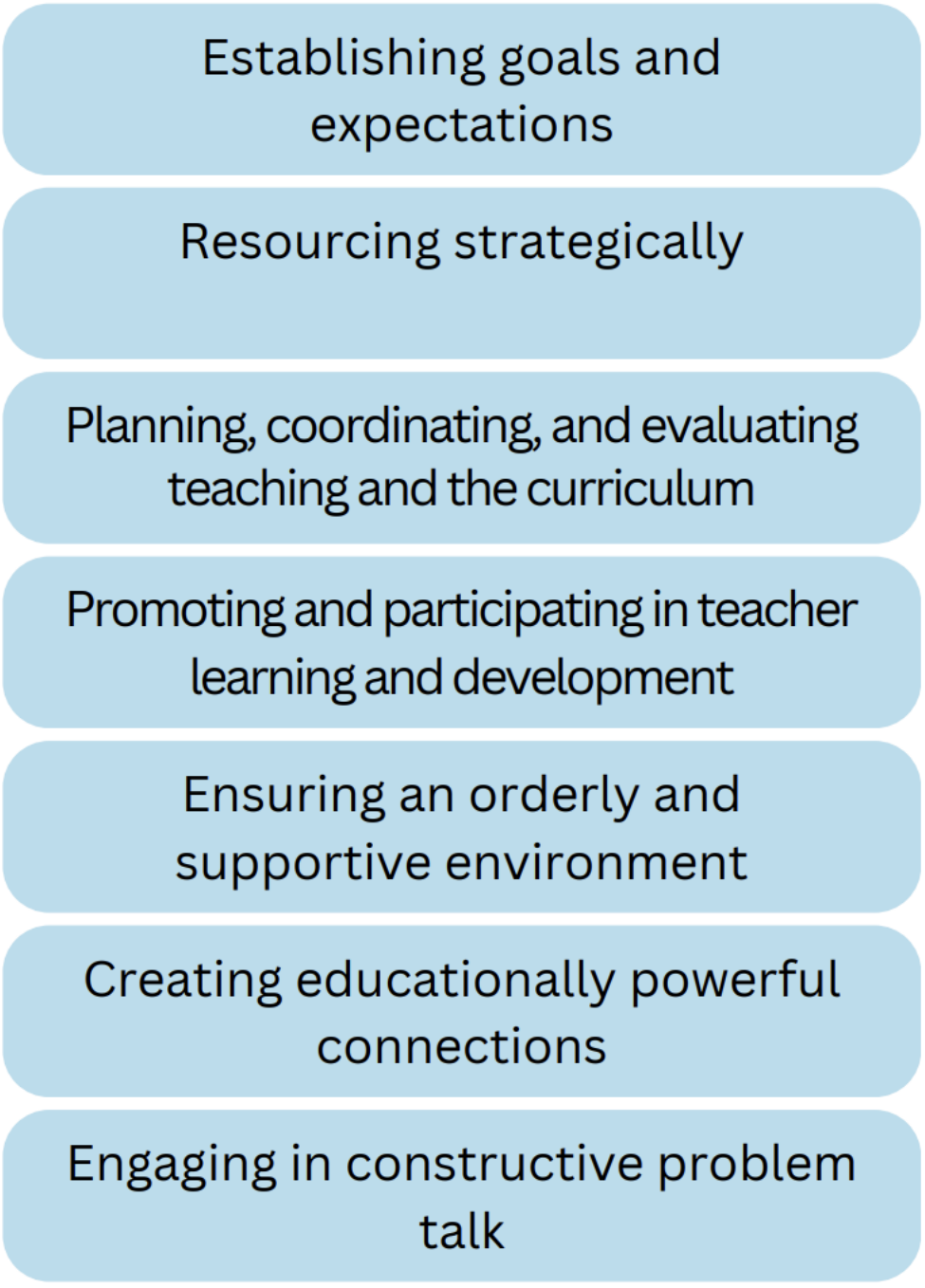
Appendix 12 – Focus Group Questions

My literature review seeks to craft a document entitled Characteristics of an effective DT programme, based on seminal and current literature about leadership and digital technologies programmes. Additionally, a Strategic Actions of Leaders Framework will be established. These documents will play a vital role in my research and are referred to in the questions below.

- What is your role and how does it relate to your school's DT programme?
- What are your ideas and views about characteristics of effective DT programmes.
- Where do you go to access information when planning your DT lessons (what documentation do you draw from)?
- ACTION: Put out a couple of large copies of the 'Characteristics of effective DT programmes' statement out on the table. Explain the document.
- Please discuss your thoughts on this document's content.
- Can you give any specific examples of these kinds of characteristics in your DT programmes at (school)?
- Which of these characteristics do you consider strengths within your current DT programmes? Discuss
- Which of these characteristics would you consider next steps or gaps within your current DT programmes? Discuss
- ACTION: Put the framework criteria out on the table.
- Please order these dimensions first to last, in terms of what has made the biggest difference to the implementation of effective DT programmes and discuss.
- Are there any other dimensions that you would add to this list that you think have had a positive impact on DT programmes in your school?
- Is there anything else that you would like to discuss, relevant to the DT programmes?

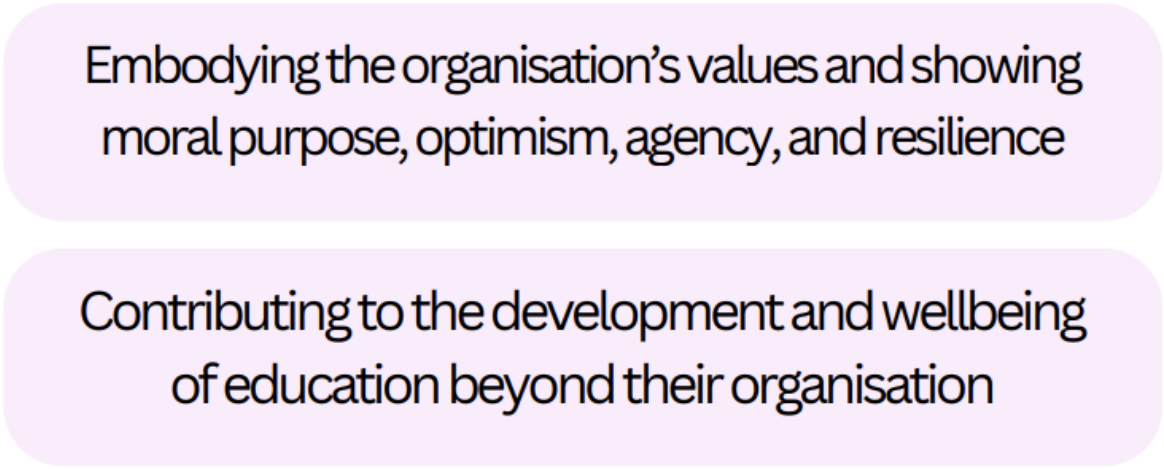
Appendix 13 – Resources for Focus Group and Interview (From BES and Educational Leadership Capabilities)

Teachers order these leadership actions and justify their positions:



Appendix 13 – cont.

Appendix 13 – cont.



Appendix 14: Observation Framework

How do Schools implement Effective Digital Technologies Programmes? Classroom Observation Tool		
Date/Time:	**Teacher:**	**School:**
Lesson:		
Lesson Outcomes: •		
Past Lesson Understandings: •		
Lesson Overview:		

Appendix 14: Cont.

CTDT • Make, follow and debug algorithms (instructions) online and offline. • Develop and debug programs involving inputs and outputs. • Develop and debug programs involving sequence and iteration. • Predict the behaviour of programs. • Decompose problems into step by step instructions. • Understand there can be more than one algorithm for the same problem. • Understand that digital devices store data in bit (binary digits). DDDO • Create, test and manipulate digital content with consideration of end users. • Store, retrieve and share digital content with consideration of end users. • Understand that digital devices impact on humans and society. • Identify individual and collective roles of components in input-process-output systems. • Recognise the control role that humans have in systems. • Select from an increasing range of applications and file types to develop digital outcomes.	• Code.org • Edisons • MBots • Micro:bits • Minecraft EDU • Scratch • Sphero • "Unplugged" activities such as those from Digital Kete • Animation • Augmented Reality • Book Creator • Canva • Explain Everything • Genial.ly • Google Drive • Google Maps • Google Workspace • iMovie • Kahoot • MaKey MaKey • Micro:bit • Minecraft EDU • Pixton • Stop Motion • Thinglink • Tinkercad Other:	

Appendix 14: Cont.

Running Notes:
Noticings: •
Questions: •