4 Early childhood education curriculum and pedagogy in the digital age

This chapter discusses rationales for and ways to adapt curriculum frameworks and pedagogical approaches in light of the digital transformation. Curriculum frameworks can capture emerging trends that shape childhood and early childhood education and care (ECEC) and thereby constitute a core policy lever for making ECEC responsive to digitalisation. The chapter presents the notion of early digital literacy and discusses its integration into ECEC curriculum frameworks across countries. It discusses pedagogical approaches that can support a future-oriented curriculum framework and foster early digital literacy development, including through approaches that do not require screen exposure. Finally, the chapter reviews various digital tools that can be used with young children in ECEC settings and the principles for ensuring age-appropriate uses.

Key findings

Rationales to revise curriculum frameworks in light of the digital transformation include recognising changes in children's play, supporting 21st century skills from an early age, and setting common goals for all ECEC settings and staff.

Results from the *ECEC in a Digital World* policy survey (2022) indicate that, as of 2022, ECEC curriculum frameworks in a large majority of countries and jurisdictions recognise digitalisation but put the focus on the use of digital technologies and less so on seeing digitalisation as a trend shaping children's development, learning and well-being.

Digital literacy includes several dimensions that can be developed from an early age: getting a sense of how to protect oneself against digital risks; how to use digital technologies for play, self-expression and learning; and how a computer works (computational thinking). According to the *ECEC in a Digital World* policy survey (2022), curriculum frameworks recognise early digital literacy as an area for young children's learning and development in a majority of countries and jurisdictions. However, for most dimensions of early digital literacy, around half (or less) of those surveyed have specific development goals in their ECEC curriculum frameworks. Notions of computational thinking are rarely included in curriculum frameworks of countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022).

Pedagogical approaches used in ECEC generally aim to support whole-child cognitive, social and emotional development, which is well aligned with a 21st century curriculum. Rationales to revise pedagogical approaches in light of the digital transformation include using digital technologies to promote early digital literacy and to support innovative pedagogies for all areas of children's development.

Research points to several principles for using digital technologies with young children, such as ensuring that children are actively engaged and work together and that activities with digital technologies do not replace or limit other play and learning opportunities. Responses to the *ECEC in a Digital World* policy survey (2022) suggest that curriculum frameworks generally point towards pedagogical practices that are aligned with these principles.

Not all the digital tools that can be used with children offer the same potential to support children's learning, development and play. ECEC authorities of countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022) support the provision of multiple types of digital resources for ECEC settings, but there is a limited focus on materials offering greater opportunities to engage young children in more interactive, collaborative and playful activities, such as robotics kits.

Only a minority of countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022) indicate that their ECEC curriculum frameworks discourage the use of digital technologies with children. However, tensions exist for ECEC policy and practice as international and national guidelines tend to recommend no or minimal screen time for young children, especially before age 3.

Early digital literacy can be developed without direct exposure to screen-based digital tools through so-called unplugged approaches, which are particularly well-suited for the youngest children. Unplugged materials are not broadly supported by governments.

Introduction

A core dimension of making ECEC responsive to digitalisation is ensuring that it promotes children's development, learning and well-being, taking into account that digitalisation changes children's everyday life, their home and global environments, and their future. By defining goals, learning and development content, and types of activities for ECEC, curriculum frameworks are crucial to make ECEC responsive to changes in children's lives brought about by the digital transformation. Curriculum frameworks can be regulated, changed and adapted to evolving goals and quality standards, thereby constituting a core lever for policies. Furthermore, curriculum frameworks aim to constitute overarching agreements among various institutions and stakeholders at the national or subnational level, and to articulate a broad vision within the context of ECEC and education systems. As the topic of digitalisation and young children is often highly debated in many countries, curriculum frameworks can steer a common vision that goes beyond what is done in ECEC settings.

Pedagogy refers to the practices and methods employed by staff to support children's development, learning and well-being. How curricula are implemented through pedagogy has direct effects on children's experiences in ECEC (OECD, 2018[1]; Shuey et al., 2019[2]). Concerning digital technologies in particular, how they are used, for what purpose and in which environment greatly condition the impact that these technologies might have on children's development, learning and well-being. Pedagogical approaches to using digital technologies with children and, more generally, to prepare children for the future, are at the core of the mechanisms to make ECEC responsive to digitalisation. Pedagogical approaches are more difficult to impact through policies, but curriculum frameworks generally specify the pedagogical approaches to be used in ECEC settings. Furthermore, policies can influence these curriculum implementation and pedagogical practices through initial education and continuous professional development of the ECEC workforce (see Chapter 5).

This chapter starts by discussing the rationales for adapting ECEC curriculum frameworks in light of the digital transformation. It presents the notion of early digital literacy and discusses how this is integrated into curriculum frameworks. It continues with a discussion on the need to adapt pedagogical approaches to the challenges brought about by digitalisation. The chapter further discusses the various types of digital tools that can be used with children in ECEC settings. It ends with a selection of policy pointers.

Digitalisation and 21st century curriculum frameworks for early childhood education and care

Curriculum frameworks are major tools for steering the main directions of education systems. They set principles, goals, guidelines, values and approaches to children's development, learning and well-being in a country or jurisdiction. For ECEC, they generally cover knowledge, competencies and skills areas, the characteristics of children's interactions with staff and other children, and the experiences and resources that children are offered within the ECEC setting and sometimes in the home-learning environment. Curriculum frameworks can be revised and adapted to incorporate the main trends shaping ECEC and education systems, including digitalisation.

Rationales and goals for revising ECEC curriculum frameworks in light of the digital transformation

There are several reasons and directions to incorporate digitalisation into ECEC curriculum frameworks. A common feature of most ECEC curriculum frameworks is to place children at the centre and build on children's perspectives as a driving principle of ECEC. This strong focus on children's global development and well-being, in addition to learning, is a specificity of ECEC and is mostly justified by the child's age.

From this point of view, curriculum frameworks can reflect the prevalence of digital technologies in children's lives and, more specifically, in their play and discovery of the world, which is the first reason to review curriculum frameworks in light of digitalisation. Most OECD countries have ECEC curriculum frameworks that are centred around children's interests and recognise play as central to children's development, learning and well-being (OECD, 2021[3]). Over the last decades, young children have started to engage with a range of technologies through their play activities (Marsh et al., 2016[4]). An important change to children's play universe is the relationship between online and offline spaces. Children now move across physical and virtual domains when playing and integrate material and immaterial practices. Curriculum frameworks can recognise the extension of the universe of play brought about by digitalisation and how digitalisation changes children's everyday experiences. The focus can be on building new opportunities while mitigating risks.

The digital transformation changes the world of work and societies and, therefore, the skills mix people need to thrive in a digital world (OECD, 2019[5]). Some skills gain in importance while others become less important (see Chapter 2). The ability to learn, the capacity to solve problems with complex sets of information and creative thinking are viewed as crucial skills in a rapidly changing environment. The digital transformation also creates new jobs in digitalisation-intensive sectors. Curriculum frameworks for higher levels of education are being adapted to incorporate computational thinking, coding or other digital skills. A second rationale for revising ECEC curriculum frameworks is to promote the development of these skills at an early age to ensure continuity with primary education, but also because there might be advantages to starting at an early age. However, curriculum frameworks for the early years are not always articulated around specific skills areas but more broadly around children's development and well-being (OECD, 2021[3]). Preparing for primary education is also not an explicit goal of ECEC in several countries. However, digitalisation can be integrated into curriculum frameworks as a general trend shaping children's future or, more specifically, as a reason to promote children's development and skills in some areas.

Ensuring equal opportunities is the main argument for making ECEC responsive to digitalisation (see Chapter 6). Digitalisation has exacerbated inequalities between geographical areas and between individuals according to their socio-economic background. For instance, high-skilled occupations are generally less exposed to the risk of automation and children from low socio-economic backgrounds are less likely to enter these occupations. Research also shows the importance of the family context for developing digital literacy (see Chapter 6). Finally, the gender gap in access to science, technology, engineering and mathematics (STEM) and high-tech occupations can be mitigated by acting against gender stereotypes at an early age. ECEC can help create equal opportunities for all children to benefit from the digital transformation. By setting shared goals and approaches for all ECEC settings and staff, curriculum frameworks can help ensure that children equally benefit from opportunities and are protected against risks related to digitalisation, which is the third main reason to review curriculum frameworks. A specificity of ECEC is the heterogeneity of ECEC settings and the diversity of ECEC staff's education, background and experience. Curriculum frameworks play an important role in setting common goals for all settings and staff.

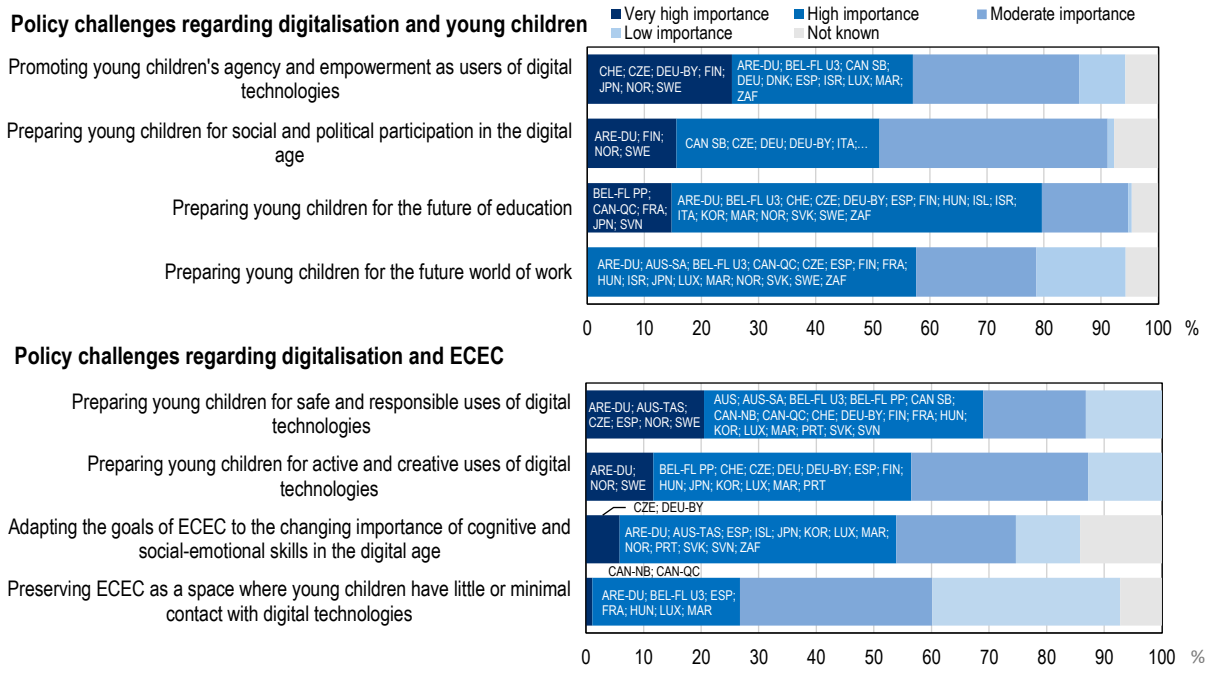
While curriculum frameworks play a crucial role in setting common and age-appropriate goals and approaches to make ECEC responsive to digitalisation, this policy lever should not be activated in isolation. Other policies, such as general guidelines for protecting children, ECEC workforce development, governance, funding and monitoring (discussed in other chapters of this report), are also important and need to be considered together with curriculum framework policies. Furthermore, evidence on approaches and tools that can support changes made to curriculum frameworks to integrate digitalisation and their impact on children is still lacking. Further research is needed in these areas.

Challenges related to curriculum frameworks for ECEC in a digital world

The *ECEC in a Digital World* policy survey (2022) asked countries about the important policy challenges regarding digitalisation and young children generally and digitalisation and ECEC specifically. While risk-focused challenges dominate policy agendas around digitalisation for young children in countries and jurisdictions having responded to *ECEC in a Digital World* policy survey (2022) (see Chapter 2), respondents also pointed to challenges that are rationales to adapt curriculum frameworks. For instance, preparing young children for the future of education in light of the changes brought about by digitalisation is considered to be a key challenge of almost all countries participating in the survey (Figure 4.1) and ranks third among the ten challenges presented to countries in the *ECEC in a Digital World* policy survey (2022) (see Chapter 2, Figure 2.4). Preparing young children for the future world of work and for social and political participation in the digital age or promoting young children's agency and empowerment as users of digital technologies are considered to be of relatively less importance, but are still perceived to be important challenges for a majority of countries and jurisdictions. This might come from the fact that in some countries, the goals of ECEC are mainly framed around children's well-being and less with the view to preparing children for their future social and economic roles.

Figure 4.1. Policy challenges related to 21st century curriculum

Percentage of countries and jurisdictions identifying the following policy challenges, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. Some countries and jurisdictions responded for multiple curriculum frameworks and therefore appear more than once with the same country and jurisdiction code. See Annex A. The response category "very high importance" was limited to three out of ten response items maximum.
BEL-FL PP: pre-primary education in Belgium (Flanders). BEL-FL U3: ECEC for children under age 3 in Belgium (Flanders). CAN SB: school-based sector in Canada.
Items are sorted in descending order by the share of countries selecting response categories "very high importance".
Source: OECD (2022[6]), *ECEC in a Digital World* policy survey, Tables B.1 and B.2.

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Along with these challenges related to digitalisation and young children, when asked about the specific challenges for ECEC, two-thirds of participating countries and jurisdictions indicated that preparing young children for safe and responsible uses of digital technologies was of "very high" or "high" importance. Preparing young children for active and creative use of digital technologies is also considered a priority for ECEC by a slight majority of participants. These two challenges rank high compared to other challenges listed in the *ECEC in a Digital World* policy survey (2022) (see Chapter 2, Figure 2.7). These results suggest that countries see the importance of developing multiple dimensions of digital literacy to empower and protect children as users of digital technology. Beyond the use of digital technologies, one approach consists of adapting the goals of ECEC to the changing importance of cognitive and social-emotional skills in the digital age. This more general challenge is considered of "very high" or "high" importance by a majority of countries and jurisdictions. Just over one-quarter (27%) of countries and jurisdictions [Belgium (Flanders for children under 3), Canada (New Brunswick and Quebec), France, Hungary, Luxembourg, Morocco, Spain and the United Arab Emirates] aim to preserve ECEC as a space where young children have little or minimal contact with digital technologies. Overall, answers from countries and jurisdictions point towards challenges that require curriculum framework policies alongside others discussed in this report.

Approaches to digitalisation in curriculum frameworks and other guidelines

ECEC curriculum frameworks vary substantially across countries in their general approach and level of detail. This reflects differences across countries in the goals assigned to ECEC and how curriculum frameworks are used and framed to support these goals. Countries where ECEC is seen as a way to foster children's development, learning and well-being tend to have curriculum frameworks that are framed around these whole-of-child goals and the general environment in which children develop (e.g. Ireland, Japan, Sweden). Some countries see ECEC as advancing children's learning and development in a number of areas that might be explicitly linked to primary education (e.g. Portugal, South Africa). Curriculum frameworks in these countries tend to be more specific. Because of these fundamental differences in how curriculum frameworks are framed, the way they incorporate digitalisation also differs substantially. Curriculum frameworks that are drafted in general terms may not mention digitalisation specifically, but they can still set expectations for ECEC to respond to digitalisation as one of the trends shaping children's lives. More specific curriculum frameworks are more likely to explicitly mention digitalisation and include skills development goals in this area.

Recognising these differences in approaches, the *ECEC in a Digital World* policy survey (2022) asked participating countries to indicate how digitalisation is recognised in their ECEC curriculum framework or other relevant documentation to account for the fact that other documents might complement the curriculum framework (see Figure 4.2). In a large majority of countries and jurisdictions, the framework sees digital technologies as "one among many other tools" to be used with children in ECEC settings (with more than 90% of countries and jurisdictions responding this is the case to a "great" or "moderate" extent). The focus is, therefore, on the possibility of integrating digital technologies into interactions with children as part of broader approaches to foster their development, and alongside other pedagogical tools.

Beyond the use of digital technologies, curriculum frameworks can recognise that digitalisation shapes children's development and learning more generally. For instance, in pre-primary education curriculum frameworks (3-5/primary entry), digitalisation is seen as a trend "shaping how young children learn and develop in our time" in almost all participating countries and jurisdictions and as a trend "shaping young children's socio-emotional development" in a majority of them. This is, to some extent, the case but less so in curriculum frameworks covering children 0-5/primary school entry.

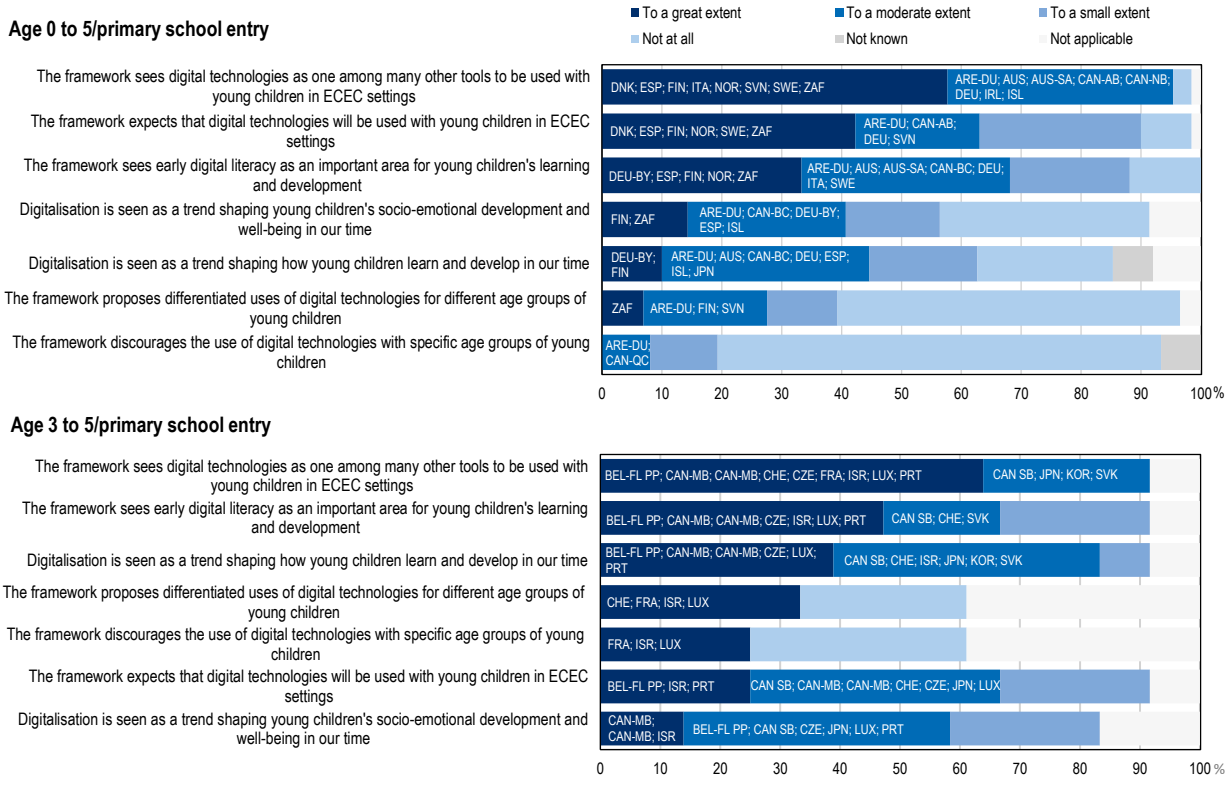
Responses to the *ECEC in a Digital World* policy survey (2022) suggest that some countries and jurisdictions integrate digitalisation into their curriculum frameworks as a trend shaping children's learning, development and well-being but also expect digital technologies to be used with children in ECEC settings.

This is the case “to a great extent” for Belgium (Flanders, 3-5/primary school entry), Denmark, Finland, Israel (3-5/primary school entry), Norway, Portugal (3-5/primary school entry), South Africa, Spain and Sweden. This chapter, therefore, gives more information on these countries and jurisdictions while also mentioning others.

Overall, ECEC curriculum frameworks are more specific about digitalisation when they target pre-primary education children as reflected by the fact that a higher percentage of countries have answered to a “greater extent” questions on the recognition of digitalisation in curriculum frameworks for pre-primary education than for curriculum frameworks covering a broader age range. Curriculum frameworks covering a broader age range might favour a whole-child approach to the goals of ECEC and approaches with children and might therefore be less specific than pre-primary curriculum frameworks about digitalisation. Furthermore, curriculum frameworks propose differentiated uses of digital technologies with specific age groups of young children to a greater extent for pre-primary education curriculum frameworks than for those covering the full age range. This might be because countries adopt a more cautious approach for the youngest children.

Figure 4.2. Perspectives on digitalisation in early childhood education and care curriculum frameworks

Percentage of countries and jurisdictions reporting the following, by age coverage of the curriculum framework and other relevant documents, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. Some countries and jurisdictions responded for multiple curriculum frameworks and therefore appear more than once with the same country and jurisdiction code. See Annex A. BEL-FL PP: pre-primary education in Belgium (Flanders). CAN SB: school-based sector in Canada. CAN-MB: kindergarten sector only in Canada (Manitoba).

Items are sorted in descending order by the share of countries selecting response categories “very high importance”.

Source: OECD (2022[6]), *ECEC in a Digital World* policy survey, Tables B.6 and B.8.

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To address the lack of specificity about digitalisation in their ECEC curriculum frameworks, some countries and jurisdictions have developed digitalisation strategies for education or other types of documents (e.g. directives, statements) that are relevant for ECEC in the context of the digital transformation and that complement the curriculum framework. These strategies put ECEC into a broader perspective, including other levels of education and possibly the role of families.

Among survey participants, such additional documents exist in Australia, Belgium (Flanders, pre-primary), Canada, the Czech Republic, Denmark, Germany (Bavaria), Finland, Ireland, Israel, Luxembourg (for more information see Case Study LUX – Annex C), Japan, Slovenia, South Africa, Switzerland, Sweden and the United Arab Emirates. Korea has also developed a series of initiatives to complement the ECEC curriculum framework that includes little explicit reference to digitalisation (Case Study KOR – Annex C). These documents generally cover the whole education system and are more specific about digitalisation than curriculum frameworks. They are, for instance, specific on the types of digital skills to be developed and on the methods to be used with children. While they typically do not give indications for ECEC in particular or explicit recommendations for practices with young children, some countries and jurisdictions have developed a digitalisation strategy specifically for ECEC (Case Study DEU_Bav – Annex C). Furthermore, staff may not be aware of these documents that go beyond education institutions and may tend to mainly focus on the curriculum framework. In most OECD countries, curriculum frameworks include or are accompanied by implementation guides (OECD, 2021[3]). To ensure a consistent approach to digitalisation, it is important to update these guidelines so that they state clear directions on how ECEC settings and staff can respond to digitalisation in their approaches with children.

Early digital literacy and its integration into early childhood education and care curriculum frameworks

Definitions

The early development of skills that are needed in a digital world can be a focus area of curriculum frameworks. Beyond the general view that the skills mix to thrive in a digital world has changed, for instance because skills that are used for tasks that can now be automated will be less needed, some new skills and knowledge are important to benefit from the opportunities brought by digitalisation and protect against its risks. These skills are grouped under the umbrella of digital literacy and are increasingly seen as important developmental and well-being areas that can be integrated into curriculum frameworks.

Digital literacy includes the ability to use digital devices or software, to be capable of consuming and producing digital content, and to meaningfully participate in a digital world (Nascimbeni and Vosloo, 2019[7]). The definition has evolved towards a more comprehensive understanding of what it should mean to be digitally literate today and has moved away from the concept of “digital skills”, which relates more narrowly to the use of digital devices. Digital literacy encompasses notions of being able to use digital technologies but also understanding the risks and benefits of digital technologies and being able to protect oneself and realise the potential of digital technologies. Digital literacy is understood as a combination of knowledge, skills and attitudes involving the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work and participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property-related questions, and problem solving and critical thinking (European Council, 2018[8]).

For children, the OECD Recommendation on Children in the Digital Environment advocates to promote digital literacy as “an essential tool for meeting the needs of children in the digital environment”. The recommendation does not propose a formal definition and has a clear focus on risk minimisation, but it also recognises that digital literacy encompasses other aspects, such as an understanding of how the

digital environment operates and how actions in the "online world" can have consequences in the "offline world". These directions are similar to those followed by other international organisations, governments and researchers that recommend a holistic approach to digital literacy for children. An important element emerging from the research is the call for an active role for children as content creators and engaged actors. The notion of empowerment also seems particularly relevant for children, as it goes with protection and helping children to benefit from opportunities while mitigating risks. Overall, several dimensions are important: understanding the role of digital technologies and the types of technologies that can be used for different purposes, the skills to use these technologies, the ability to translate uses into outcomes and derive benefits, and the ability to prevent potential harms from participating in the digital environment.

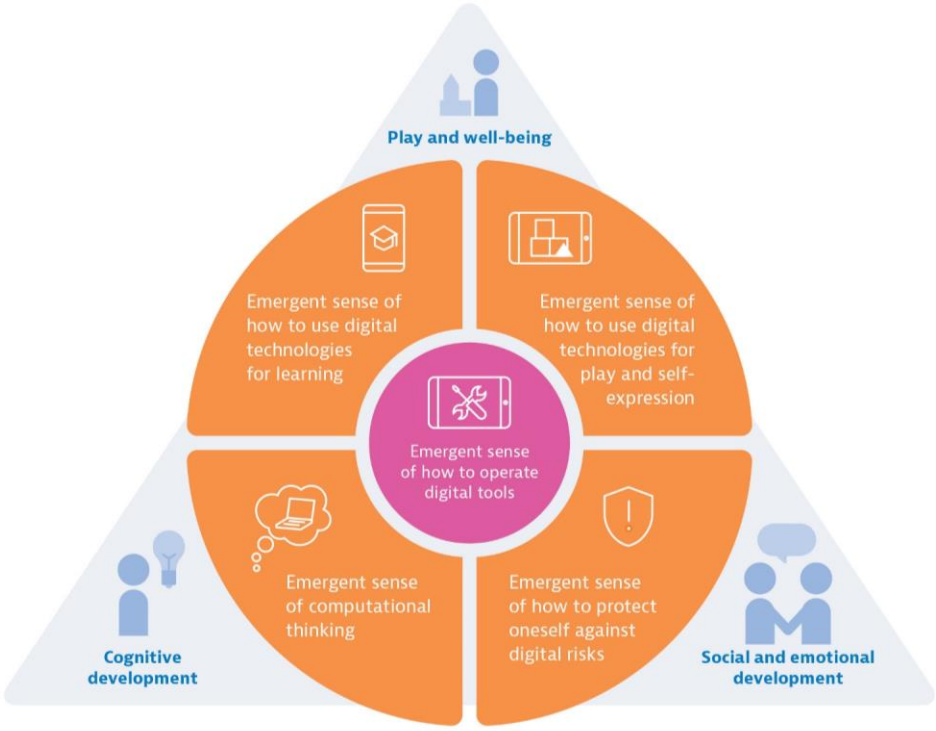
Experts in computer science have developed the concept of computational thinking and while multiple definitions exist, it can be considered as one aspect of digital literacy. The notion of computational thinking encompasses a broad set of analytic and problem-solving skills, dispositions, habits, and approaches most often used in computer science, but that can serve in multiple other contexts (Barr, Harrison and Conery, 2011[9]; Barr and Stephenson, 2011[10]; Lee et al., 2011[11]). One commonly used definition is that computational thinking describes the thought processes involved in formulating problems and in constructing and/or decomposing the sequential steps of a solution in a form that can be executed by a computer, a human or a combination of both (Wing, 2011[12]; Aho, 2011[13]; Kim and Lee, 2016[14]). Computational thinking represents a type of analytical thinking that shares similarities with mathematical thinking (e.g. problem solving), engineering thinking (designing and evaluating processes) and scientific thinking (systematic analysis) (Bers, Strawhacker and Sullivan, 2022[15]). The concept of computational thinking does not focus on a particular technology, but on the ideas and the science behind the technology of the digital revolution. Computational thinking can be developed both through direct engagement with digital tools and through approaches that do not entail their use, known as "unplugged approaches".

This report adopts the notion of "early digital literacy" to situate the concept of digital literacy in the context of early childhood. Early digital literacy is about laying the foundations of digital literacy and children's approaches to and knowledge of digital technologies as it develops throughout the years when they first engage with these technologies but are typically not yet ready to make an informed use of them fully autonomously. Children may appear to acquire an understanding of digital technologies at a very early age as they can operate some devices, but this does not necessarily involve the development of other dimensions of digital literacy. The characterisation of young children as "digital natives" has been shown to be a myth and the development of early digital literacy requires efforts in the same way as the development of early literacy and numeracy does (Burns and Gottschalk, 2020[16]).

Early digital literacy encompasses all the dimensions of digital literacy, as they can find expression in the developmental stages of young children (Figure 4.3). At an early age, children can learn about some risks of digital technologies, such as excessive use, inappropriate content and privacy issues, and how to protect themselves against these risks, which are key aspects of digital literacy. These include, among others, a basic understanding that the Internet can be a commercial space and that data can be shared and used by others. For instance, in their interactions with smart toys, children might not realise that when telling toy robots personal information, the toy can record their conversations. Children can be trusting of these devices and influenced by them (Williams et al., 2019[17]). Children can also learn to benefit from the opportunities of digital technologies by being exposed to content that steers their curiosity and becoming actively engaged in creative activities. They can also be introduced to some notions of computational thinking, such as solving problems by breaking them down into sequential steps and getting an understanding of how a computer works (Bers, Strawhacker and Sullivan, 2022[15]). For children, acquiring both digital literacy, in general, and computational thinking, in particular, consists of becoming empowered users of digital technologies. Developing early digital literacy can therefore be a long-term investment that prepares for working and living with any technology in the future. Concerning computational thinking more specifically, rationales to start at an early age also include preparing for primary education and addressing socio-economic and gender inequalities in the development of these skills. Digital literacy, in general, and

computational thinking, more specifically, can be developed both with and without direct exposure to digital devices, as discussed later in this chapter, or a combination of both approaches.

Figure 4.3. Key dimensions of early digital literacy



Dimensions of early digital literacy integrated into curriculum frameworks

Curriculum frameworks can promote a shared vision by all ECEC staff and leaders on developing early digital literacy. In countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022) (OECD, 2022[6]), early digital literacy is seen as an important area for young children's learning and development (to a great or moderate extent) in 68% of the countries and jurisdictions with ECEC curriculum frameworks and guidelines for ages 0-5/primary school entry and in 66% of the countries and jurisdictions with curriculum frameworks and guidelines for ages 3-5/primary school entry (see Figure 4.2).

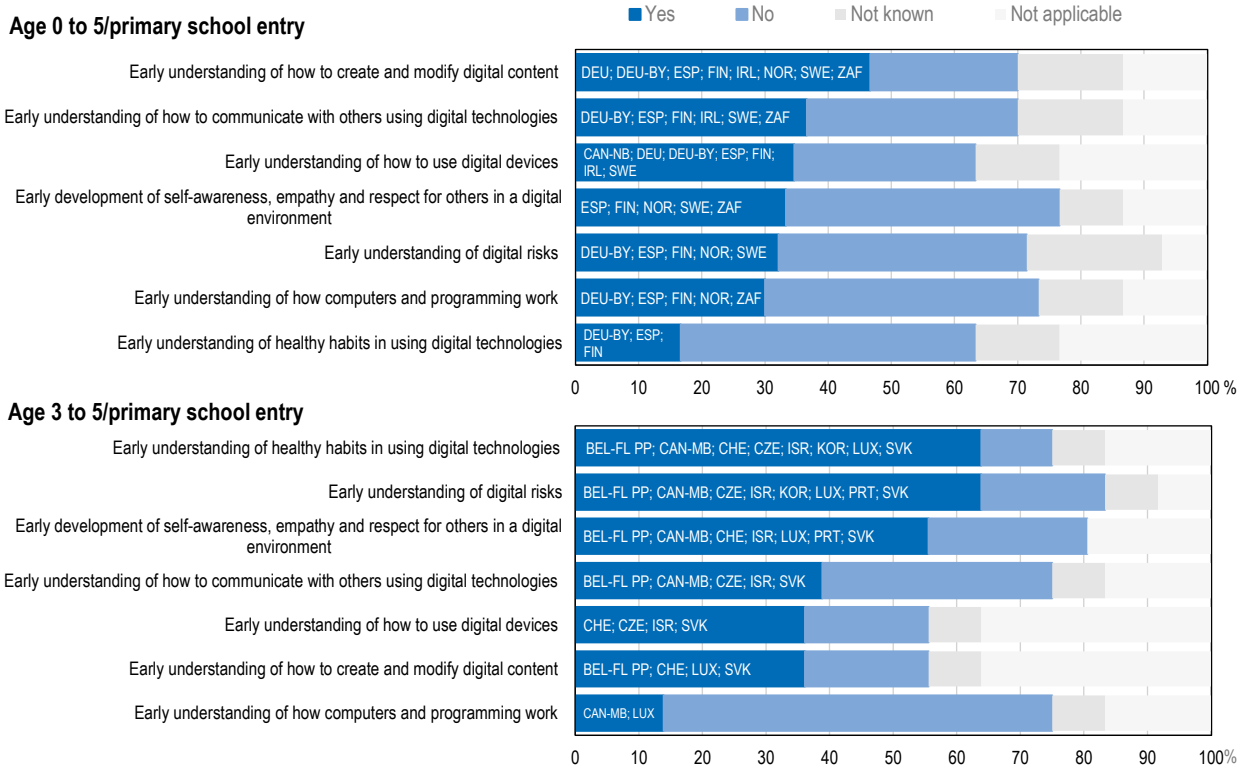
However, when asked about the components of early digital literacy specified in curriculum frameworks, only between 14% and 64% of the surveyed countries and jurisdictions have specific goals for early digital literacy development, depending on the dimension of early digital literacy and the age coverage of the curriculum framework. Among the specific dimensions of early digital literacy, an early understanding of how to create and modify digital content is the dimension that is incorporated in curriculum frameworks and guidelines for ages 0-5/primary school entry by the highest percentage of countries (Figure 4.4). Getting an early understanding of how to communicate with others using digital technologies is also at the top. The focus, therefore, seems to be placed on the opportunities these tools bring. An early understanding of healthy habits in the use of technology (e.g. sleep, posture) is the least commonly incorporated dimension for this age group. Norway, Spain and Sweden have many dimensions of early digital literacy incorporated into their curriculum frameworks. Some countries include only one or two. In Germany, the focus is on using digital devices and creating content. In curriculum frameworks for ages 3-5/primary school entry, a higher percentage of countries have curriculum frameworks that incorporate specific dimensions of early digital literacy. Dimensions around understanding risks and healthy habits are commonly included and rank at the top. Early development of self-awareness, empathy

and respect for others in a digital environment is also a relatively common focus area for those curriculum frameworks that target early digital literacy, for both age groups.

Computational thinking (early understanding of how computers and programming work) is incorporated into the curriculum frameworks of only a limited number of countries and jurisdictions participating in the *ECEC in a Digital World* policy survey (2022): Canada (Manitoba, kindergarten sector), Finland, Germany (Bavaria), Luxembourg, Norway, South Africa and Spain. This dimension of early digital literacy is, therefore, still relatively rare in ECEC curriculum frameworks.

Figure 4.4. Components of early digital literacy specified in curriculum frameworks and other relevant documents

Percentage of countries and jurisdictions reporting the following, by age coverage of the curriculum framework, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. Some countries and jurisdictions responded for multiple curriculum frameworks and therefore appear more than once with the same country and jurisdiction code. See Annex A. BEL-FL PP: pre-primary education in Belgium (Flanders). CAN-MB: kindergarten sector only in Canada (Manitoba).
Items are sorted in descending order by the share of countries selecting response categories "very high importance".
Source: OECD (2022[6]), *ECEC in a Digital World* policy survey, Tables B.6 and B.8.

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In countries where early digital literacy is incorporated into ECEC curriculum frameworks, the focus appears to be placed on the dimensions that are considered to be more important for children by experts, governments and international organisations, such as raising awareness of the risks or involving an active role of children (creating content, using technologies for communicating). However, there are broad-ranging differences in how early digital literacy is included in curriculum frameworks, even among countries that have generally indicated in their responses that digitalisation is integrated into their

curriculum frameworks. Some countries and jurisdictions make explicit reference to digital literacy in the curriculum framework, while in others, the focus is broad and references are implicit (Box 4.1).

Box 4.1. Early digital literacy in early childhood education and care curriculum frameworks

Countries have different strategies for incorporating early digital literacy into their curriculum frameworks. References to early digital literacy can be quite specific or general.

In **Canada (Manitoba, kindergarten sector)**, the curriculum framework "A Time for Learning, A Time for Joy" includes a section on "Landscape of Literacy with Information and Communication Technology". It defines digital literacy as "thinking critically and creatively, about information and about communication, as citizens of the global community, while using information and communications technology (ICT) responsibly and ethically". The starting point is that children nurture the seeds of digital literacy within pre-primary settings. The focus is placed on inquiring with ICT (plan and question, gather and make sense, produce to show understanding, communicate, and reflect). The framework sees the integration of digital literacy in ECEC as an opportunity to foster both social-emotional and cognitive development. It states that technology should be available to children on a "just in time, just enough" basis, focusing on interactive whiteboards and touch-screen tablets, digital cameras, and programmable robots.

In **Finland**, ICT competencies and media literacy are recognised as important skills for the future and are included in the National Core Curriculum for ECEC as a transversal competence. However, several studies have indicated that the integration of these skills into teaching and ECEC activities varied among ECEC centres and municipalities. Therefore, in 2020, the Ministry of Education and Culture launched a pilot programme focusing on developing new literacies. The National Agency for Education co-ordinates the programme together with the National Audiovisual Institute. The aim is to strengthen the following skills for children: ICT skills such as responsible and safe use of ICT, creative work with ICT and interacting with others; media literacy such as interpreting information from the media and operating in media environments; and programming skills such as computational thinking and programming environments. The programme was developed in close co-operation with experts and ECEC professionals.

In **Japan**, the curriculum framework for pre-primary schools is expressed in broad terms but also includes more specific goals for children. It emphasises the importance of pre-primary education for lifelong learning. In 2017, the curriculum framework was revised to state that children should become creators of sustainable societies. Each setting should set up a curriculum framework in line with the national one with specific aims. In addition, since 2017, the curriculum framework should clarify the daily life that is appropriate for children and the type of skills children should develop. It also states that activities need to be selected and developed by setting concrete aims and content, and that children should gain the experience they need through proactive interaction with the environment. Emphasising the importance of direct experiences in early childhood, it recommends when using equipment such as audio-visual teaching materials and computers, to supplement the experience to make it one that is otherwise difficult to obtain in life at the ECEC centre, and consider how it relates to children's experiences (Case Study JAP_3 – Annex C).

The **Portuguese** curriculum framework is organised by learning areas and includes one on the digital world and the use of digital technologies. It recognises that children interact with complex instruments and techniques and have access, through the media and digital technologies, to knowledge about more distant realities. The objective is to lay the foundations for structuring scientific thought, build a research attitude, centred on the ability to observe, the desire to experiment, the curiosity to discover from a critical perspective and knowledge sharing. The area is embodied in the knowledge of the world domain

together with sciences methodologies and approaches. Learning areas to be promoted are understanding the functions of digital technologies, using various digital supports carefully and safely, and developing a critical attitude towards digital technologies. It states that understanding technologies implies that the child is not only a consumer (consulting, watching films, etc.), but also a producer (photographing, recording, etc.), thus expanding the child's knowledge and perspectives on his/her reality.

In **Sweden**, the curriculum framework defines broad objectives for ECEC, such as encouraging children to express their thoughts and ideas and creating the conditions for this to happen. The starting point should be the interests of children, as well as the knowledge and experiences that children have already acquired. Digital technologies can be part of these experiences. The focus is on a holistic approach to children's development and includes several broad areas of development and learning. The curriculum framework specifically states that "each child should develop an interest in stories, pictures and texts in different media, both digital and other, and their ability to use, interpret, question and discuss them" and that ECEC staff should "challenge children's curiosity and understanding of language and communication, and also of mathematics, science and technology" and "create conditions for children to develop their ability to communicate, document and convey occurrences, experiences, ideas and thoughts using different forms of expression, both with and without digital tools".

In **South Africa**, the curriculum framework is strongly oriented towards the development of 21st century skills. It states, among other outcomes, that young children should learn to use science and technology effectively and critically, showing responsibility towards the environment and the health of others. It also states that early education should lay strong foundations for lifelong learning, which in a broad sense can be seen as preparing children for a changing world, including for changes brought about by digitalisation.

Source: Country input for OECD (2022[6]) and countries' curriculum frameworks.

Early digital literacy and computational thinking in relation to other developmental areas

Generally, research suggests making connections between domains of education and development where activity across domains is mutually supportive of learning in each domain (National Academies of Sciences, Engineering, and Medicine, 2022[18]). There can be value in partial integration, full integration or interdisciplinary approaches, but research suggests eschewing superficial connections between domains or add-on approaches without any meaningful integration. More integration is not necessarily better. Research comparing various types of integrated curricula does not always support full integration.

Digital literacy is linked specifically with computational thinking, on the one hand, and with other areas of learning, on the other (Bers, Strawhacker and Sullivan, 2022[15]). Advocates of promoting computational thinking from an early age argue that it fosters development in many areas: problem solving and mathematical thinking; cognitive development more broadly such as number sense, language skills and visual memory; and social-emotional development such as collaboration skills, social interactions and pro-social behaviour, for instance through working with other children on a project.

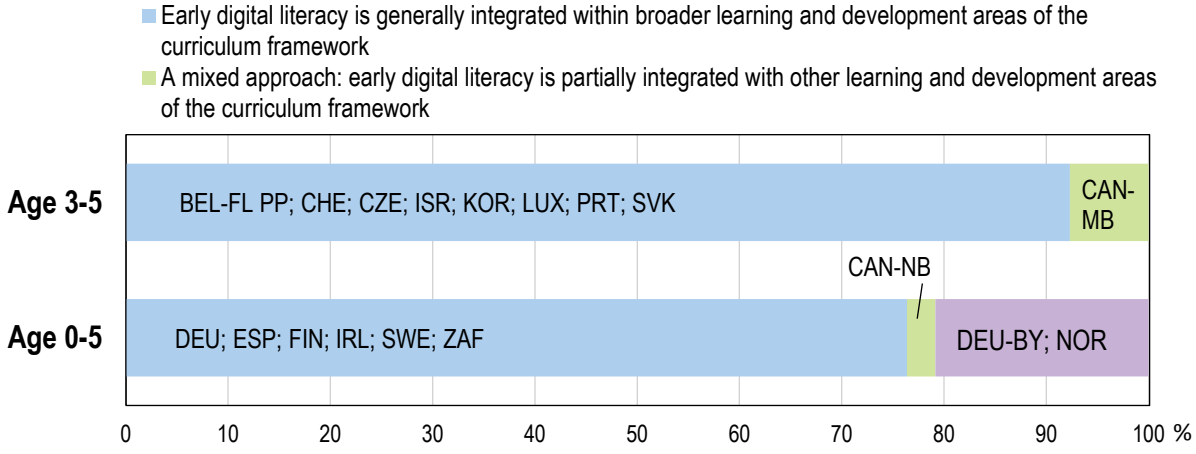
Given that computational thinking might support learning across domains and that several learning areas can provide a meaningful context for engaging in computational thinking, there are arguments for integrating computational thinking with other learning and development areas. In particular, some research argues that computational thinking is well suited to be part of science, technology, engineering, arts, mathematics (STEAM) education that proposes an integrated approach to those areas (Bers, Strawhacker and Sullivan, 2022[15]). Within an early childhood context, a STEAM education means finding ways for children to explore these subjects in an integrated and playful manner through hands-on projects, books, discussions and experiments. New technological tools such as robotics kits and programming languages

designed for young children provide ways for children to engage in STEAM education. However, it is important to note that this body of research is in its infancy and some claims are yet lacking systematic verification in empirical studies. Furthermore, experiences of integrating computational thinking into pre-primary education at a large scale (e.g. at a country or subnational level) are rare or very recent, which makes it difficult to assess their outcomes conclusively.

Most countries and jurisdictions participating in the *ECEC in a Digital World* policy survey (2022) indicated that early digital literacy is integrated within broader learning and development areas of curriculum frameworks, with the exception of Germany (Bavaria) and Norway, where early digital literacy is considered as a learning and development area in its own right (Figure 4.5). These results are similar to those obtained from a broader survey covering several levels of education which shows that, across countries, digital skills tend to be integrated into existing subject areas (Burns and Gottschalk, 2020[16]). For instance, in South Australia, the "STEM in the Early Years" project aims to increase the knowledge, skills and dispositions of children and educators in STEM learning and teaching within a play-based curriculum (Case Study South AUS – Annex C). The skills identified by the project, curiosity and critical and creative thinking, are both important to navigate a digital world. Digital devices are used as an additional mode of representation of science issues aiming to expand communication and children's level of engagement.

Figure 4.5. Early digital literacy in relation to other areas of the curriculum framework

Percentage of countries and jurisdictions reporting the following, by age coverage of the curriculum framework, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. See Annex A.
BEL-FL PP: pre-primary education in Belgium (Flanders). CAN-MB: kindergarten sector only in Canada (Manitoba).
Source: OECD (2022[6]), *ECEC in a Digital World* policy survey, Tables B.7 and B.9.

StatLink https://stat.link/ylasp8

Pedagogical approaches in a digital world

While curriculum frameworks are important to set common guidelines for all ECEC staff on the goals of ECEC and on specific learning and development content, pedagogy is at the core of the interactions with staff that matter the most for children's development, learning and well-being (OECD, 2021[3]). There are multiple understandings of pedagogy and the relationships between curriculum and pedagogy are complex. In a narrow sense, pedagogy refers to the practices and methods employed by staff to support children's development, learning and well-being. With this definition, pedagogy can be considered as a subsidiary to curriculum and a variety of pedagogical practices may be employed within a given curriculum

framework. In a broader sense, pedagogy can denote the theoretical foundation of a curricular approach, setting principles and values for specific methods of teaching or interacting with children. Taken in this sense, pedagogy can be considered to both inspire and support curriculum (OECD, 2021[3]).

The increasing focus of curriculum frameworks on preparing children for a changing world and supporting, from an early age, the development of 21st century skills such as collaboration, persistence, creativity and curiosity, as well as becoming lifelong learners, requires a correspondingly strong focus on pedagogies conducive to the development of these skills (Paniagua and Istance, 2018[19]). Likewise, the development of digital literacy that encompasses various domains and skills calls for pedagogical approaches deliberately designed to foster these competencies. Overall, preparing young children for a digital world requires pedagogical approaches that help to both attain the new specific goals set by curriculum frameworks (pedagogy as a subsidiary to curriculum) but also more generally to support future-oriented ECEC.

Rationales for adapting pedagogical approaches

A first rationale for adapting pedagogical approaches is to support a 21st century curriculum. The digital transformation changes the skills mix required to work and live, with skills required to perform routine tasks becoming less in demand while skills to perform non-routine tasks are more in demand (OECD, 2019[5]). These include advanced cognitive skills but also many social-emotional skills such as co-operation, creativity and the ability to learn. Aligned pedagogical approaches are a critical enabler of the development of these skills.

In many countries, ECEC, in fact, already puts the focus on comprehensive cognitive, social and emotional development. Staff are expected to use multiple pedagogical approaches that are play-based, children-centred and developmentally appropriate, and view learning as an active exchange between the child and the environment (constructivist/interactive approach) (OECD, 2021[3]). These approaches are well suited to support a 21st century curriculum. The recognition of the importance of the quality of the interactions children experience (or process quality) for their learning, development and well-being should be accompanied by policies (e.g. ECEC staff education and training; monitoring tools) that encourage pedagogical approaches supporting broad development rather than narrow didactic teaching. On these aspects, ECEC may therefore need to adapt to a lesser extent than other levels of education. However, ensuring that all staff are prepared to design such learning and development environments for all children is still challenging in many countries. These questions have been discussed in depth in previous Starting Strong publications (OECD, 2021[3]; 2019[20]) and are therefore not further addressed in this report.

A different but related rationale is that digital technologies might enable implementing innovative pedagogies that offer opportunities for more interactivity, feedback, self-regulation, collaboration and exposure to open-ended challenges.

A third rationale comes from the fact that the digital transformation also means that more tasks at work and in everyday life will be performed with digital technologies, creating a need for all children to develop digital literacy. Using digital technologies and integrating digital technologies in practices with young children is generally seen as the most direct way to develop early digital literacy. However, other pedagogical approaches are also possible and both early digital literacy, in general, and computational thinking, more specifically, can also be developed without or with very limited exposure to digital tools, through so-called “unplugged approaches”.

The following sections discuss pedagogical uses of digital technologies and approaches to foster digital literacy. When digital technologies are used with children in ECEC settings, this needs to be done to protect children against the harms that may result from heavy screen exposure and privacy breaches. Having clear guidelines and regulatory frameworks that protect children against multiple digital risks (e.g. exposure to inappropriate content, collection and misuse of personal data) is a condition for any use of digital technologies with children in ECEC settings (see Chapter 3).

Pedagogical uses of digital technologies: Meaning and guiding principles

ECEC staff build on their professional knowledge and experiences about how young children play, learn and develop to provide children with meaningful learning and development opportunities. When doing so, ECEC staff take pedagogical decisions. ECEC staff take decisions on using or not digital technologies in certain situations and when they use digital technologies on how and for what reason to use them (Early Childhood Australia, 2018[21]). All these decisions and practices can be broadly called the pedagogical uses of digital technologies.

Different pedagogical traditions exist in ECEC in OECD countries and there is generally no consensus on a pedagogy that should prevail, as various factors affect how pedagogical practices influence process quality in practice, such as cultural factors. Furthermore, most curriculum frameworks in participating countries and jurisdictions encourage the use of multiple pedagogical approaches (OECD, 2021[3]). In their use of digital technologies with children, it is expected that staff follow the pedagogical approaches that they generally use for other activities or with other materials.

However, experts have highlighted some guiding principles that are particularly important for the use of digital technologies with children. Guidelines in some countries underscore that digital technologies can be used to complement staff's practices with children but not to replace other activities and even less so interactions with adults or children. In the United States, recommendations indicate that digital technologies can be used as a means for a goal and not for their own sake (NAEYC and Fred Rogers Center for Early Learning, 2012[22]). Highlighting that interactions between children and adults are essential to children's development, this position argues that digital technologies can be used to support learning and children's access to new content but should not replace creative play, real-life exploration, physical activity, outdoor experiences, conversation or social interactions. Passive use of technology should be avoided.

Using digital technologies with children requires establishing clear routines. Children like to play with digital tools and like with other games, playing with digital games/toys can help them concentrate and focus on a task while providing satisfaction. However, children can also become unduly attracted to using digital technologies, partly because designers of digital material aim to create highly engaging experiences for users (Early Childhood Australia, 2018[21]). It is, therefore, important for ECEC staff to establish routines and structures to move from an activity with digital technologies to an activity without. While protecting children in the short run, this approach would also empower children to use digital technologies safely.

While research papers and guidelines highlight the importance of several conditions to ensure good outcomes, curriculum frameworks in ECEC are often quite general on the use of digital technologies or do not mention it explicitly. There are, however, some examples of countries where curriculum frameworks are explicit on how to use digital technologies with children (Box 4.2). When curriculum frameworks are not specific about it or when they are modified to become more future-oriented, it is particularly important to ensure that staff are well trained for the use of digital technologies with children and have a good understanding of its potential role in children's development and learning in the digital age (see Chapter 5 and Case Studies: EST, ESP, LTU, NOR, SVN_2 – Annex C).

Box 4.2. Guidelines on using digital technologies with children in early childhood education and care settings

In **Finland**, ICT devices, digital toys and other equipment can be used with children in a way that is defined by ECEC providers and agreed upon with parents. The focus is on the role of ICT in daily life and the use of various devices to promote safe behaviour. Children should have an active role when using digital technologies and get an understanding that technology is a product of human activity. The pilot programme launched in 2020 by the Ministry of Education and Culture on new literacies development provides examples of good pedagogical activities in the three areas of skills development (see Box 4.1). For ICT skills, it mentions play activities that encourage children's production of content on their own. For media literacy, it recommends that children, with ECEC staff, look at how the media is visible and influences their everyday life, such as in play but also producing content, for instance, through digital storytelling and sound recording. For programming skills, it recommends that children gain experiences with technology by playing together and that they practise logical thinking skills, such as categorisation and comparison. Between 2020 and 2022, the programme was piloted by around 40 ECEC providers as well as in basic education (starting with primary education). The institutions in charge of the programme have developed an online library with pedagogical resources and provide training to ECEC staff and teachers.

In **Japan**, the guidelines indicate that digital technologies can be used with children but with a clear instruction plan. They can be used to provide children with experiences that would be difficult to gain through other material. For instance, teachers help children search for information with a tablet on animals, mushrooms, etc. that is difficult for children to obtain in kindergarten activities.

The **Norwegian** curriculum framework sets broad and holistic goals for ECEC and children and includes a section on digital practices in kindergarten. It states that digital practices shall encourage children to play, be creative and learn. The use of digital tools must support the children's learning processes, create a rich and varied learning environment for all children, and help children develop an early ethical understanding of digital media. Staff shall be actively involved with the children when using digital tools. Digital tools must be used with care and not become a dominant practice. The curriculum framework states that staff shall enable children to play, learn and create using digital forms of expression and that staff should do this together with the children.

The **Portuguese** curriculum framework indicates that access to the computer in pre-primary settings enables learning not only in the field of knowledge of the world, but also in artistic languages, written language, mathematics, etc. It recognises that digital technologies are integrated into children's play universe, including through pretend play. Observing these situations should enable staff to understand the role of technologies in children's lives and to start from what they know to broaden their knowledge and support ways of using it. Following these directions, the curriculum gives examples of situations in which staff can promote these learning areas. For instance, ECEC staff should encourage children to observe, talk about and understand the usefulness of different technological resources present in their surroundings. They should talk with children about their favourite TV shows and "heroes"; encouraging debate between different opinions; and about what is real, imaginary or manipulated. They should encourage children to talk about care and norms in using technological resources, aiming to adopt safe behaviours. The curriculum framework also provides suggestions for reflection, such as whether staff know about technological resources that may be accessible in the community surrounding the ECEC centre, use them and alert families about their existence and potential. It also invites staff to reflect on whether children use technologies in a diversified way in the classroom and to think about the most frequent functions children are using.

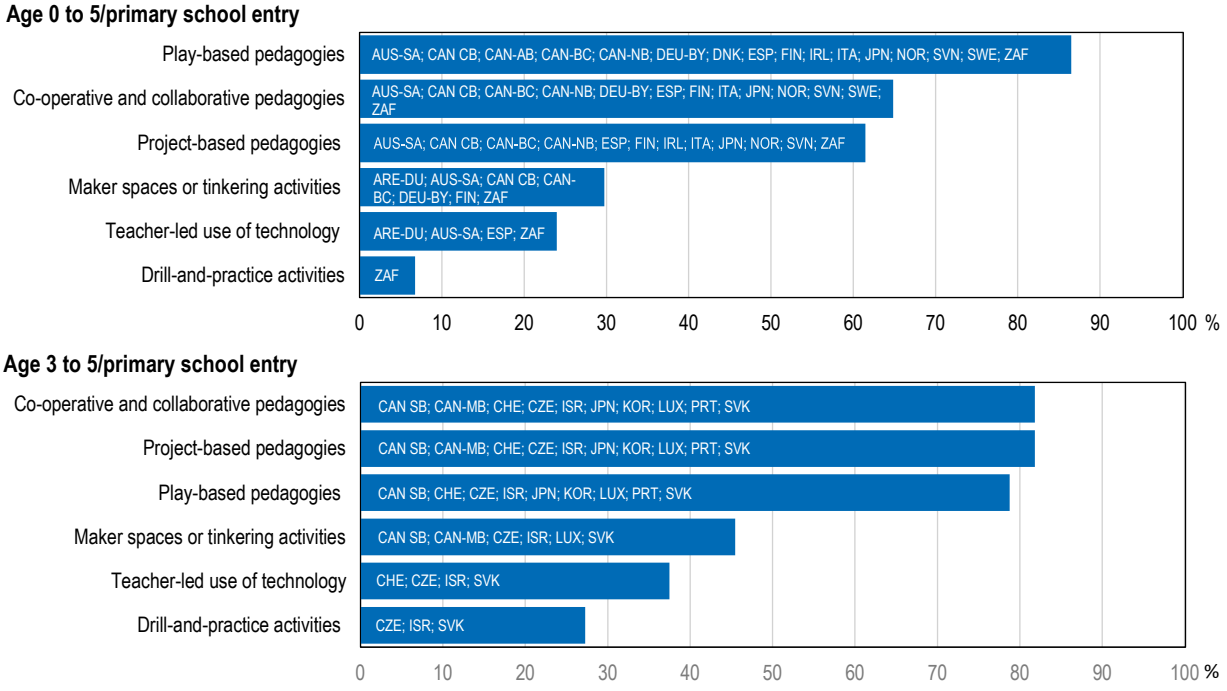
In **South Africa**, a specific goal is that children explore design, make items and use technology. Guidelines are differentiated by age. For babies, it is about showing interest in resources that may include technology and in how things work. Examples for adults are talking to children about what they see, hear and touch, explaining what is happening. For toddlers, it is about investigating how things work, showing interest in turning on and operating electronic items. Adults are invited to talk about the electronic items and how they can be used safely, where available let children operate the items under adult guidance, for example computers and other electronic devices such as cell phones. Older children can experiment with different tools and techniques, know how to operate simple equipment. Adults can encourage children to build their own creations, introduce them to different tools and techniques, and encourage them to operate equipment such as electronic toys and computers.

Source: Country input for OECD (2022[6]) and countries' curriculum frameworks.

The *ECEC in a Digital World* policy survey (2022) asked countries and jurisdictions whether curriculum frameworks and other relevant documents specify a range of pedagogical approaches to integrate digital technologies in relation to interactions with young children within ECEC settings (Figure 4.6). The results are discussed further below.

Figure 4.6. Pedagogical approaches for using digital technologies in interactions with young children in early childhood education and care settings specified in curriculum frameworks and other relevant documents

Percentage of countries and jurisdictions reporting the following, by age coverage of the curriculum framework, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. Some countries and jurisdictions responded for multiple curriculum frameworks and therefore appear more than once with the same country and jurisdiction code. See Annex A. CAN CB: centre-based sector in Canada. CAN SB: school-based sector in Canada. CAN-MB: kindergarten sector only in Canada (Manitoba). *Items are sorted in descending order.*

Source OECD (2022[6]), *ECEC in a Digital World* policy survey, Tables B.7 and B.9.

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Play-based pedagogies involving digital technologies

Answers to the *ECEC in a Digital World* policy survey (2022) indicate that play-based pedagogies are a commonly proposed approach in curriculum frameworks and other relevant documentation, as they are considered by around 86% of the participating countries and jurisdictions in frameworks for children ages 0-5/primary school entry and by 79% in frameworks for children ages 3-5/primary school entry (Figure 4.6).

In general, research emphasises that pedagogical approaches with young children should promote learning through play (OECD, 2021[3]). For digital technologies, there are specific reasons to adopt play-based pedagogies. The starting point is that children integrate digital tools into their play, for instance by using digital games or pretending they are using digital technologies. Some researchers have proposed a pedagogical approach in which there is no distinction between digital and traditional play, called "converged" or "connected" play. Here children move fluidly across and between different modes and, for instance, use a technology and/or are inspired by popular culture characters to participate in traditional play activities (Edwards, 2016[23]). The main argument in favour of this type of approach is that it builds on children's own interests, expertise and knowledge in technologies, and on the digital media and popular culture they have access to in their home environments. These researchers also argue that converged play enables children to develop positive dispositions for learning and can relate to knowledge and learning areas that are generally included in national ECEC curriculum frameworks. It is, however, difficult to assess how effective these pedagogical approaches can be on a large scale.

Some researchers have also argued that computer science and developing computational thinking are well suited for ECEC (starting around age 3) as it offers an environment where young children can play and learn at the same time (Bers, Strawhacker and Sullivan, 2022[15]). In a play-based learning environment, young children can engage in basic coding or early programming and have the possibility to develop problem-solving and computational thinking skills as well as mathematical reasoning and spatial awareness when supported by well-designed and developmentally appropriate digital technologies (Murcia, Campbell and Aranda, 2018[24]).

Children's digital play practices tend to be more advanced than teachers' adaptation of curriculum and pedagogical approaches to incorporate digital technologies, digital media and popular culture into their practices with children (Edwards, 2016[23]; Wood et al., 2019[25]). ECEC staff may not always connect digital activities well with curriculum frameworks despite the importance of children's digital play and of play being at the core of many ECEC curriculum frameworks. Furthermore, ongoing debates and lack of certainty on the appropriateness of digital technologies tend to discourage staff from using digital technologies with children as part of play activities. Lack of clarity of guidelines for ECEC on the use of digital technologies with children (see Chapter 3) and legislated curriculum frameworks that value traditional modes of learning and play and academic learning outcomes also act against the introduction of digital play. By training staff on how to integrate digital play into their practices and more concretely reflecting these approaches in curriculum frameworks, ECEC authorities could help staff be better equipped to support a 21st century curriculum. Some countries have curriculum frameworks that explicitly specify the use of digital technologies in relation to play (Box 4.3) or have developed initiatives to recognise digital play (Case Study KOR – Annex C).

Box 4.3. Digital play in early childhood education and care curriculum frameworks

The **Norwegian** curriculum framework, which generally assigns a core role to play, states that digital practices in ECEC settings shall encourage children to play, be creative and learn. The use of digital tools must support children's learning processes and help create a rich and varied learning environment for all children. Staff are expected to be actively involved with the children when using digital tools,

which should be used with care and not become a dominant practice. It gives a number of broad directions for staff, such as: enabling the children to explore, play, learn and create using digital forms of expression; evaluating the relevance and suitability and participating in the children's media usage; exploring the creative and inventive use of digital tools together with the children.

In **Portugal**, the curriculum framework also recognises the prevalence of digital play. It states that digital technologies are present in children's play, for instance when the child pretends to talk on the phone. It explains that these situations enable ECEC staff to understand the role of technologies in the child's life and to start from what children know to broaden their knowledge and support ways of using it.

Source: Country input for OECD (2022[6]) and countries' curriculum frameworks.

Co-operative, collaborative and project-based pedagogies

In addition to play, curriculum frameworks in ECEC generally include the "constructivist/interactive" and "social pedagogy" approaches that view learning and social development as constructed through interactions with others and underline the importance of learning in groups (OECD, 2021[3]). Digital technologies provide many options for play activities and interactions with others.

In the *ECEC in a Digital World* policy survey (2022), a large majority of countries and jurisdictions (82% for pre-primary education curriculum frameworks and 67% for 0-5/primary school entry curriculum frameworks) indicated that the curriculum framework specifies co-operative and collaborative pedagogies for using digital technologies with young children.

Project-based learning, which shares some features of co-operative and collaborative pedagogies, has been increasingly used in higher levels of education and has now entered early education (Claussen, 2017[26]). This pedagogical approach builds on the learning-by-doing concept and consists of getting children to gain knowledge and skills by "working" for a period of time on a question, problem or challenge. With this approach, children learn in a specific context, are active in the learning process and interact with others to achieve a common goal (Krajcik and Blumenfeld, 2006[27]). While not necessarily involving digital tools, this approach fits well with the use of technology tools that can support learning. For instance, children or students make use of technology tools to support their investigations and communicate with others (Case Study JAP_2 – Annex C).

In a majority of countries and jurisdictions having participated in the *ECEC in a Digital World* policy survey (2022), project-based learning and co-operative and collaborative technologies are specified in curriculum frameworks for using digital technologies with young children (see Figure 4.6). These approaches are somewhat more prevalent in curriculum frameworks for pre-primary age children than for those that cover the full ECEC age range, as they can be more difficult to implement with younger children or groups of children of different ages.

The active role of children and the co-operative feature involved in these approaches are particularly important for using digital technologies with young children. These approaches are, for instance, aligned with what is recommended in the Statement on Young Children and Digital Technologies by Early Childhood Australia (2018[21]), which aims to guide ECEC professionals in their role and optimal use of digital technologies with, by and for young children in ECEC. Building on research, the document provides concrete examples of these practices and explains their goals. The statement recognises that digital technologies can be used to support interactions between ECEC staff and children, as children often enjoy looking at digital photographs and videos of themselves, family members and peers. These images and videos can be used to promote opportunities for language development. Children also enjoy using digital technologies with others and sharing what they have learnt. Using digital technologies with children can create opportunities for social and emotional development by encouraging children to take the lead, share

experiences and listen to others. ECEC staff can engage with children to create content and document learning.

Teacher-driven versus child-driven activities

One dimension that has been receiving increasing attention in pedagogical approaches is the importance of seeing children as contributors to their knowledge rather than consumers and putting individualised learning, children's choices and self-direction at their core. Rather than focusing on transmitting some specific knowledge, teachers can use open-ended questions and present challenging activities to children that lead to various learning opportunities. In particular, these approaches have been recommended by researchers in computational science, who consider that open-ended coding and programming environments offer children the most playful learning opportunities. More generally, given that digital technologies provide open education sources, when digital technologies are used with children, the approach can consist of adopting approaches in which children are given an active role in learning.

To some extent, pedagogies that favour child-driven activities contrast with top-down approaches to teaching and learning and with classic methods favouring mainly teacher-initiated activities, including repetition. There are, however, some cultural variations in regard to the perceived value of more didactic approaches, such as whole-group teaching versus more constructivist and personalised methodologies, such as child-initiated play. For instance, a study on the use of ICT in seven ECEC centres in Hong Kong (China) by teachers who completed a course on this matter showed that teachers used ICT mainly in the context of a teacher-directed approach (Hu and Yelland, 2017[28]). The experience led to few child-directed activities and very few child-initiated activities. The authors conclude that school factors, the curriculum framework, the type of digital tools and teachers' approaches to interactions with children played an important role in how teachers incorporated ICTs into their practices with children. When the context is supportive, a more integrated and balanced approach could also be possible. When using digital technologies with young children, teacher-led use of technology can be helpful to initiate activities or ensure all children participate and then complement this approach with other ones that give a stronger role to children.

Along these lines, a minority of countries and jurisdictions participating in the *ECEC in a Digital World* policy survey (2022) (24% for 0-5/primary school entry curriculum frameworks and 38% for pre-primary curriculum frameworks) have indicated that teacher-led use of technology was specified in the curriculum framework. Related to this, approaches that build on repetitive learning processes, such as "drill-and-practice" approaches, are mostly not included in curriculum frameworks. Co-operative, collaborative and project-based learning approaches that are included in curriculum frameworks of a higher percentage of countries are well suited to include this open-ended component. Approaches that include "maker spaces or tinkering activities" that focus on helping children to solve a problem through open-ended questions and give children time to design and build their products have the open dimension but are specified in the curriculum frameworks of a minority of countries and jurisdictions and more so for pre-primary curriculum frameworks. While these approaches might be well suited to ECEC children in general, implementing them for the use of digital technologies might be complicated with young children, which could explain the relatively low percentage of countries and jurisdictions specifying this approach in their curriculum frameworks.

Unplugged approaches

An age-appropriate use of digital technologies is needed for young children. The World Health Organization (WHO) recommends that children under five spend less time sitting watching screens and more time in active play. Furthermore, WHO recommends no screen time for children one-year-old or under, and sedentary screen time such as watching TV or videos and playing computer games limited to an hour per day for children ages 2-5 (WHO, 2019[29]). In line with these recommendations or to align with national ones, some countries might choose to discourage the use of digital technologies in ECEC settings. There might also be the view that ECEC should not add to children's exposure at home and parents might fear that sedentary screen time replaces play activities. However, in countries and jurisdictions responding to the *ECEC in a Digital World* policy survey (2022), the use of digital technologies with children is strongly discouraged only in a limited number of countries for specific age groups (France, Israel and Luxembourg in pre-primary curriculum frameworks) (see Figure 4.2).

An important reason to develop digital literacy at an early age is to mitigate inequalities in the use of digital technologies between children depending on their socio-economic background (see Chapter 7). It is, therefore, important that even if the use of digital technologies with children is discouraged or if digital technologies are not available in ECEC settings, all children have equal opportunities to develop early digital literacy. These skills can be developed without exposure to digital technologies and some experts even argue that the so-called "unplugged approach" is the most appropriate one for young children.

Unplugged approaches have been developed mainly for computational thinking. These approaches involve engaging children in the principles of computational thinking through activities without actual computers, for example, using hands-on activities such as drawing, role-play and interacting with physical objects (Murcia, Campbell and Aranda, 2018[24]). In particular, the Computer Science Unplugged movement considers that before engaging children in learning how to programme, it is important for them to learn basic concepts, including how to decompose problems into smaller, more manageable parts and how to design precise steps to solve those problems and represent solutions in code, all of which can be explored without a computer (Bers, Strawhacker and Sullivan, 2022[15]).

Unplugged approaches to computer sciences are play-based and introduce children to ways of thinking about computer science without relying on learning computer programming. For example, an unplugged computer science activity in pre-primary education might involve creating bead necklaces in binary numeric code with beads that represent 1s and 0s, using a grid and symbols to put classic fairy tales in a logical order, or making a peanut butter sandwich following a set of instructions or algorithm (Bers, Strawhacker and Sullivan, 2022[15]). This concrete example shows that computational thinking can be developed without direct engagement with digital tools, but also underlines that ECEC staff need to be intentional in their interactions with children to develop these skills. If unplugged approaches are prioritised for some age groups, ECEC settings or countries, they need to be integrated into curriculum frameworks and ECEC staff need to be trained to engage in them. In Germany, the Little Scientists' House, a non-profit early childhood education initiative in the STEM area, launched a programme in 2017 to develop computational thinking for children ages 3-10 starting in ECEC centres. The programme includes material and training for staff using unplugged approaches (Case Study DEU_2 – Annex C). In Spain, the School of Computational Thinking and Artificial Intelligence is a project developed by the Ministry of Education and Vocational Training in collaboration with the regional educational administrations for the whole education system (ages 3-20) (Case Study ESP – Annex C). The objective is to offer open educational resources and teacher training to support teachers in embedding computational thinking and coding in their daily teaching. For pre-primary education, the focus is on activities without a computer.

Like for other approaches to computational thinking, evidence on the impact of unplugged approaches is lacking on a large-scale basis. However, some researchers question the effectiveness of attempts to teach and learn computational thinking concepts in the absence of practical coding experiences, given the importance of a learning-by-doing and iterative approach in this domain (Bers, Strawhacker and Sullivan, 2022[15]).

Beyond computational thinking, other aspects of digital literacy can be developed without exposing children to digital technologies. There does not seem to be much research into this topic so far. However, especially for the youngest children, there is potential for these approaches beyond computational thinking. Through pretend play, children can, for instance, learn to develop routines about the use of digital devices such as smartphones and get a first understanding of some of the risks.

Types of digital technologies and their possible uses

In addition to the goals stated by curriculum frameworks and the pedagogical approaches followed to develop children's early digital literacy, the type of digital resources (specific devices and content) that ECEC staff and children may engage with in ECEC settings also matters. Different types of technologies do not offer the same potential for children's learning, development and well-being. The possible impacts of these tools on children's learning, development and well-being are, therefore, likely to depend on how they are used as well as on the characteristics of the technology.

Policies can support the development of digital infrastructure and digital educational materials in ECEC settings that are safe and appropriate for the children's age and relevant for their learning, development and well-being, including for the development of early digital literacy. For instance, in Germany during the COVID-19 pandemic, the government supported the use of software to support literacy development when children were at home with their parents. A committee made up of psychologists and early childhood and pedagogical professionals tested and reviewed the suitability of various digital materials for children's literacy development (Case Study DEU_1). Furthermore, when investment is made in the provision of digital materials, it is important to develop guidelines for ECEC staff to inform their practices using these materials (Case Studies BRA_1 and CZE).

The *ECEC in a Digital World* policy survey (2022) asked countries whether ECEC authorities at the national, regional or local level provide or support the provision of digital infrastructure and educational materials to ECEC settings (Figure 4.7). The results are discussed below.

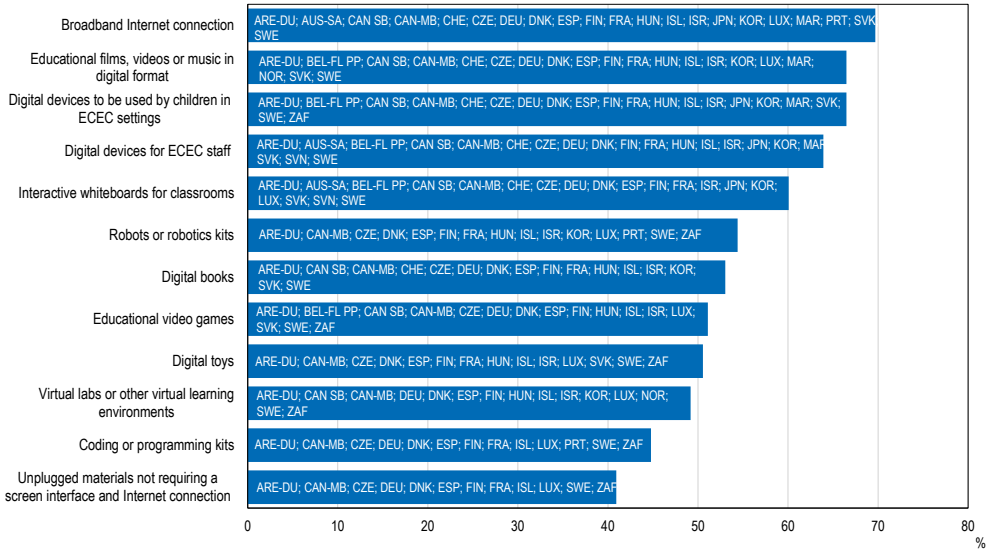
Broadband connectivity

Broadband connectivity is a pre-condition to any use of digital technologies with children and for integrating digital technologies into ECEC more generally, such as for ECEC staff work without children (e.g. workforce development practices) (see Chapter 5); connection with other institutions and services; and for the development of data, for instance for quality assurance mechanisms (see Chapter 6). Inequalities in broadband connectivity can create inequalities among children both for developing early digital literacy and benefiting from modern ECEC services (see Chapter 7).

The COVID-19 pandemic has highlighted gaps in Internet connectivity for ECEC centres (OECD, 2021[30]). However, a large majority of countries and jurisdictions having participated in the *ECEC in a Digital World* policy survey (2022) indicated that, as of 2022, they support broadband Internet connection either at the national or federal, regional or local level (Figure 4.7).

Figure 4.7. Digital infrastructure and educational materials in early childhood education and care settings

Percentage of countries and jurisdictions providing or supporting the provision of digital infrastructure and educational materials to ECEC settings, 2022



Notes: Responses are weighted so that the overall weight of reported responses for each country equals one. See Annex A.
BEL-FL PP: pre-primary education in Belgium (Flanders). CAN SB: school-based sector in Canada. CAN-MB: kindergarten sector only in Canada (Manitoba).
Items are sorted in descending order.
Source: OECD (2022[6]), *ECEC in a Digital World* policy survey, Table B.10.

StatLink https://stat.link/fimrxb

Screens, touchscreens and tablets

While often used in home environments, digital devices involving screen exposure (e.g. tablets) are generally the main reason for reluctance for integrating digital devices into ECEC settings. However, research increasingly highlights that it is the qualitative aspects of screen time (e.g. for what activities, with what content, in what context) that matter for children more than the amount of exposure (see Chapter 2). Combined with pedagogical approaches that lead to an active role of children in co-operation with others and with a specific goal, these digital devices can help develop both digital literacy and other cognitive and socio-emotional skills.

Research indicates that the active role of children is crucial, as is the goal of using the digital device. For example, researchers have observed young children becoming socially isolated when they are focused on a screen, while when playing with tangible coding technologies (e.g. robots designed for young children) they collaborate and communicate with others as they code the actions of the "robot" (Murcia, Campbell and Aranda, 2018[24]). Furthermore, research suggests that children's best learning experiences come when they are engaged not simply in interacting with materials, but in designing, creating and inventing with them (Sullivan, Kazakoff and Umashi Bers, 2013[31]).

A majority of countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022) indicate that the government supports the provision of digital devices to be used by children, such as tablets and notebooks, as well as educational films and videos (see Figure 4.7). On the positive side, investment from the government in these digital devices can help mitigate inequalities between children (see Chapter 7). However, these digital tools run the risk of too much screen exposure and passive use. It

is therefore important to accompany this investment by promoting pedagogical approaches that lead to an active role of children, open-ended learning and co-operation practices. For instance, in Israel, an initiative aims to combine physical space (in the ECEC centre) and traditional material (e.g. furniture, building blocks) with digital materials (e.g. smartphones, cameras) to create "physital spaces" that provide opportunities for play and learning to support physical development and the acquisition of digital skills (Case Study ISR – Annex C).

Children-specific and advanced digital tools

Some digital tools are specifically designed for young children and generally have some educational goals. Digital books have become highly popular and are supported by governments in around half of the countries and jurisdictions having responded to the *ECEC in Digital World* policy survey (2022) (see Figure 4.7). A meta-analysis of 39 studies looking at the story comprehension and vocabulary learning of children ages 1-8 showed that when digital books only differ from paper ones by their digitalisation, comprehension was lower with digital books (Furenes, Kucirkova and Bus, 2021[32]). However, with story-congruent enhancements, digital books outperformed paper books. An embedded dictionary had no or a negative effect on children's story comprehension but positively affected children's vocabulary learning. Adults' mediation when reading print books was more effective than the enhancements in digital books read by children independently. These findings point to the importance of choosing the right products if digital books are introduced in ECEC settings as well as ensuring that digital books do not replace reading paper books with ECEC staff.

Positive effects on learning outcomes are also being documented for high-quality resources such as educational apps or online educational programmes for children. A meta-analysis synthesised findings from 36 intervention studies evaluating the effectiveness of high-quality (interactive, based on learning science principles and focused on specific learning goals) educational apps for preschool to primary school children (Kim et al., 2021[33]). Results show positive effects in both numeracy and literacy skills. One study evaluated the effects of an online version of Reading Camp, a well-structured early literacy training programme for 5-year-olds and also found a positive effect on reading acquisition (Weiss et al., 2022[34]). These examples speak to the potential benefits of early learning of digital educational resources with a design guided by developmental science and evidence-based practice.

In addition to digital books and apps, responses to the *ECEC in a Digital World* policy survey (2022) indicate that in around half of the participating countries and jurisdictions, governments support other education digital tools such as educational video games and robots or robotics kits and more advanced technologies, such as virtual labs or other virtual learning environments. A smaller percentage of countries and jurisdictions support coding and programming kits.

Concerning the characteristics of these digital education tools, researchers in computer sciences have made recommendations on digital tools that aim to promote computational thinking. There are differences between these tools, with some using programming languages that are quite repetitive while others stimulate children's creativity (Sullivan, Kazakoff and Umashi Bers, 2013[31]). Researchers in this area recommend that for young children, programming languages are simple and offer open-ended opportunities for the child to create and explore. Programming languages that are restricted and, for instance, follow a series of sequential levels instead of letting the child drive the experience would require more adult direction and involve children's creativity to a lesser extent. Overall, researchers in the field of computational thinking highlight a number of features of digital tools appropriate for young children, such as: offering visual (i.e. picture, symbol or icon-based) languages as opposed to text-based languages; a syntax that offers multiple levels of complexity and that supports multiple combinations and solutions, as opposed to supporting just one correct outcome; the possibility to create something easily right away; and programming scripts that run as a sequence of text (e.g. from left to right in the Western world rather than top to bottom as in many adult programming environments).

There are differences between these digital tools that make them adapted to children of different ages. Robotic kits often target the youngest children and do not necessarily involve screen exposure. Programmable robotics kits allow young children to explore the foundations of computer science in a hands-on way. Social robots have been used in small-scale experiences, but can be adjusted to the children's age. For instance, the language of a social robot can be adjusted to the children's age and the robot can act as a slightly more advanced peer in a storytelling game between children and the robot (Kory-Westlund and Breazeal, 2019[35]). Digital games and puzzle-style software applications aim to support young children's learning of computer science concepts without the need to experiment with a programming language and can therefore be appropriate for young children, although they involve screen exposure. They also propose a limited set of experiences. Researchers in computational science consider that open-ended coding and programming environments offer the most playful learning opportunities. They can be tangible (e.g. KIBO), screen-based (Scratch Junior) or a combination of the two, but evidence suggests that tangible tools may be more effective as a first introduction to programming in the early years.

Finally, for the youngest children, digital toys that are technology-augmented toys with lights, sound, motion and programmed interactions have also developed. Governments support the provision of these toys in half of the countries and jurisdictions having responded to the *ECEC in a Digital World* policy survey (2022). There are debates on the pros and cons of these toys versus more traditional ones. The main argument for integrating these tools into ECEC settings is to expand the universe of play and better recognise digital play as a possible pedagogical approach, as discussed earlier in this chapter (Stephen and Plowman, 2014[36]). Digital toys for children are often presented as having some educational properties for commercial reasons, but they are generally very simple and are unlikely to provide more learning opportunities than other toys. However, an open debate exists on whether these toys may enhance or inhibit development while they, in fact, do not have the potential to do so. There is much less focus on how digital toys and other resources for young children are integrated into play activities and can bring play value rather than educational value. An argument against digital toys and other devices is that play with digital technologies may be less likely to extend children's physical capacities than traditional play activities, but evidence also suggests that young children continue to enjoy traditional toys and motor activities after being initiated to digital play, and that they can transition easily between digital and non-digital play (Arnott, Palaiologou and Gray, 2019[37]).

Policy pointers

Policy pointer 1: Ensure that curriculum frameworks set clear and comprehensive goals for ECEC in light of children's increasing exposure to digital technologies

- ECEC curriculum frameworks can have different levels of ambition and granularity for responding to digitalisation, but it is important that the directions build on research evidence and are clearly set and explained. Curriculum frameworks also need to create a shared understanding of the goals and concepts that are accessible to all stakeholders (e.g. staff, parents, education providers).
- The goals set by curriculum frameworks can be comprehensive (e.g. addressing the digital divide at an early age, protecting children against digital risks) and reflect the broad impact of digitalisation on children's development, learning and well-being rather than focusing only on the use of digital technologies with or by children.

- Given that digital literacy can be developed at an early age, curriculum frameworks and other documents can set clear goals for children's early digital literacy development. Given the age of children in ECEC settings, the goals should be to lay the foundations for digital literacy development at a later age and should not involve any goals that are inappropriate for the early years. However, curriculum frameworks can adopt a broad rather than a narrow view of digital literacy. Beyond using digital technologies per se, the focus can also be put on getting a first understanding of how technology works, developing safe behaviours in the use of technology, learning to create content and exploring self-expression with digital technologies.
- Beyond digital literacy, ECEC curriculum frameworks that place a great importance on child play can better recognise that digital technologies have changed the universe of play. This may provide opportunities to connect with children's own interests and build on their shared knowledge.

Policy pointer 2: Develop pedagogical guidelines on practices and choice of material aligned with the goals of the curriculum framework

- Curriculum frameworks need to include or be accompanied by guidelines for ECEC staff on how to support and implement parts of the curriculum framework relating to digitalisation. The implications of digitalisation for young children are complex and multifaceted and it cannot be taken for granted that ECEC staff will know how to support a 21st century curriculum framework without clear guidelines. At the same time, designing these guidelines is, in itself, a challenge given the lack of evidence and consensus on what could be an appropriate approach. Directions to move forward include involving several stakeholders in their design, building on research evidence and ensuring that they are well aligned with other guidelines on implementing curriculum frameworks.
- In countries where digital technologies can be used in ECEC settings, guidelines need to provide principles and examples of good practices that are based on recent and robust research. Principles that have led to a consensus so far include the importance of an active role for children (instead of passive consumption of digital media), group activities and a focus on creating material.
- In countries where the use of digital technologies is not recommended or restricted in ECEC settings, children can be introduced to digital literacy without direct exposure to digital tools, through so-called "unplugged approaches", which can also be included in guidelines. More generally, there is potential to expand "unplugged approaches" that are particularly appropriate for the youngest children.
- Digital technologies can be used to support other areas of learning and development, e.g. literacy, numeracy, curiosity and co-operation. However, there is no evidence that this can be easily done with a relatively large group of children of that age. Activities using digital technologies should therefore complement or enhance rather than replace other activities.
- Not all technologies offer the same pedagogical potential. It is important to carefully choose technologies and prioritise those that are appropriate to the children's age, can be used in group activities with an active role of children, provide the possibility to create things easily, and support multiple combinations and solutions. While tablets are often prioritised, other types of material (e.g. robotics kits) can offer valuable experiences to children, including some that do not lead to screen exposure. Guidelines can also recognise the interconnectedness between digital and traditional play, children's right to make choices and the role of adults in guiding those choices.

Policy pointer 3: Complement changes in the curriculum framework in light of digitalisation with aligned workforce training, funding and assessment plans

- Curriculum frameworks alone cannot trigger changes in the right direction. Changes in the curriculum framework brought about by the digital transformation need to be accompanied by workforce training (see Chapter 5).

- Introducing digital activities in ECEC settings can be costly in terms of material, workforce training and the required number of staff per child. Ambitions to develop digital literacy need to be accompanied by adequate funding to ensure that all settings are equipped to develop these approaches (see Chapter 7).
- As for other areas of the curriculum framework and any practices with children, it is important to monitor the effects of introducing digital technologies on process quality in ECEC settings as well as on the development of children's early digital literacy (see Chapter 8).

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