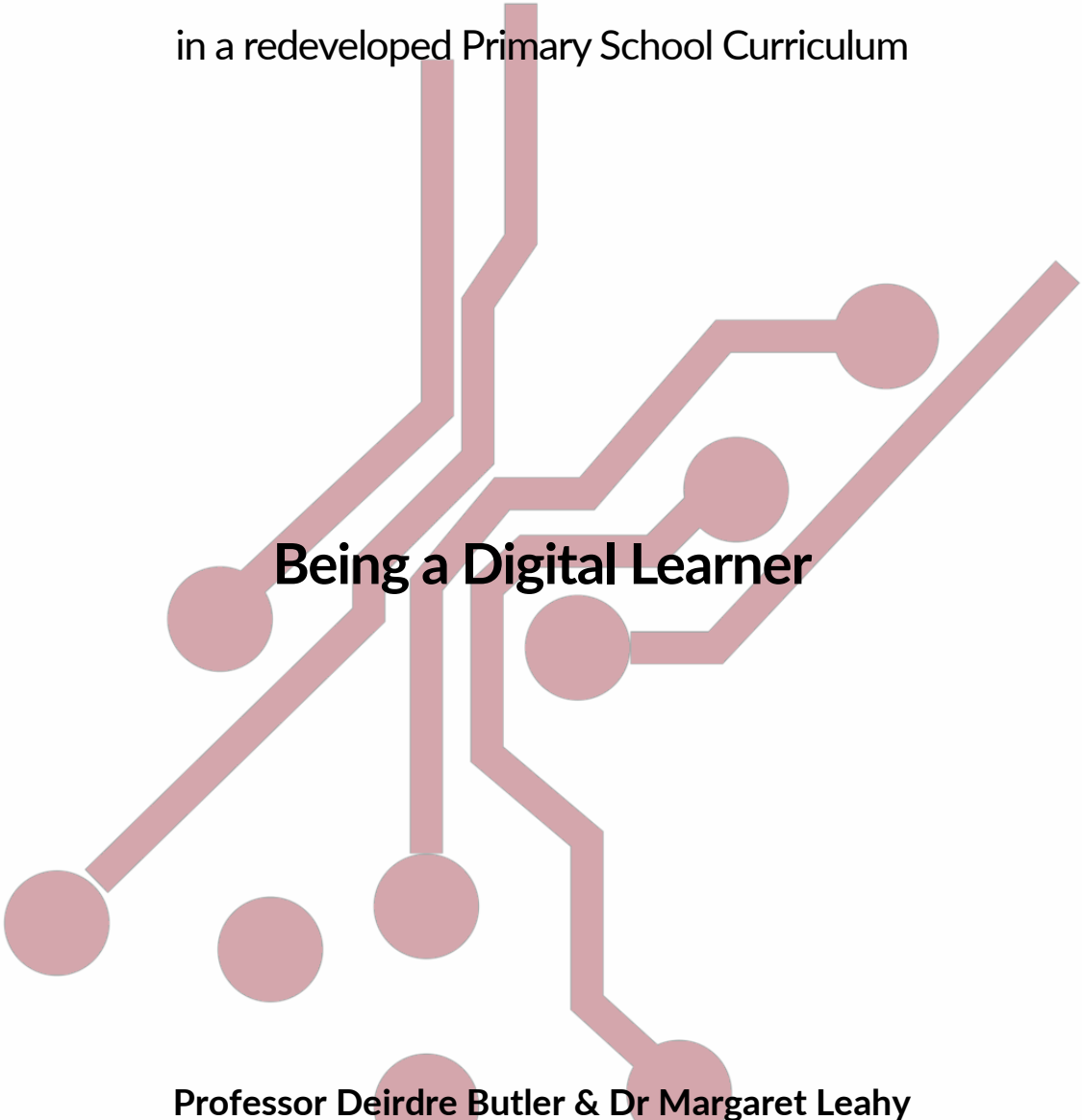
NCCA
An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

Research Paper in Support of the Introduction of Technology

in a redeveloped Primary School Curriculum



Being a Digital Learner

Professor Deirdre Butler & Dr Margaret Leahy
Dublin City University

Contents

Reading Note

The *Draft Primary Curriculum Framework* proposes the inclusion of learning associated with digital technology as both a key competency – 'Being and Digital Learner' – and as part of a subject named as 'Science and Technology' located within the curriculum area of 'Mathematics, Science and Technology' (NCCA, 2020, p. 7 and p. 11). Building upon the data gathered as part of the NCCA *Coding Initiative* (2019) and cognisant of the wider policy landscape supporting digital technology in schools, the NCCA has commissioned a suite of research papers, of which this paper is one. The purpose of the research papers is to inform the development of curriculum provision to support:

- children to become curious, creative, confident and critical users of digital technology;
- children's ability to collaborate and thrive in a world increasingly immersed in technology;
- children to critically engage and contribute to a digitally connected and interdependent world. (NCCA, 2020, p. 8)

As schools and communities continue to manage the daily challenges related to the COVID19 pandemic, it is important to acknowledge the strides made across our education system in relation to the use of digital technology. As documented in the recent report from the *Children's School Lives* study, the substantial efforts from school leaders, teachers, children and parents to engage with technology was striking during the extended period of school closures from March to September 2020. Recent discussions at the Early Childhood and Primary Board, as well as Council, have also drawn attention to the innovations related to teaching and learning in which remote learning, blended learning, synchronous/asynchronous learning, and digital learning platforms have all become more prevalent in the vernacular of Irish educators.

With this context in mind, it is timely to consider what 'Being a Digital Learner' might look like in a redeveloped Primary School Curriculum. This paper, building on the proposals of the draft framework, aims to support discussion around this topic. Indeed, given the current context in our

education system and wider society we might ask ‘what, if any, impact has COVID19 had on our understandings of what ‘Being a Digital Learner’ in a redeveloped Primary School Curriculum is?’

1. Introduction

A key challenge for educators is to prepare children to thrive in an uncertain, rapidly changing digital world. This is no small challenge as the world 'struggles to respond to economic, environmental and social transformations—including technological advances, climate change and migration' (OECD, 2019 p. 9). These transformations have led to demands for citizens who can leverage the power of digital tools to think critically and creatively in order to generate original solutions, solve problems and have the confidence to bring about positive change (Fadel, 2015). Equally, they have led to concerns and uncertainty about the future, for example: the potential impact of artificial intelligence on some workplaces; how to manage the explosive growth of data and universal data access; how to keep up with an accelerating pace of change; or how to manage global competition for skills.

It is also the case that the use of digital technologies is increasingly pervasive in the lives of young people, who are using them for a multitude of activities both in and outside of schools (OECD, 2020). Children's experiences with digital technologies have changed considerably over the past decade (Auxier, Anderson, Perrin, & Turner, 2020; Ofcom, 2018; Smahel et al., 2020). Children are now generally younger when they first begin to engage with digital technologies. For example, in a recent USA survey of over 3,500 parents, more than one-third of parents with a child under 12 said their child began interacting with a smartphone before the age of 5 (Auxier et al., 2020). Mobile devices such as tablets and smartphones are the preferred means of going online, with the majority of children using these devices daily (Ofcom, 2018; Smahel et al., 2020). YouTube has emerged as a key platform for both younger and older children with rising popularity particularly among 8- to 11-year-olds (Smahel et al., 2020). Within this, vloggers are an increasingly important source of content and creativity; according to Ofcom (2018), 'making a video' was one of the most popular online activities for approximately half of 5- to 15-year-olds. Social media is prevalent among teenagers but children as young as 8 years old have social media profiles using a range of social networking

sites including WhatsApp, TikTok, SnapChat and Instagram. Online gaming is also increasingly popular: three-quarters of 5-to 15-year-olds who play games do so online (Ofcom, 2019; Smahel et al., 2020). Streaming services such as Netflix and Amazon Prime are quickly gaining popularity as the time spent in front of traditional television sets is decreasing. Finally, developments such as the Internet of Things (IoT) and/or the Internet of Toys represent a movement of digital technologies beyond the screen and are becoming more prevalent in children's lives (Graafland, 2018). The IoT refers to objects that, when tagged, can communicate with other tagged objects. Wearable fitness trackers and devices that track children's location are two examples. Toys which are wirelessly connected to other toys (internet-connected toys) are projected to increase in popularity in the coming years (Mascheroni & Holloway, 2017).

Within this global context, the education system is expected to ensure learners have the skills and competencies necessary to live, learn, work and play. Digital technologies have a key role to play in transforming education systems to meet these needs, not only because they change many aspects of society which impact on education, but also because they provide us with additional ways of supporting learners. Today's children will face a continual stream of new issues and unexpected challenges in the future. Many things that they learn today may be obsolete tomorrow. To thrive, they must learn to design innovative solutions to the unexpected problems that will undoubtedly arise in their lives (Resnick, 2014). Their ability to think critically and act creatively, leveraging the digital technologies in which their lives are immersed, will be crucial.

Against this backdrop, we must ask ourselves the question: what does a quality curriculum look like in a digital era? And in particular, what does 'being digital' in learning mean? In attempting to answer these questions we need to think about:

- What knowledge, skills, attitudes and values do today's children need to thrive and shape their world which is constantly changing, complex and digital (e.g., see Erstad and Voogt, 2018)?

- How can instructional systems (in this case primary schools) develop such knowledge, skills, attitudes and values effectively (e.g., OECD, 2018)?

This paper sets out to deliberate **what it means to be a digital learner**, the **importance and relevance of this competence** for children's learning as well as the **key concepts or big ideas** associated with *Being a digital learner* as a key competency in the context of the *Draft Primary Curriculum Framework* (NCCA, 2020). In doing so, and mindful of Dewey's (1934) advice that 'any education is, in its forms and methods, an outgrowth of the needs of the society in which it exists', an understanding of the context and the factors that determine what it is understood by 'being a digital learner' is important.

There are three main parts to the paper. The first presents the context, beginning by discussing what is understood by digital learning and being a digital learner. It then looks beyond the individual stressing the importance of having alignment between educational vision, practice and policy. The *Digital Strategy for Schools* (DES, 2015), the *Digital Learning Framework* (DES, 2017) and the *Primary Curriculum Framework* (NCCA, 2020) are presented as being critical towards such an alignment in primary schools in Ireland and the alignment between them is clearly highlighted. It is against this backdrop that we explore *Being a digital learner* as a key competency in the Draft Primary Curriculum Framework in the second part of the paper. Digital competence, digital literacies and computational thinking are discussed in the context of being a digital learner. Connections are also made with the other key competencies that are included in the proposed primary curriculum framework. The third and final part of the paper addresses other key considerations in relation to being digital in learning. These include the challenges of system-wide alignment and the key role of the agentic teacher.

2. Digital learning and being a digital learner

The term 'digital learning' can be considered a 'suitcase word' in that it has different meanings for different fields and different meanings for people with different backgrounds (Minsky, 2007). What

this implies is that digital technologies do not have an independent existence and cannot be considered separately from the values that people bestow on them. So there is a consistency, explicit or implicit, between how people understand knowing and the nature of knowing, and what technologies are valued and how they are used. The ways digital technologies may or may not be used reflect these understandings.

To explain: the tools which people use as they grapple with the realities they encounter in their environments are not only determined by the culture in which they live but also embody an accumulated set of cultural values and beliefs. Some may argue that 'these digital technologies are just another "tool" and won't fundamentally change what we do'. However, Bruner (1973, p. 22), saw thinking as the 'internalisation of "tools" provided by a given culture', while Vygotsky (1978) believed changes in tools bring about changes in thinking, and that these changes in turn are associated with changes in culture. This is a reciprocal relationship. These tools thus not only influence the ways in which people interact with the world, but also shape the way they think about the world. This is not a simple process whereby the available cultural tools help towards the completion of tasks and activities. Instead, they function as intellectual partners and are a fundamental part of the interactions and outcomes of thinking (Salomon & Perkins, 1998). Individuals, tools and cultural constructions of tool use involved in the action are thus inseparable and held together in an 'irreducible tension' (Wertsch, 1998, p. 25). Learners are learning *with* the tools that support, guide and change their thinking processes, enabling them to undertake activities that would usually be beyond their unassisted abilities (Pea, 1993; Salomon & Perkins, 1998). This implies that learning does not take place solely within the individual mind. Rather, it positions individuals as embedded in and inseparable from their social and cultural worlds. Learning in this sense is distributed among individuals, their cultural tools and activities and the contexts in which it takes place.

It follows that when tools change, so must the nature of human thinking and learning and so must human practices. And, just as changes in tools transform social practices, so must they transform individuals who acquire a new set of instruments by means of which they can relate to the world (Vygotsky, 1981). In their book *A New Culture of Learning* (2011), Douglas Thomas and John Seely Brown highlight how the internet, in particular, has changed the way we think about both information and technology, noting:

> information technology has become a participatory medium, giving rise to an environment that is constantly being changed and reshaped by the participation itself…the more we interact with these environmental spaces, the more the environment changes, and the very act of finding information reshapes not only the context that gives that information meaning but also the meaning itself. (p.42)

This connection between the tools a culture uses and how its thinking develops is critical when one is deciding how digital technologies (today's tools of society) are to be used. So, if we believe that the learner constructs knowledge and that each individual is an active maker of their own meanings, then we need to empower learners to use and shape the world with these 'convivial tools', rather than be shaped by them (Illich, 1974). We need to ask what these new tools will enable us to do, and what is worth doing? We cannot consider the question of how digital technologies are to be used in education in isolation; we must view it according to our definition of the nature of knowledge and the nature of knowing. Concepts of learning and our understandings of knowledge are linked. We therefore cannot possibly have a view of learning without also implying a view of knowledge.

The view of learning as presented in the *Draft Primary Curriculum Framework* (NCCA, 2020) is one where learning is viewed as an active process of enquiry, reflection and dialogue, and children are considered co-constructors of knowledge in collaboration with their peers, teachers and the wider

community. This social constructivist perspective of learning provides the foundations of both the *Draft Primary Curriculum Framework* (NCCA, 2020) and the *Digital Strategy for Schools* (DES, 2015). This is in keeping with the ideas expressed by Jonassen (1996; 1999) who used the term 'mindtools' to highlight the power of digital technologies as mediators of learning. He argues that digital technologies should not support learning by attempting to instruct learners but rather should be used as knowledge construction tools that children can learn *with*, not *from*. In this way, learners are conceived as designers, using the technologies as tools for analysing the world, accessing information, interpreting, organising and constructing their personal knowledge, and representing what they know to others (Jonassen & Reeves, 1996; Jonassen, Peck & Wilson, 1999). Learners therefore become more engaged in the active processing of information and in constructing personal and socially shared understandings of the phenomena they are exploring (Jonassen, 1999; 2000; Perkins, 1993).

One of the most important challenges within our education systems worldwide is that of empowering learners with the intellectual tools of our culture (Vygotsky as cited in Wertsch, 1985); an empowerment that starts when they are very young and continues throughout their lives (Davis, 2018). They need to be more than add-ons; they need to be more than acquiring the know-how to use the tools, as they will change thinking, the ways that individuals see the world and indeed define cultures. So developing digital competence is more than just using another tool: it is concerned with knowledge, skills, values, beliefs, disposition and attitudes.

Across the globe, educators are challenged to continually adapt in the face of ever-changing technologies, societal futures, and learner needs. Indeed, some time ago OECD's Andreas Schleicher noted:

> School systems need to find more effective ways to integrate technology into teaching and learning to provide educators with learning environments that support 21st century

> pedagogies and provide children with the 21st century skills they need to succeed in tomorrow's world. (OECD, 2015)

But what would this look like in a primary school curriculum?

3. Towards the alignment of policy and practice

The importance of having alignment between educational vision, practice and policy is well established (e.g., Butler et al., 2013; Fullan, 2013; Twining et al., 2013). Evidence demonstrates that digital learning initiatives/innovations can have a greater impact when the policies and programmes designed to implement them are aligned with other aspects of the education system (Law, 2013). As a starting point, it is therefore helpful to look beyond the individual as a digital learner and document the landscape as it has evolved in the last decade or so in Ireland.

There is growing evidence that 'digital technologies change the way children learn, the way teachers teach, and where and when learning takes place' (21st Century Learning Reference Group, 2014, p. 4). However, research has consistently demonstrated that digital technology per se is not necessarily a driver or catalyst for change and the introduction of digital technology into schools does not in and of itself lead to the development of innovative teaching practices or the transformation of education (e.g., European Schoolnet and University of Liège, 2013; Kozma, 2003; Law et al., 2008; OECD, 2015; Shear et al., 2010; 2011; Twining, 2018. In order for digital technologies to be effectively used in teaching and learning at school level, their use has to be part of the school vision and must be supported by specific national policies and strategies (Plomp et al., 2009; Shear et al., 2011). This is already occurring in Ireland to a large extent as the use of digital technologies is now an integral part of teaching, learning and assessment endorsed in all educational policies and plans published in the last decade or so. *The National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020*, (DES, 2011); *Project Maths*

(NCCA, 2008); *Key Skills Framework* (NCCA, 2009); the *Framework for Junior Cycle* (DES, 2012); The School Self-Evaluation Programme (DES Inspectorate, 2012) and the STEM Education Policy Statement and Implementation Plan (DES, 2017b; 2017c) all require that digital technologies are used as a part of learning. In addition, the Irish Teaching Council has identified ICT as a key national priority area (The Teaching Council, 2017).

Despite this, and acknowledging the time lag usually observed between policy implementation and change in practice, policy has not yet translated to classroom practice in relation to digital learning. Findings from a number of national research studies and surveys have repeatedly demonstrated that the use of digital technologies in primary schools in Ireland has mainly been as a teaching tool by teachers who generally use them for presenting information in class or for preparing lessons. Children are provided with few occasions to use digital technologies in school and when they do use them, it is mainly to retrieve information online or practice routine skills (Conway & Brennan, 2009; Cosgrove et al., 2014; DES, 2008; Eivers, 2019; European Schoolnet and University of Liège, 2013). The most recent DES Inspectorate report, while outlining some encouraging changes in usage, found that 'overall, [the] inspectors' findings are showing that there is scope to use digital technologies more regularly as part of teaching and learning in schools and that their use would improve learning for children and young people in many instances'. (DES Inspectorate, 2020, p. 15). Large scale international surveys such as PIRLS and TIMMS also highlight the lack of digital activities that require learners to draw on their capacity for higher-order activities such as analysis, synthesis and evaluation. Similarly, teaching children to be critical when reading on the internet was a less common activity in Irish classrooms than across most PIRLS participating countries (Eivers, 2019). Overall, this type of usage is indicative of a more traditional view of learning and suggests that for the most part, the use of digital technologies in schools is at the *technology literacy level* (UNESCO 2008a; 2008b; 2011), where digital technology is used to strengthen existing teaching

and learning practices, rather than as intellectual tools that empower and challenge learners to think harder and deeper about what they are studying.

Digital Strategy for Schools (DES, 2015) and the Digital Learning Framework (DES, 2017)

The publication of the *Digital Strategy for Schools* (DSS) (DES, 2015) was perceived as the glue that would not only leverage existing educational policies but would also be the catalyst for enabling the move towards systemic transformation of Irish schools (Butler et al., 2018). Building on government policy to equip all learners with the 'knowledge and skills they need to participate fully in society and the economy, one that enables all learners to learn how to learn' (Department of Public Expenditure and Reform, 2014, p. 43), the *Digital Strategy for Schools* (DES, 2015) and the subsequent *Digital Learning Framework* (DLF) (DES, 2017) promote embedding digital technologies into a wide range of teaching and learning activities. The *Digital Strategy for Schools* states that

> The Department's vision for ICT integration in Irish schools is to realise the potential of digital technologies to enhance teaching, learning and assessment so that Ireland's young people become engaged thinkers, active learners, knowledge constructors and global citizens to participate fully in society and the economy. (DES, 2015, p. 5)

As part of achieving this vision, the DES mandated that digital learning is to be embedded in all future education policy and curriculum reform initiatives (DES, 2015). The strategy is underpinned by five key principles as listed in Figure 1.

Figure 1. Underpinning principles of the *Digital Strategy for Schools* (DES, 2015, p. 8).

Principle	Descriptor
1. A Constructivist Pedagogical Orientation underpinning the embedding of ICT in schools.	A constructivist pedagogical orientation supports teachers in effectively using ICT with their students i.e. learners are actively involved in a process of determining meaning and knowledge for themselves.
2. The use of ICT in teaching, learning and assessment can enhance the learning experiences of all students.	ICT plays an important role in supporting inclusion and diversity for all learners by enhancing learning opportunities for all students.
3. The use of ICT in teaching, learning and assessment is embedded in school curricula, Department policies and teacher education.	The Department and its agencies will play a proactive role in implementing the Digital Strategy for Schools.
4. ICT is used in an ethical and responsible way.	Schools and the Department enable all users to use ICT in an ethical and safe way.
5. ICT Planning is required to ensure ICT integration in teaching, learning and Assessment.	All levels of the education system are engaged in inclusive planning for the effective integration of ICT.

The role of children and teacher is accordingly envisioned as follows:

Children:

- Using ICT to open up new forms of learning and collaboration to support different styles of learning.
- Experiencing joy, satisfaction, passion and success in their education and lifelong learning.
- Actively engaged in learning—both in and out of school.
- Accepting ownership of their learning—involving the ability to be self-directed, a decision-maker, and a manager of priorities in and out of school.
- Using technology to achieve personal learning goals and to succeed in various learning activities (Adapted from McGinn, 2007).
- Using ICT critically and ethically.

Teachers:

- Taking a more facilitative role, providing child-centred guidance and feedback, and engaging more frequently in exploratory and team-building activities with children.

- Using ICT to 'support an enquiry process and enable [children] to work on solving complex real-world problems' by engaging in 'collaborative project-based learning activities that go beyond the classroom' (Butler et al., 2013; p. 8).
- Supporting children to create and innovate so that they are engaged in managing their own learning goals and activities.
- Accepting ownership of their own professional learning and, where appropriate, designing and participating in learning communities that make extensive use of technology.

In an effort to bridge the gap from policy to school and classroom practice, the *Digital Learning Framework* (DLF) for primary and post-primary schools (DES 2017a; 2017b) was published in September 2017. It was designed as a support to the DSS (DES, 2015) to help teachers embed the use of digital technologies in learning, teaching and assessment as envisioned in the strategy. This was followed by *Digital Planning Guidelines* and a *Planning Template* in December 2017, to help guide schools on how best to effectively use digital technologies to transform their teaching and learning practices. The notion of 'embedding' is core to the DLF which defines embedding digital technology as: 'Moving beyond ICT integration, where digital technology is seamlessly used in all aspects of teaching, learning and assessment to enhance the learning experiences of all children' (DES, 2017a, p. 15).

The DLF is articulated as a set of domains and standard statements across two dimensions: Teaching and Learning, and Leadership and Management. Each standard is illustrated by at least one example of effective and highly effective practice (Butler, Hallissy & Hurley, 2018). In using the DLF, schools are encouraged to engage in a process of reflection as part of the School Self-Evaluation Process (DES, 2012) that culminates in action, i.e. the creation of a Digital Learning (DL) Plan that outlines how they will enhance their existing digital learning practices over a defined period of time.

With the publication of the *Digital Strategy for Schools* (DES, 2015), the Department of Education and Skills has outlined its vision and policy for digital learning. The DLF (DES, 2017) in turn is an

instrument which supports educators to reflect on their current understanding/use of digital technologies in their practice. However, if the Digital Strategy and the DLF are to have their intended effects, they cannot be implemented in isolation but rather must be considered within the context of the entire education system (Butler et al., 2018). Policy change without a corresponding change in curriculum can lead to uncertainty; unless there is some change at 'curriculum level', schools can for the most part continue with 'business as usual'. The connection between policy and practice is for the most part not concrete enough. For example, one of the findings of the DLF trial evaluation report (Cosgrove et al., 2018) was that schools had difficulty in unpacking the DLF domains and translating them into practice. The articulation of digital learning in the *Draft Primary Curriculum Framework* (NCCA, 2020) is therefore a critical step towards the alignment of policy and practice. The inclusion of digital learning or *Being a digital learner* as a key competence in the curriculum framework is pivotal.

Digital learning and the *Draft Primary Curriculum Framework*

The inclusion of digital learning or *Being a digital learner* in the *Draft Primary Curriculum Framework* (NCCA, 2020) both aligns with government policy and contributes to realising the vision set out in the *Digital Strategy for Schools*. *Being a digital learner* is defined in the curriculum framework as follows:

> to support children to become curious, creative, confident and critical users of digital technology. Being a digital learner fosters children's ability to collaborate and thrive in a world increasingly immersed in technology. Children develop their knowledge, skills, concepts, attitudes, values and dispositions through problem-solving, experimenting and creating. As children develop this competency, children's confidence in using a range of digital technology to harness their imagination and expand their creative thinking and creative expression increases. Through empowering children to be active digital citizens, this competency develops their responsible, safe and ethical use of technology. This

> competency enables children to critically engage and contribute in a digitally connected and interdependent world. (NCCA, 2020, p. 8)

Building on this, a set of attributes are articulated which describe the learning and development opportunities which will be embedded in each of the curriculum areas and subjects in the curriculum framework for primary schools. These include:

- communicating and collaborating with others through digital technologies
- accessing, analysing and managing content using digital technology
- enabling content creation, problem-solving and creativity using digital technology
- interacting ethically and responsibly with digital technology (NCCA, 2020, p. 10).

From this, it is evident that both the *Digital Strategy for Schools* (DES 2015) and the *Draft Primary Curriculum Framework* (NCCA, 2020) strive to provide learners with 'more open-ended learning experiences that develop the learners' higher-order thinking, creativity, independence, collaborating and ownership of learning' (DES, 2013, p. 20). More specifically, the emerging ideas of digital learning or being an effective digital learner as presented in both documents are highlighted in Table 1.

Table 1. Common themes/concepts across the *Digital Strategy for Schools* and the *Draft Primary Curriculum Framework*.

Emerging ideas of what an effective digital learner is				
Ownership	Setting personal learning goals	Self-direction	Confident	Lifelong
Knowledge constructors	Problem-solving	Experimentation	Creating	Curious
Collaboration	Complex	In and out of school	Digitally connected	Interdependent world
Digital	Immersive	Ethical	Critical	Creative

As can be seen, many of the concepts listed in the table are familiar, reflecting the learning principles included in the Primary School Curriculum (DES/NCCA, 1999). However, those presented in the last two rows capture the increasing complexity of today's world, and in particular, the centrality and pervasiveness of digital technologies in shaping all aspects of life and living. What this implies is the need for all individuals/learners to be digitally competent so that they can be in control and shape the world they live in, rather than be controlled by it. It also suggests that how we view digital learning or being a digital learner needs to take cognisance of the development of the individual's potential within the social context, while being mindful of each of our responsibilities for universal wellbeing (Butler et al., 2018). This symbiotic relationship of individual fulfilment and universal wellbeing is how the development of capabilities or competencies of being a digital learner should be framed and understood.

4. The Draft Primary Curriculum Framework and key competencies

In a review of international trends and practices in curriculum development which was carried out as part of developing the Draft Primary Curriculum Framework, Walsh (2018) identified that one of the key characteristics of international practices was the preparations of curriculum frameworks rather than prescribed curricula, allowing flexibility in interpretation and enactment at a school level. While such frameworks provide an insight into the issues underlying curriculum development debates internationally, key points to note here are that frameworks such as the *EU Key Competences Framework* (European Commission, 2019) and the *OECD Learning Framework 2030* (OECD, 2018) see the purposes of education in terms of capacities, competencies or capabilities, so articulation is not 'in terms of what the children should learn but in terms of what they should become' (Biesta & Priestley, 2013, p. 4). This provides a stimulus for national curricula to think more broadly about what knowledge, competencies and dispositions children need to thrive and shape their world (e.g., see Erstad & Voogt, 2018) and thus should be included in a curriculum (i.e. a 'plan for learning' which supports young people in acquiring the knowledge, competences and dispositions needed to be successful in the digital era).

In line with this approach to curriculum design, the NCCA is presenting the Primary School Curriculum as a framework which pursues broader learning goals beyond traditional subjects. The framework is developed around a core set of key competencies which are seen as useful across a range of learning contexts and situations (Figure 2). A key competence is a 'broad concept and encompasses skills, dispositions, attitudes and values,

as well as knowledge about the context in which the competency is learned and demonstrated. …[it] is a learner's capacity to act in response to the demands of a more complex situation or task' (McGuinness, 2018, p. 39). *Being a digital learner* is included as a key competency in the *Draft Primary Curriculum Framework* (NCCA, 2020).

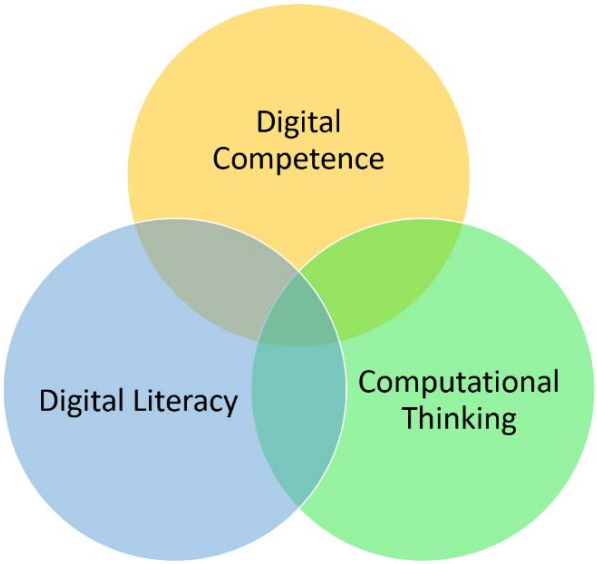
Figure 2. Key competencies. *Draft Primary Curriculum Framework* (NCCA, 2020).

It is against this backdrop that we explore *Being a digital learner* as a key competency in the Draft Primary Curriculum Framework (NCCA, 2020).

5. The Draft Primary Framework: being a digital learner

For the purpose of this discussion, digital competency, digital literacy and computational thinking are presented separately. This is because digital literacy is positioned as an essential element of literacy and literacy development in the *Draft Primary Language Curriculum* (NCCA, 2019) while computational thinking is currently presented in the math/science/technology curriculum areas in the Draft Primary Curriculum Framework (NCCA, 2020).

Figure 3. Being a digital learner.



Being a digital learner: Digital competence

Although 'digital competence' is implied in the key competency of *Being a digital learner*, understandings of digital competency vary widely and as a concept, it is not yet well defined. It follows that the understanding of digital competence and what it means to be digitally competent adopted in the Draft Primary Curriculum Framework (NCCA, 2020) is vital as it has implications as to how being a digital learner is interpreted in the framework.

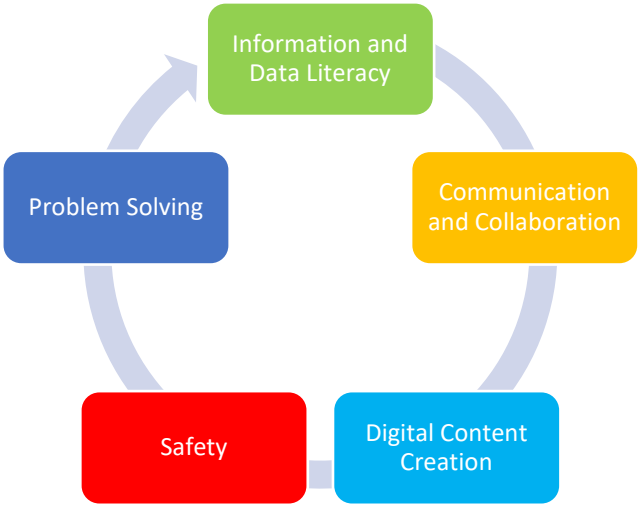
The development of digital competence has achieved increased attention and is regarded as a crucial competence to successfully participate in education, work, and society (Griffin, McGaw, & Care, 2012). An in-depth discussion of digital competence is beyond the scope of this paper, however it is noted that there has been increasing interest in outlining and detailing the specific knowledge, competences, attitudes and skills that children need to become sufficiently digitally competent. It is also noted that the concept of digital competence is defined in a multiplicity of ways ranging from skills-focused definitions, models, and frameworks to broader competency models that recognise the more diverse knowledge, capabilities and dispositions of children. Terms such as ICT literacy, digital skills, digital literacy, computer literacy, ICT fluency, technological literacy, internet skills, information literacy, media literacy have all been used to describe the

knowledge, skills, and attitudes relating to the use of digital technologies (Ala-Mutka, 2011; Law, Lee, & Yuen, 2010). Moreover, it is difficult to clarify what are the similarities and differences between these concepts (Lankshear & Knobel, 2008). In fact, they have often been used interchangeably and largely reflect the same content (Law et al., 2010). Most recent emphases favour broader competency models that encompass the diverse knowledge, capabilities, dispositions and values needed by individuals to learn, work and participate in society.

There has been an increasing and sustained interest in developing digitally-competent citizens. Digital competence is regarded as a core concept in policy documents (Ilomäki et al., 2016). In Europe for example, digital competence has been a priority for the European Commission for some time in policies, actions, and communications (e.g., European Commission, 2010; 2013. Similarly, at school level, there is increasing interest in the development and use of digital competence frameworks; some of which have been developed as international or national initiatives and others in the context of national curriculum development. Among the most well-known are the ISTE Standards Framework (ISTE, 2017) in the USA and the European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker, 2017). The main purpose of both of these frameworks is to detail a conceptual understanding of competence for education at school level. The DIGCOMP 1.0 Framework and its subsequent developments (Ferrari, 2013; Vuorikari, Punie, Carretero & Van den Brande, 2016; Carretero et. al., 2017) is a useful competence framework to discuss as it has become a reference for the development and strategic planning of digital competence initiatives across Europe including DigCompEdu (Redecker, 2017) and the Digital Learning Framework in Ireland (see Butler, Hallissey & Hurley, 2018). Defining digital competence as 'the confident, critical and creative use of ICT to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society' (Ferrari, 2013, p. 2), DIGCOMP addresses the knowledge skills and attitudes that enables the confident, creative, critical and responsible uses of digital technologies for learning, work, leisure and active participation in society. The framework identifies five areas of competence with eight levels of proficiency in each area. The areas are

information and data literacy; communication and collaboration; digital content creation (including programming); safety (including digital wellbeing and competences related to cybersecurity); and problem solving (Figure 4). The term 'digital technologies' in the framework is used as an umbrella term for digital resources and devices, thus comprising any kind of digital input: software (including apps and games), hardware (e.g., classroom technologies or mobile devices) or digital content/data (i.e. any files, including images, audio and video).

Figure 4. DigComp 2.1 (Carretero, 2017).



Comparing DigComp 2.1 (Carretero, 2017) to other digital competence frameworks that have been developed for schools highlights a similarity in approach and areas of competence identified. Most present competency as a broad concept that encompasses skills, dispositions, and values; and while they differ in the terminology using terms such as 'ICT capabilities', 'digital literacy' and 'ICT standards', these terms reflect the same content and there are strong similarities in the areas of competence identified across countries (see Table 2). As can be seen, there is overlap between these areas and those identified in the NCCA (2020) definition of being a digital learner, i.e. collaboration, problem-solving, experimenting and creating, creative thinking and creative expression, and digital citizens.

Table 2: Comparison of how digital competence is framed in a range of national curricula/frameworks.

Country/Region	Framework	Areas of competence

Australia	ICT Capability learning continuum[1]	ICT capabilities	• Applying social and ethical protocols/practices using ICT • Investigating with ICT • Creating with ICT • Communicating with ICT • Managing/operating with ICT
Toronto, Canada	Toronto District School Board ICT Standards[2]	ICT standards	• Technology operations & concepts • Research & information fluency • Critical thinking & problem solving • Communication & collaboration • Digital citizenship • Creativity & innovation
Wales, UK	Digital Competence Framework[3]	Strands	• Citizenship • Interacting and collaborating • Producing • Data/computational thinking
New Zealand	Technology-New Zealand Curriculum[4]	Strands	• Technological practice, • Technological knowledge • Nature of technology
Netherlands	National Curriculum	Digital literacy: Big ideas	• Data and information • Safety and privacy • Using and controlling • Communication/cooperation • Digital citizenship • Digital economy • Applying and designing • Sustainability

Being a digital learner: Digital literacy

Literacy as understood in the Primary Language Curriculum (NCCA, 2019) refers to 'the capacity to read, understand and critically appreciate various forms of communication including spoken language, printed text, broadcast media, and digital media' (DES, 2011, p. 8). It implies a broader understanding of the skill, including speaking and listening, as well as communication using not only traditional writing and print but also digital media. The definition of 'text' in the curriculum

[1] https://www.australiancurriculum.edu.au/media/1074/general-capabilities-information-and-communication-ict-capability-learning-continuum.pdf
[2] https://schoolweb.tdsb.on.ca/elearning/Resources/ICT-Standards
[3] https://hwb.gov.wales/storage/85f69bca-0134-426d-bff1-c46b4c1d067b/digital-competence-framework-your
[4] https://technology.tki.org.nz/Technology-in-the-NZC

accordingly refers to all products of language use including electronic and digital (NCCA, 2019). Digital literacy is viewed as the child's ability to leverage technology to locate, select, critically analyse and use relevant information in multiple modes (text, visual and audio) and in multiple representations to and with a variety of audiences and in a variety of contexts (NCCA, 2019, p. 50) The Primary Language Curriculum also focuses on the use of technology as a tool for literacy development and learning, stating that 'appropriate use of digital technologies in the classroom can help children to demonstrate knowledge, skills and understanding in accordance with the learning outcomes for all three strands of the [literacy] curriculum' (NCCA, 2019, p. 50). As such, the curriculum supports children's abilities to engage with technology to acquire, comprehend and communicate knowledge to and with a variety of audiences and in a variety of contexts.
For further detail see Kennedy et al. (2012).

Being a digital learner: Computational thinking

The concept of computational thinking originates in the work of Seymour Papert (1980; 1991) when he introduced the 'idea of the computer being the children's machine that would allow them to develop procedural thinking through programming' (Dede, Mishra & Voogt, 2013, p. 2), enabling them to combine critical thinking with computing power as the foundation for innovating solutions to real-life problems (Tabesh, 2017). Wing's seminal article in 2006 reintroduced the term stating that computational thinking was not just programming but rather a 'fundamental skill' for everyone. She defined it as the thought process of formulating and solving problems by 'drawing on the concepts fundamental to computer science' (p. 33) when 'equipped with computing devices' (p. 35). Within this broader context, she outlined the central components of computational thinking, including algorithms, abstraction, decomposition and automation, all of which can be found in many contexts and disciplines and which assist learners in how to approach and solve problems in a systematic way.
In the Irish context the NCCA has been investigating possible approaches to the introduction and development of computational thinking in primary schools (NCCA, 2016; 2017).

Preparatory work for the initiative included several components:

- An initial desktop audit of twenty-two jurisdictions with a focus on identifying the presence of coding in the curriculum (NCCA, 2016).
- A follow-on in-depth curriculum investigation which explored how six international jurisdictions integrated coding and computational thinking into their curricula (NCCA, 2017).
- A review of literature on computational thinking and its importance for children's learning as well as its place in a primary curriculum. This was commissioned to clarify questions regarding computational thinking and its use as a foundation for teaching the fundamentals of coding in a primary school setting (Millwood et al., 2018).

For further detail see Millwood et al. (2018).

Table 3. Core Elements of Computational Thinking (Taken from Angeli et al.,2016 and Shute, Sun & Asbell-Clarke, 2017).

Element	Definition
Abstraction	Entails reducing unnecessary details, highlighting the relevant details to make the process simpler and easier to understand. Leads towards creation of a model/representation to solve a problem.
Algorithmic thinking	Devising a step-by-step solution to a problem. Includes: algorithm design: planning an algorithm, sequencing actions correctly; parallelism; efficiency; and automation.
Decomposition	Breaking down complex problems into manageable smaller problems or into their component parts so that each part can understood and solved separately. Overall solution is reached by assembling collections of smaller parts (Csizmadia et al., 2015).
Generalisation	Looking for a general approach to a class of problems. Ability to identify common patterns between older and newer problem-solving tasks and use sequences of instructions previously employed, to solve a new problem (reusing and remixing). Is a way of solving new problems based on previous solutions to problems, and building on prior experience Csizmadia et al., 2015).
Debugging	Skill to identify, remove, and fix errors.
Iteration	Iteration refers to repeating the problem-solving process to refine the solution toward an optimal solution.

Although presented separately, there is considerable overlap in what have been identified as the skill sets of digital competence, digital literacy and computational thinking. Essentially all involve the confident, critical and responsible use of, and engagement with, digital technologies for learning, at

work, and for participation in society. Skills relating to information and data literacy, communication and collaboration, problem solving and so on, are similarly embedded in each area.

What is significant in how this competence, *Being a digital learner* is framed in the *Draft Primary Curriculum Framework* (NCCA, 2020) is that the emphasis is on 'being', which is not static: it implies change and development and embodies the process of learning. The central tenet is that the focus is on the person, not on particular digital technologies. Consequently, reaching a static definition of digital learning or being a digital learner is not possible, due to constantly evolving technological, cultural and societal landscapes redefining what, when and how digital technologies are used in personal and professional activities.

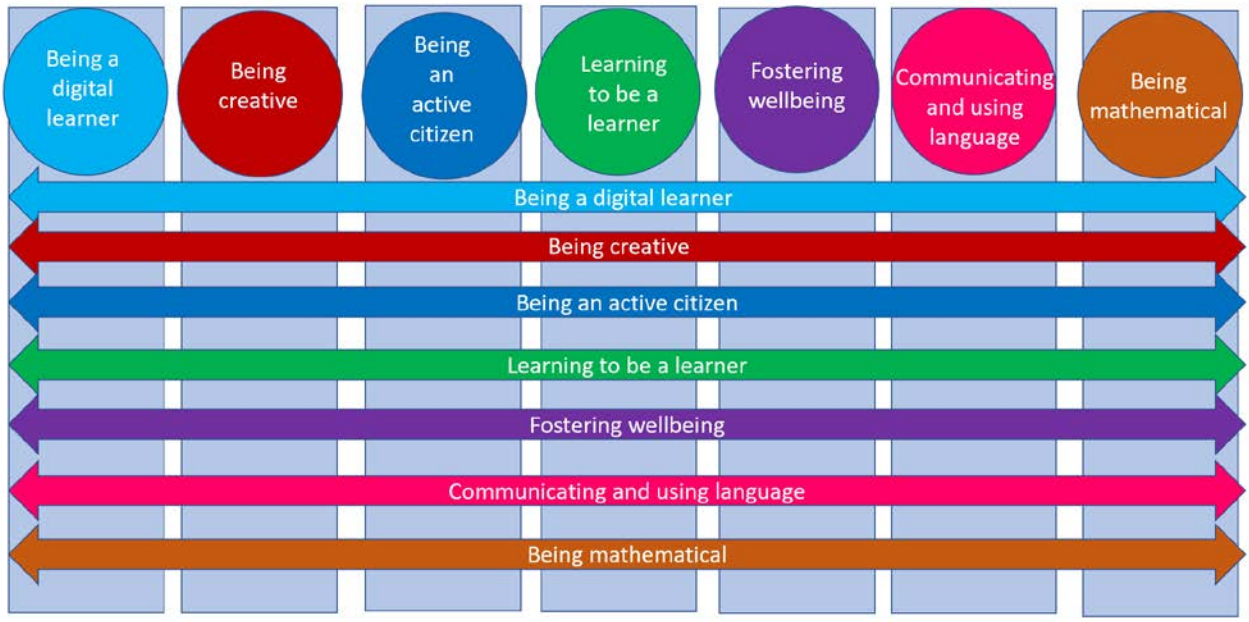
Being a digital learner: Connections with the other key competencies

Being a digital learner is not a competence that should be viewed in isolation but is one of the key competencies which underpins how learning experiences are to be designed for primary children—for if I am truly a digital learner, I can leverage digital technologies in ways that enable me to be creative in ways that were not possible heretofore. I can extend my mathematical thinking, communicate and collaborate in new ways (e.g., using translation software to talk with people who speak different languages or who may have speech difficulties by using speech-to-text functions) and across boundaries of time and place. It also means that I have a duty as an active citizen to be aware of how digital technologies can inform my worldview, and how digital technologies are informing decisions that are made about me (e.g., AI and the need to understand data in order to understand how decisions are being made that affect our daily lives, for example in credit rating algorithms). Consequently, we need to have the ability to question the underlying algorithms that are influencing our daily lives and to understand that the decisions I make or questions I ask may in turn benefit or detract from personal and or societal wellbeing. For example, how digital technologies can be used to help attain the UN Sustainable Goals (e.g., the importance of equity of access to a quality education and how access to technology can hamper or enhance this) or how alternatively they can amplify inequalities (e.g., how the algorithms that are being used in AI may be

biased or not built on robust data sets so decision making may be skewed, resulting in a degradation of conditions for a certain sector of society or particular individuals). Finally, being a digital learner can help me learn to be a learner. For example, engaging in computational thinking using digital technologies helps me think systematically as I engage in a design process to create 'an object to think with'. This helps me externalise my thinking, enabling me to engage others in my learning and to debug/decompose/generalise, while enabling me to reflect on my learning as I learn new concepts and ways of interacting with the world.

The 'importance of maintaining the visibility of key competencies within subjects and in making connections across subjects' is essential, 'if the transversal impact of competencies is to be realised' (Mc Guinness. 2018, p. 39). Consequently, they cannot be examined separately but ALL of the key competencies need to be considered and embedded firmly into planning learning experiences in the primary classroom as illustrated in Figure 5.

Figure 5. Maintaining the visibility of key competencies within subjects and in making connections across subjects.



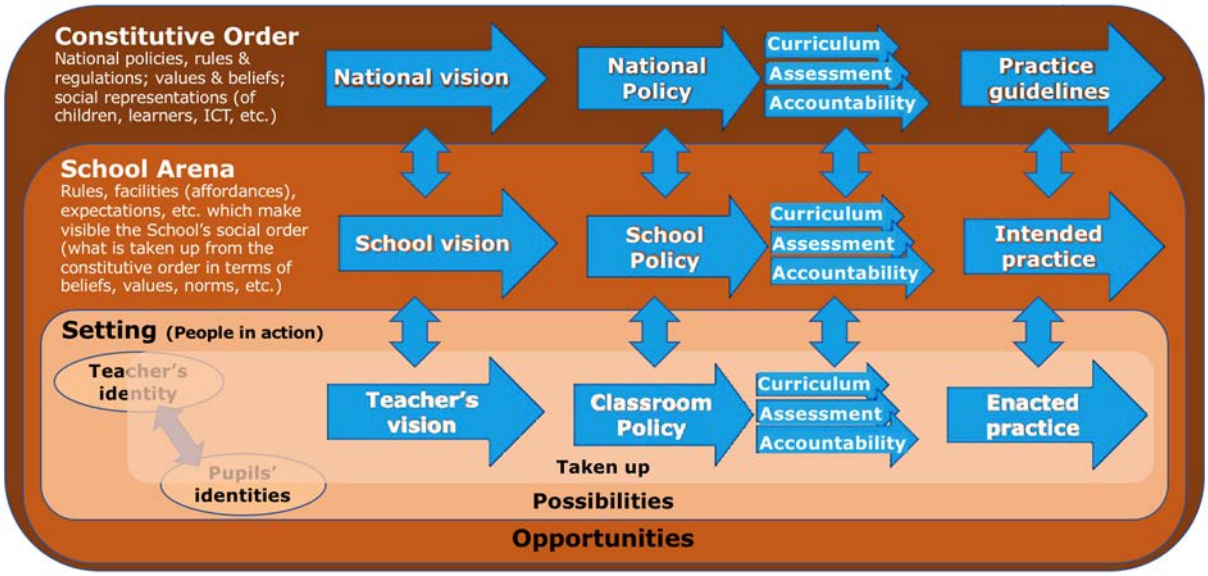
6. Being a digital learner: Other key considerations

While we have tried to build an understanding of what being a digital learner can be what is essential to acknowledge at this point are the challenges of system-wide alignment and the key role of the agentic teacher (Priestly, Biesta, & Robinson, 2015).

The challenges of system-wide alignment

As stated earlier, one of the key characteristics in curriculum development internationally has been the development of curriculum frameworks rather than prescribed curricula, which allows flexibility in interpretation and enactment at a school level so that meaningful learning experiences can be designed for learners at local level (Walsh, 2018). However, the challenges this approach presents must also be acknowledged and planned for. While there has been considerable effort in achieving alignment across policy initiatives such as the *Digital Strategy for Schools* (DES, 2015), the *Digital Learning Framework* (DES, 2017) and the *Draft Primary Curriculum Framework* (NCCA, 2020), there is a need to ensure this vision is understood, shared and enacted at school and classroom levels in a coordinated and coherent way. All components of the system must work together and reinforce each other as part of an interrelated and interdependent learning ecosystem if change can be successfully implemented and sustained (Butler et al., 2018), as shown in Figure 6.

Figure 6: Alignment within and across levels (Twining, 2018).



This framework has three levels:

- **The constitutive order**—the broader context, including cultural norms, values and beliefs, as well as more explicit policies, rules and regulations. This includes any nationally specified curriculum.
- **The arena**—the enduring elements of the school context which are taken up from the constitutive order. For example, how policies and expectations at the national level are interpreted and enshrined in the school expectations, policies and facilities. This includes any school specified curriculum (e.g., school schemes of work).
- **The setting**—the local context (e.g., the classroom) in which practice is implemented. At this level of analysis, the actors (e.g., teacher and children) perceive what is possible within the context of the school arena.

Successful enactment of the *Draft Primary Curriculum Framework* (NCCA, 2020) will depend on factors ranging from stakeholder engagement and commitment across all levels. Teachers are a particularly important group because ultimately they will enact the curriculum at the setting level. In terms of digital learning, this assumes an understanding of what being digital in learning can be, how learning experiences can be designed to enable its development and how it can be assessed.

Key role of the teacher

It is well known that the mere introduction of (new) digital technologies into schools is not enough in and of itself. Technologies do not come pre-programmed for learning nor can it be assumed that teachers themselves are competent and confident digital learners who can use digital technologies meaningfully in their classroom practice. Yet, it is teachers who are the key agents in ensuring that children become digital learners. It is therefore critical to capture and build on the expertise of teachers so that they become invested and genuinely participative in enabling the children to become confident and competent digital learners.

There are two aspects to this: first, as recommended by McGuinness (2018), there is a need to invest substantial effort and resources into creating, and co-creating with teachers, a sufficiently detailed description of the meaning of 'being a digital learner'. This will allow teachers know 'what it looks like' in their classrooms but equally, by involving teachers in this process of defining and understanding what being a digital learner is, will enable teachers to become invested in and develop ownership of the reform.

Alongside this, teachers must also know how to design learning environments that enable children to become competent and confident digital learners. This demands thoughtful consideration of how professional learning opportunities can be provided for teachers. It requires a broader approach to professional learning than simply 'retooling' teachers for specific tasks or enabling them to 'fit' digital technologies into their existing practices. Instead, it requires changing beliefs about digital technologies (Russell et al., 2003) and challenging assumptions around the effective use of digital technologies in learning by articulating clearly what effective classroom practice looks like.

7. Conclusion

As indicated in the introduction, the purpose of this paper is to spark discussion around **what it means to be a digital learner**, the **importance and relevance of this competence** for children's

learning as well as the **key concepts or big ideas** associated with being a digital learner as a key competence.

The importance of unpacking the key 'suitcase words' (Minsky, 2007) by everyone, for themselves and in dialogue with others, cannot be overstated. For words such as learning, digital, competence have vastly different meanings for different fields and different meanings for people with different backgrounds.

While we are working out our own understandings, it is important to be mindful that significant recent policy documents (*Digital Strategy for Schools* [DES, 2015] and the *Draft Primary Curriculum Framework* [NCCA, 2020]) are underpinned by a socio-cultural theoretical perspective. Knowledge therefore is viewed as a process with an intimate connection between knowledge and activity while also taking account of the contexts (social, historical and physical) of a learning situation. Consequently, knowledge is considered to be situated and distributed while learning is viewed as a social participatory process.

In addition, the complexity of unpacking the multiple layers of meaning can sometimes be oversimplified if we do not also acknowledge the importance of understanding the connection and interplay between how our thinking and the tools, we use in our cultural settings are interdependent.

Consequently, digital technologies do not have an independent existence and cannot be considered separately from the values that people bestow on them. So there is a consistency, explicit or implicit, between how people understand knowing and the nature of knowing and what technologies are valued and how they are used. The ways digital technologies may or may not be used reflect these understandings. The *Digital Strategy for Schools* acknowledges that embedding digital technologies in teaching, learning and assessment is a complex endeavour and the mere presence of digital technologies in a school/classroom does not equate to its effective use.

So the challenge here is that we all need to dig deep and confront our own assumptions and biases in relation to what we understand as 'learning' and how 'digital' technologies can be used as we

engage in understanding what 'being digital in learning' can be; how we as educators can become digital learners and in turn design learning environments to enable others to do so in order to shape the world they live in.

The only thing we are certain of is the uncertainty of the future in our rapidly-changing digitally connected world and that to thrive our young people need to learn to deal effectively with this uncertainty. To be able to do this we need to shift the focus from 'what the children should learn' to 'what they should become'. Moving from a sole focus on 'knowledge about' to developing a framework of competencies as outlined in the *Draft Primary Curriculum Framework* (cf. Figure 2). Framing a set of competencies is in line with what is happening internationally. However what is significant in Ireland is the approach taken to how 'digital' is framed. In the *Draft Primary Curriculum Framework*, this competence is phrased as *Being a digital learner*, indicating clearly that the focus is learner centered and active and that the use of digital technologies are firmly embedded in the act of learning.

Being digital is recognised as being part and parcel of what it is to be a learner—not something to be added on but at the core of what it means to be a learner. As asserted in this paper, it goes beyond what some have framed as digital competence and includes digital literacy as well as computational thinking (cf. Figure 3). But as argued, it is greater than the sum of these parts, as the emphasis is on 'being', which implies change and development as one engages in a process of learning: the focus is on the person and not the particular digital technologies.

What clearly needs to be acknowledged and understood is that while the *Draft Primary Curriculum Framework* outlines a set of key competencies that allows flexibility in interpretation and enactment at a school level, which can enable real contextualisation at school level, the caveats and challenges of this approach will need to be honestly recognised, owned (e.g., alignment cf. Figure 6) and planned for (e.g., recognising teacher professionalism while also enabling them to be 'digital learners' and learning designers) so teachers can truly embrace the role as agentic teachers (Priestly, Biesta, & Robinson, 2015).

The ideas outlined in this paper are only a starting point, which we hope will help seed debate for all concerned with the education of our primary school children, the future makers, so they are challenged to imagine and innovate by the inspirational learning experiences designed for them by courageous teachers, enabling them not only to be digital learners but fluent digital learners for their lifetimes.

References

21st Century Learning Reference Group. (2014). *Future-focused learning in connected communities*. Wellington, New Zealand: Ministry of Education. Retrieved from: http://www.education.govt.nz/assets/Documents/Ministry/Initiatives/FutureFocusedLearning30May2014.pdf

Ala-Mutka, K. (2011). Mapping digital competence: Towards a conceptual understanding. *Sevilla: Institute for Prospective Technological Studies*, 7-60.

Angeli, C., Voogt, J., Fluck, A., Webb, M., Cox, M., Malyn-Smith, J., & Zagami, J. (2016). A K-6 computational thinking curriculum framework: Implications for teacher knowledge. *Journal of Educational Technology & Society*, *19*(3), 47-57.

Auxier, Anderson, Perrin, & Turner. (2020). *Parenting children in the age of screens.* Pew Research Centre. Retrieved from: https://www.pew research.org/internet/2020/07/28/kids-and-screens-methodology/

Biesta, G. and Priestley, M. (2013). Capacities and the curriculum. In M. Priestley, and G. Biesta (Eds.), *Reinventing the curriculum: New trends in curriculum, policy and* practice (pp. 35-49). London: Bloomsbury.

Bruner, Jerome (1973). *The relevance of education*. New York. Norton.

Butler, D., Leahy, M., Shiel, G., & Cosgrove, J. (2013). *Building towards a learning society: A national digital strategy for schools*. Dublin: St. Patrick's College of Education, Education Research Centre. Retrieved from: https://www.education.ie/en/Schools-Colleges/Information/Information-Communications-Technology-ICT-in-Schools/Digital-Strategy-for-Schools/Building-Towards-a-Learning-Society-A-National-Digital-Strategy-for-Schools-Consultative-Paper.pdf

Butler, D., Hallissy, M., & Hurley, J. (2018). The digital learning framework: What digital learning can look like in practice, an Irish perspective. In *Society for Information Technology & Teacher Education International Conference* (pp. 1339-1346). Association for the Advancement of Computing in Education (AACE).

Butler, D., Leahy, M., Twining, P., Akoh, B., Chtouki, Y., Farshadnia, S., Moore, K., Nikolov, R., Pascual, C., Sherman, B. and Valtonen, T. (2018). Education systems in the digital age: The need for alignment. *Technology, Knowledge and Learning*, *23*(3), 473-494.

Csizmadia, A., Curzon, P., Dorling, M., Humphreys, S., Ng, T., Selby, C., & Woollard, J. (2015). *Computational thinking-A guide for teachers.* Retrieved from: https://eprints.soton.ac.uk/424545/

Carretero, S., Vuorikari, R., & Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*.

Conway, P. & Brennan, E. (2009). National policies and practices on ICT in education: Ireland. In T. Plomp, N. Law and J. Pelgrum (Eds.), *Cross-national information and communication technology. Policies and practices in education* (pp. 383-402). Charlotte, North Carolina: Information Age.

Cosgrove, J., Butler, D., Leahy, M., Shiel, G., Kavanagh, L., Creaven, A. (2014). *The 2013 ICT census in school report*. Dublin: Educational Research Centre.

Cosgrove, J., Chobhthaigh, S. N., Shiel, G., & Leahy, M. (2018). *Digital learning framework trial evaluation.*

Crompton, H. (2017). ISTE standards for educators: A guide for teachers and other professionals. *Teaching & Learning Faculty Books.* 24. https://digitalcommons.odu.edu/teachinglearning_books/24

Davis, N. (2018). *Digital technologies and change in education: The arena framework.* New York & London: Routledge.

Dede, C., Mishra, P., & Voogt, J. (2013). Working group 6: Advancing computational thinking in 21st century learning. *International Summit on ICT in Education*, 1-6.

Department of Education and Skills (DES). (1999). *Irish primary school science curriculum.* Government Publications Office. Dublin, Ireland.

Department of Education and Skills (DES). (2008). *ICT in schools. Inspectorate evaluation studies.* Dublin: Author. Retrieved from: http://www.education.ie/en/Publications/Inspection-Reports-Publications/Evaluation-Reports-Guidelines/ICT-in-Schools-Inspectorate-Evaluation-Studies.pdf

Department of Education and Skills (DES). (2011). *Literacy and numeracy for learning and life: The national strategy to improve literacy and numeracy among children and young people 2011–2020.* Retrieved from: https://www.education.ie/en/Publications/Policy-reports/lit_num_strategy_full.pdf

Department of Education and Skills (DES). (2012). *A framework for Junior Cycle.* Dublin: Author. Retrieved from: http://www.education.ie/en/Publications/Policy-Reports/A-Framework-for-Junior-Cycle-Full-Report.pdf

Department of Education and Skills (DES). (2015). *The digital strategy for schools 2015-2020*. Dublin: Author. Retrieved from: https://www.education.ie/en/Publications/Policy-Reports/Digital-Strategy-for-Schools-2015-2020.pdf

Department of Education and Skills (DES). (2017a). *Digital learning framework for primary schools*. Dublin: Department of Education and Skills. Retrieved from: https://www.education.ie/en/Schools-Colleges/Information/Information-Communications-Technology-ICT-in-Schools/digital-learning-framework-primary.pdf

Department of Education and Skills (DES). (2017b). *Digital learning framework for post-primary schools*. Dublin: Department of Education and Skills. Retrieved from: https://www.education.ie/en/Schools-Colleges/Information/Information-Communications-Technology-ICT-in-Schools/digital-learning-framework-post-primary.pdf

Department of Education and Skills (DES). (2017c). *STEM education policy statement and implementation plan*. Dublin: Department of Education and Skills. Retrieved from: https://www.education.ie/en/The-Education-System/STEM-Education-Policy/stem-education-implementation-plan-2017-2019-.pdf

Department of Public Expenditure and Reform (2014). Public Service Reform Plan 2014-2016. https://reformplan.per.gov.ie/2014/downloads/files/Reform%20Plan%202014.pdf

DES Inspectorate. (2012). *An introduction to school self-evaluation of teaching and learning in primary schools. Inspectorate guidelines for schools*. Dublin: Inspectorate, Department of Education and Skills. Retrieved from: https://www.education.ie/en/Publications/Inspection-Reports-Publications/Evaluation-Reports-Guidelines/School-Self-Evaluation-Guidelines-2016-2020-Primary.pdf

DES Inspectorate. (2020). *Digital learning 2020: Reporting on practice in early learning and care, primary and post-primary contexts*. Dublin: Inspectorate, Department of Education and Skills. Retrieved from: https://www.education.ie/en/Publications/Inspection-Reports-Publications/Evaluation-Reports-Guidelines/digital-learning-2020.pdf

Dewey, J. (1934). Individual psychology and education. *The Philosopher, 12*. Retrieved from: http://www.the-philosopher.co.uk/2016/08/individual-psychology-and-education-1934.html

Eivers, E. (2019). *Left to their own devices: Trends in ICT at primary school level.* Cork:IPPN.

Erstad, O., & Voogt, J. (2018). *The twenty-first century curriculum: Issues and challenges.* Springer International Handbooks of Education, 19-36.

European Commission. (2010). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and Committee of the Regions: A digital agenda for Europe. Brussels: Author. Retrieved from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF

European Commission. (2019). *Key competences for lifelong learning*. Luxembourg: Publications Office of the European Union.

European Commission. (2013). *Opening up education. Innovative teaching and learning for all through new technologies and open educational resources*. Com (2013) 654 Final. Brussels: European Commission. Retrieved from: https://ec.europa.eu/transparency/regdoc/rep/1/2013/EN/1-2013-654-EN-F1-1.Pdf

European Schoolnet and University of Liège. (2013). *Survey of schools: ICT in education. Benchmarking access, use and attitudes to technology in Europe's schools. Final Report (ESSIE).* Brussels: European Union. Retrieved from: http://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf

Fadel, C. (2015). 21st century curriculum: A global imperative. Leading edge: Deeper learning: Beyond 21st century skills.

Ferrari, A. (2013). *DIGCOMP: A framework for developing and understanding digital competence in Europe.* Luxembourg: European Union. Retrieved from: http://ftp.jrc.es/EURdoc/JRC83167.pdf

Fullan, M. (2013). *Stratosphere: Integrating technology, pedagogy, and change knowledge*. Canada: Pearson.

Graafland, J., (2018). New technologies and 21st century children: Recent trends and outcomes. *OECD Education Working Papers 179*, OECD Publishing. Retrieved from: https://ideas.repec.org/p/oec/eduaab/179-en.html

Griffin, P., McGaw, B., & Care, E. (2012). The changing role of education and schools. In *Assessment and teaching of 21st century skills* (pp. 1-15). Dordrecht: Springer.

Illich, I. (1974). *Tools for conviviality*. Marion Boyars.

Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence–An emergent boundary concept for policy and educational research. *Education and Information Technologies*, *21*(3), 655-679.

ISTE. (2017). *ISTE standards for educators.* Retrieved from: https://www.iste.org/standards/for-educators

Jonassen, D. (1999). Computers as mindtools for engaging critical thinking and representing knowledge. Upper Saddle River, NJ: Prentice-Hall.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Upper Saddle River, NJ Prentice-Hall.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective.* Upper Saddle River, NJ: Merrill.

Jonassen, D. H. & Reeves, T.C. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 693-719). Bloomington, IN: Association for Communications and Technology.

Juškevičienė, A., & Dagienė, V. (2018). Computational thinking relationship with digital competence. *Informatics in Education*, *17*(2), 265-284.

Kennedy, E., Dunphy, E., Dwyer, B., Hayes, G., McPhillips, T., Marsh, J., O'Connor, M. and Shiel, G. (2012). *Literacy in early childhood and primary education (3-8 years).* National Council for Curriculum and Assessment.

Kozma, R. (Ed.). (2003). *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Educational Technology.

Lankshear, C. J., & Knobel, M. (2008). *Introduction: Digital literacies: Concepts, policies and practices.* Peter Lang.

Law, N. (2013). Forward. In T. Lee Yong & L. Cher Ping, *Creating holistic technology- enhanced learning experiences: Tales from a future school in Singapore*. Rotterdam/Boston/Taipei: Sense.

Law, N., Pelgrum, J. & Plomp, T. (2008). *Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study*. Hong Kong: The Comparative Education Research Centre.

Law, N., Lee, Y., & Yuen, H. K. (2010). The impact of ICT in education policies on teacher practices and student outcomes in Hong Kong. *Assessing the effects of ICT in education*, *143*.

Mascheroni, G., & Holloway, D. (2017). *The Internet of Toys: A report on media and social discourses around young children and IoTtoys.* . DigiLitEY. Retrieved from: http://digilitey.eu/wp-content/uploads/2017/01/IoToys-June-2017-reduced.pdf

McGinn, A. (2007). Senior high school education in the 21st century. *The Educational Forum 71*(4), 331-344.

McGuinness, C. (2018). Research informed analysis of 21st century competencies in a redeveloped primary curriculum. *NCCA Final Report*, *May*.

Millwood, R., Bresnihan, N., Walsh, D., & Hooper, J. (2018). Review of literature on computational thinking. Retrieved from: https://ncca.ie/media/3937/ncca-coding-in-primary-schools-initiative-research-paper-on-computational-thinking-final.pdf

Minsky, M. (2007). *The emotion machine: Commonsense thinking, artificial intelligence, and the future of the human mind*. Simon and Schuster.

National Council for Curriculum and Assessment. (2008). *Developing post-primary mathematics education. Project Maths: An overview*. Dublin: Author. Retrieved from: http://www.ncca.ie/uploadedfiles/publications/vacancies/project%20maths%20overview.pdf

National Council for Curriculum and Assessment. (2009). *Senior cycle key skills framework*. Dublin: Author. Retrieved from: http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Senior_Cycle/Key_Skills_Framework/KS_Framework.pdf

National Council for Curriculum and Assessment. (2016). *Desktop audit of coding in the primary curriculum of 22 jurisdictions.* Retrieved from: https://www.ncca.ie/en/resources/primary-coding_desktop-audit-of-coding-in-the-primary-curriculum-of-22-jurisdictions

National Council for Curriculum and Assessment. (2017). *Investigation of curriculum policy on coding in six jurisdictions.* Retrieved from: https://www.ncca.ie/media/3545/primary-coding_investigation-of-curriculum-policy-on-coding-in-six-jurisdictions.pdf

National Council for Curriculum and Assessment. (2019). *Primary language curriculum.* Retrieved from: https://curriculumonline.ie/getmedia/2a6e5f79-6f29-4d68-b850-379510805656/PLC-Document_English.pdf

National Council for Curriculum and Assessment. (2020). *Draft primary curriculum framework: For consultation.* Retrieved from: https://ncca.ie/media/4456/ncca-primary-curriculum-framework-2020.pdf

OECD. (2015). *Students, computers and learning: Making the connection.* Paris: OECD. Retrieved from: http://dx.doi.org/10.1787/9789264239555-en

OECD. (2018). *The future of education and skills: Education 2030*. Paris: OECD. Retrieved from: https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf

OECD. (2019). *Education at a glance 2019: OECD indicators*. Paris: OECD. Retrieved from: https://doi.org/10.1787/f8d7880d-en

Ofcom. (2018). *Children and parents: Media use and attitudes.* Retrieved from: https://www.ofcom.org.uk/__data/assets/pdf_file/0024/134907/children-and-parents-media-use-and-attitudes-2018.pdf

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books.

Papert, S. (1991). Situating constructionism. In I. Harel. and S. Papert (Eds.), *Constructionism* (pp. 1-12). Norwood, N.J.:Ablex.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. *Distributed cognitions: Psychological and educational considerations*, *11*, 47-87.

Perkins, D. N. (1993). Person-plus: A distributed view of thinking and learning. *Distributed cognitions: Psychological and educational considerations* (pp. 88-110).

Plomp, T., Law, N. & Pelgrum, J. (Eds.). (2009). *Cross-national information and communication technology. Policies and practices in education.* Charlotte, North Carolina: Information Age.

Priestley, M., Biesta, G. J. J. & Robinson, S. (2015). Teacher agency: what is it and why does it matter? In R. Kneyber and J. Evers (Eds.), *Flip the system: Changing education from the bottom up*. London: Routledge.

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (No. JRC107466). Joint Research Centre (Seville site).

Resnick, M. (2014). Give P's a chance: Projects, peers, passion, play. In *Constructionism and creativity: Proceedings of the third international constructionism conference. Austrian computer society, Vienna* (pp. 13-20).

Russell, M., Bebell, D., O'Dwyer, L., & O'Connor, K. (2003). Examining teacher technology use: Implications for preservice and inservice teacher preparation. *Journal of teacher Education*, 54(4), 297-310.

Salomon, G., & Perkins, D. N. (1998). Chapter 1: Individual and social aspects of learning. *Review of Research in Education*, *23*(1), 1-24.

Shear, L., Gallagher, L., & Patel, D. (2011). *ITL research 2011 findings: Evolving educational ecosystems.* Redmond, WA: Microsoft.

Shear, L., Gorges, T., Means, B., Singleton, C., Novais, G., Gallagher, L., & Lundh, P. (2010). *The Microsoft innovative schools program year 2 evaluation report*. Redmond, WA: Microsoft. Retrieved from: http://www.microsoft.com/en-us/download/details.aspx?id=9791

Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review*, *22*, 142-158.

Smahel, D., MacHackova, H., Mascheroni, G., Dedkova, L., Staksrud, E., Olafsson, K., Livingstone, S., & Hasebrink, U. (2020). *EU Kids Online 2020: Survey results from 19 countries.* Retrieved from: https://www.eukidsonline.ch/files/Eu-kids-online-2020-international-report.pdf

Tabesh, Y. (2017). Computational thinking: A 21st century skill. *Olympiads in Informatics*, *11*(2), 65-70.

The Teaching Council (2017). *Initial Teacher Education Criteria and Guidelines.* Ireland

Twining, P., Raffaghelli, J., Albion, P., & Knezek, D. (2013). Moving education into the digital age: the contribution of teachers' professional development. *Journal of Computer Assisted Learning*, *29*(5), 426-437.

Twining, P., Browne, N., Murphy, P., Hempel-Jorgensen, A., Harrison, S., & Parmar, N. (2017). NP3 – New purposes, new practices, new pedagogy: Meta-analysis report. London: Society for Educational Studies. Retrieved at: http://edfutures.net/images/e/e7/NP3_Meta-analysis_report.pdf

Twining, P. (2018) Educational alignment (and sociocultural theory). Halfbaked Education Blog, October 2018. Retrieved at: https://halfbaked.education/educational-alignment-and-sociocultural-theory/

Twining, P., Butler, D., Fisser, P., Leahy, M., Shelton, C., Forget-Dubois, N., Lacasse, M. (2020, in press) Developing a quality curriculum in a technological era, Education Technology Research and Development (ETRD)

UNESCO. (2008a). *ICT competency standards for teachers: Competency standards modules.* Paris: UNESCO. Retrieved from: http://unesdoc.unesco.org/images/0015/001562/156207e.pdf

UNESCO. (2008b). *ICT competency standards for teachers: Policy framework.* Paris: UNESCO. Retrieved from: http://unesdoc.unesco.org/images/0015/001562/156210E.pdf

UNESCO. (2011). *ICT competency standards for teachers: Policy framework*. Paris: UNESCO. Retrieved from: http://iite.unesco.org/pics/publications/en/files/3214694.pdf

Vuorikari, R., Punie, Y., Carretero Gomez, S., & Van den Brande, G. (2016). *DigComp 2.0: The digital competence framework for citizens. Update Phase 1: The Conceptual Reference Model.* Luxembourg. Retrieved from https://ec.europa.eu/jrc/sites/default/files/Infographics_DigComp.pdf

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Vygotsky, L. S. (1981). The instrumental method in psychology. *The concept of activity in Soviet psychology*, *4*(2), 134-143.

Walsh, T. (2018). *Towards an overview of a redeveloped primary school curriculum: Learning from the past, learning from others*. Dublin: National Council for Curriculum and Assessment.

Wertsch, J. V. (1985). *Vygotsky and the social formation of the mind*. Cambridge, MA. Harvard University Press.

Wertsch, J. V. (1998). *Mind as action*. Oxford University Press.

Wing, J. M. (2006). *Computational thinking*. Communications of the ACM, 49(3), 33-35.