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REVIEW ARTICLE

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Children and teachers engaging together with digital technology in early childhood education and care institutions: a literature review

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ABSTRACT

The purpose of this literature review is to identify patterns and discuss key perspectives from empirical studies published during the last decade that explore how young children (birth to six years old) and teachers together engage with digital technologies in early childhood education and care institutions. An inductive thematic analysis results in five key perspectives: 1) digital play is real play; 2) disconnected contexts; 3) teachers' knowledge and beliefs; 4) learning with and from technology; and 5) children as creators. The findings demonstrate the importance of defining digital technology in a broad way. Further, several of the articles highlight teachers' reflections and judgements regarding how they can implement and embed digital technology into their pedagogical practice. Based on the findings, I suggest that a more explicit focus on digital technology be embedded into pedagogical practice in national ECEC curricula, as well as in national guidelines for EC teacher education.

KEYWORDS

Digital technology; early childhood education and care (ECEC); young children; teachers; literature review; key perspectives

Introduction

The purpose of this literature review is to identify patterns and discuss key perspectives from empirical studies exploring young children (birth to six years old) and teachers engaging together with digital technologies in early childhood education and care (ECEC) institutions. I will present a synthesis of empirical studies focusing on various digital technologies used together with children in ECEC by examining a sampling of studies conducted between 2010 and 2020. My definition of digital technology includes digital tools and devices as well as digital resources and media, in line with Fjørtoft, Thun, and Buvik (2019, 111): 'Digital tools refer to various types of computers and tablets, interactive screens, cameras, equipment for programming, and other types of digital production. Digital resources refer to the digital content used together with the children, both online content and apps or software to be installed' (translated by the author).

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Today, many young children grow up in societies with broad access to various digital technologies intertwined in their everyday lives (Arnott and Yelland 2020; Chaudron, Di Gioia, and Gemo 2018; Danby et al. 2018; Yelland 2017). For these children, digital technology, such as tablets and smartphones, has always been there: 'Technology, as was once said, is not technology if it happened before you were born' (Robinson 2011, 76). However, with the increasing use of digital technology in society, it is important to critically examine and reconsider the ways in which the children use and engage with the technology, at home and in ECEC institutions (Holloway, Green, and Livingstone 2013; Yelland 2017). In ECEC, children still need guidance and support from proximal teachers, who make critical reflections on the possibilities and limitations of integrating digital technology, teachers who reflect upon *when*, *how* and *why* when using digital technology together with the children (Gibbons 2010; Jernes and Engelsen 2012; Selwyn 2010; Stephen and Edwards 2018).

In this paper, the two perspectives of the children and the teachers will be central, as well as their engagement together as active participants, in line with a critical and reflective focus to understand the 'state-of-the-actual' of technology use in ECEC (Selwyn 2010, 69-70). I consider children's active participation in society to be a core value, in line with the *United Nations Convention on the Rights of the Child* (1989, Article 12). Consequently, only studies focusing on children as active participants are included.

Next, I will provide some insights into digital technology in ECEC by drawing on previous literature reviews before going deeper into the key perspectives.

Previous literature reviews

The first international literature reviews of the use of digital technology among young children and teachers in ECEC were conducted in 2003 and 2005; in these reviews the researchers describe the use of digital technology with 3- to 5-year-olds (Plowman and Stephen 2003; Stephen and Plowman 2003; Yelland and Masters 2007). At that time, the term digital technology mainly referred to computers, and the teachers mostly incorporated the technology into their existing practices as an 'add-on' – instead of looking at the new opportunities provided by the technology. Stephen and Plowman (2003) conclude that digital technology can be a valuable addition to teachers' practices, but this depends on teachers' pedagogical knowledge and expertise. These three literature reviews are the only ones, to my knowledge, that have focused on both children's and teachers' technology use (Plowman and Stephen 2003; Stephen and Plowman 2003; Yelland and Masters 2007) (Appendix1).

Other previous reviews have focused on more specific aspects of technology use, such as technology and literacy (Belo et al. 2016; Burnett 2010; Kucirkova et al. 2019), technology and learning (Hsin, Li, and Tsai 2014), technology in relation to healthy practices, relationships, pedagogy and digital play (Mantilla and Edwards 2019), research design and methodologies (Miller et al. 2017), and the Internet of Toys (IoToys) (Ling et al. 2021) (Appendix 1). The researchers highlight a need for more research focusing on the way social interactions unfold during children's engagement with digital technology (Miller et al. 2017), research that includes digital and non-digital activities and the teachers' role (Belo et al. 2016), and research on young children's use of a wide range of digital technologies (Burnett 2010).

Methodology

The purpose of this literature review is to identify patterns, discuss key perspectives, and provide new perspectives to the existing literature (Booth, Sutton, and Papaioannou 2016; Grant and Booth 2009). The literature review can be described as a configurative review (Booth, Sutton, and Papaioannou 2016) of peer-reviewed research articles published in national and international journals between 2010 and 2020. The research question is as follows: *What are the key perspectives from research exploring how young children and teachers engage with digital technologies together in ECEC?*

Search procedures

Systematic searches were performed in October 2020 in *Academic Search Premier, ERIC, Scopus, Web of Science*, and *Idunn.*[1] I used two search strings across these databases: '(early childhood education OR preschool OR kindergarten OR early years) AND (digital tools) AND (technology OR technologies)' and '(early childhood education or preschool or kindergarten) AND (digital technology OR digital technologies) AND (teachers OR educators) AND (pedagogy OR pedagogical)'. In Idunn, I also included similar search strings in Norwegian.

Inclusion and exclusion criteria

By drawing on the wide definition of digital technology presented in the introduction, this literature review focuses on young children's (0-6 years old) and teachers' collaborative use of various digital technologies in ECEC institutions (Table 1). Children's participation is essential, and studies of teachers using digital technology without including children are excluded, as are studies focusing on older children or adults. Moreover, children's use of digital technology at home or together with parents and other caretakers are also excluded.

Further, only English and Norwegian search terms are used, which limits the findings to articles presented in these languages. Two articles written by me are also included because they were found through the literature search. However, by only including articles found through searches in specific databases that can be accessed from a Norwegian university,

Table 1. Literature search.

Theme	Included	Excluded
Database	Academic Search Premier, ERIC, Scopus, Web of Science, and Idunn	Other
Publication types	Peer-reviewed articles and literature reviews	Newspaper articles, books, book chapters, conference proceedings, and PhD dissertations
Time	2010–2020	Articles published before 2010
Focus	Empirical studies focusing on digital technology used together with young children (0-6 years old) in ECEC	Studies focusing on digital technology used together with older children and adults (e.g. in higher education); studies focusing on children's use of digital technology at home or together with parents and other caretakers; studies focusing on teachers using digital technology but not with children
Languages	English, Norwegian, Danish, and Swedish	Other languages
Methods	All	Articles without a distinct presentation of the method(s) used

other relevant articles may have been excluded. Reviewing previous research is essentially an act of interpretation; therefore, to ensure transparency, I have clearly stated the research question guiding this review and the inclusion and exclusion criteria.

The searches resulted in 199 articles. Drawing on Booth, Sutton, and Papaioannou (2016) and Moher et al. (2009), these articles were scanned to assess their relevance based on the title, abstract and keywords (Figure 1). Among these articles were 128 articles that focused on older children or adults, e.g. in higher education; these were excluded. The remaining 71 articles were then read thoroughly. Based on an informed filtering of what to include, more articles were excluded because they did not meet my inclusion criteria; they did not have a clear focus on digital technology used together with children in ECEC institutions. Ultimately, 35 peer-reviewed research articles were included in this literature review (see Appendix 2).

Analysis

To identify patterns and explore variations to point out key perspectives, an inductive thematic analysis of the 35 included articles was provided (Bearman and Dawson

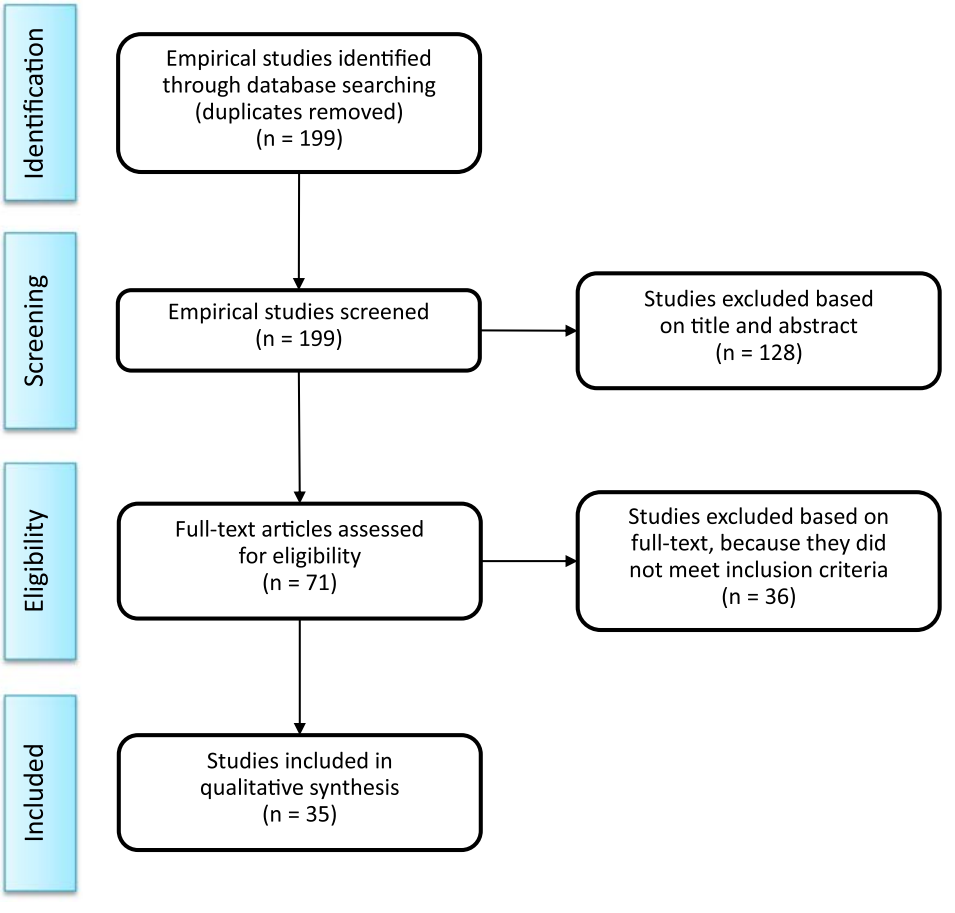

Figure 1. Process of selecting studies, adapted from Moher et al. (2009, 3).

2013; Braun and Clarke 2006). First, each article was read thoroughly to identify themes that represented how digital technology were used together with the children. Then, I explored how these themes emerged across the articles and the relationships between the themes. During this process, the themes were refined, adjusted and grouped together into five key perspectives that synthesises the findings: 1) digital play is real play; 2) disconnected contexts; 3) teachers' knowledge and beliefs; 4) learning with and from technology; and 5) children as creators (Table 2).

Results

Overview of the reviewed studies

All the included articles were published in international journals between 2012 and 2020. The articles draw on studies conducted in several countries across the world (Appendix 2). Pedagogical or educational uses of digital technology in ECEC, such as children's play and learning, creative processes, and teachers' pedagogical beliefs are emphasised in 24 of the 35 articles (Table 2). This is not surprising, due to my search for studies exploring children's and teachers' collaborative engagement with digital technology in ECEC. Most of the reviewed studies are descriptive studies, and the researchers mostly describe the use of technology in a positive way. Six of the studies provide some critical perspectives (Alvestad et al. 2017; Hoel and Jernes 2020; Jernes and Engelsen 2012; McGlynn-Stewart et al. 2018; Skantz Åberg, Lantz-Andersson, and Pramling 2014; Undheim and Jernes 2020), but only one study can be described as being critical (Lafton 2019). Further, most of the studies draw on socio-cultural perspectives, which leaves room for further studies drawing on other theoretical perspectives, for example, multimodality or actor-network theory. Most of the studies use several data collection methods, such as interviews and observations of teachers and children. Only four studies include children under the age of three (Fleer 2020; Jernes and Engelsen 2012; Lafton 2019; Ljunggren 2016) (Appendix 2).

Digital technology used in an educational setting, such as in ECEC, is often described as educational technology; however, according to Jack and Higgins (2019), no consistent definition of educational technology is available. While a narrow definition of digital technology often views technology only as computers or screens, a wider definition includes digital technology that may offer imaginative, creative and collaborative activities (Fleer 2019; Jack and Higgins 2019; Kewalramani et al. 2020; Palaiologou 2016), as presented in Figure 2. Johnston, Highfield, and Hadley (2018) highlight the importance of also including imaginary technology, such as non-functioning keyboards and phones, when defining digital technology; these technologies are often included in children's play.

Digital play is real play

Traditional beliefs about play, particularly the value of open-ended and exploratory play, can be seen as barriers to digital technology integration in ECEC (Edwards et al. 2020). However, for many children growing up today, digital technology is as natural as any other artefact or tool (Edwards et al. 2020; Fleer 2020). Fleer (2020) observed that the children used digital technology in distributed ways across the various activities and

Table 2. Key themes in relation to each study

	Discon. Contexts	Teachers' knowledge and beliefs				Play	Learning with and from technology					Children as creators	Participants' views		Defining digital technology
Study		Knowledge	Pedagogical beliefs	Teachers' role	Pedagogical use		Mathematical learning	Literacy learning	Exploratory learning	Learning to use technology	Technological impact (affordances)		Teachers' views	Children's views	
Aldhafeeri et al. 2016	X		X		X								X		
Alvestad et al. 2017	X	X				X							X	X	X
Aubrey and Dahl 2014	X	X	X										X	X	
Bird and Edwards 2015					X	X				X					X
Bourbour and Masoumi 2017					X		X						X		
Carlsen 2013				X	X		X				X				X
Carlsen et al. 2016				X	X		X				X				X
Dunn et al. 2018	X				X						X		X	X	
Edwards and Bird 2017					X	X				X					
Edwards et al. 2020	X		X		X	X								X	
Fleer 2019					X	X									X
Fleer 2020	X					X			X			X			
Hatzigianni et al. 2020												X		X	
Hoel and Jernes 2020					X			X			X				
Jack and Higgins 2019	X	X	X		X								X		X
Jernes and Engelsen 2012		X		X	X	X									

Johnston 2019					X					X						
Johnston et al. 2020	X		X		X		X								X	X
Johnston et al. 2018	X		X		X		X								X	X
Kewalramani et al. 2020					X		X									X
Lafton 2019							X								X	
Leinonen and Sintonen 2014													X			
Ljunggren 2016								X								
McGlynn-Stewart et al. 2017	X		X		X			X				X			X	
McGlynn-Stewart et al. 2018								X							X	
Palaiologou 2016			X		X										X	X
Sandvik et al. 2012								X								
Skantz Åberg et al. 2014				X								X	X			
Skantz Åberg et al. 2015				X	X			X					X			
Sulaymani et al. 2018			X		X											
Undheim 2020													X			
Undheim and Jernes 2020					X								X			
Vartiainen et al. 2019					X					X						
Vidal-Hall et al. 2020	X		X		X										X	
Yelland 2018					X			X								

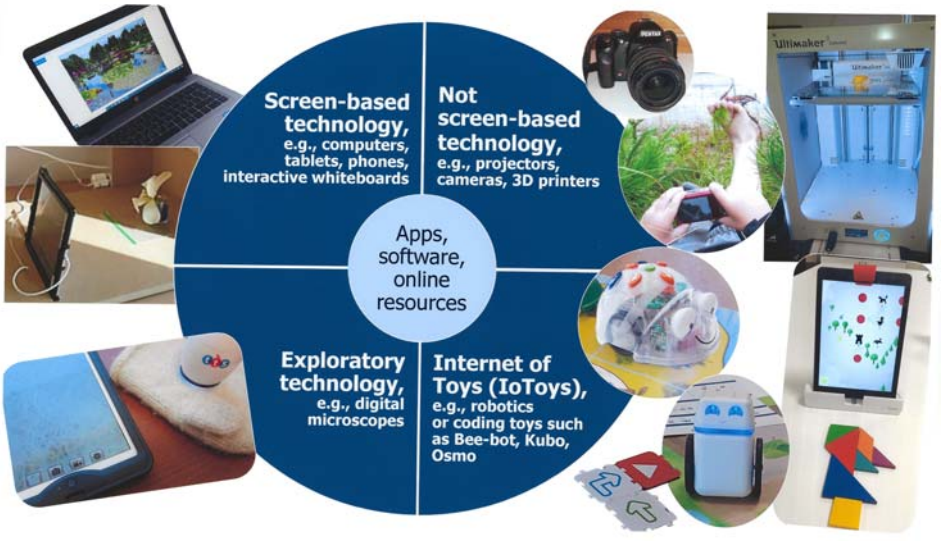

Figure 2. Digital technologies in ECEC.

rooms in the ECEC settings and included the technology in their play. However, as the digital technology became part of the social practices in these ECEC settings, more complex social practices emerged, for example, when the children started to record each other's play. Afterwards, when watching their recorded play, the children experienced a form of re-play. In this way, the digital equipment supported the children's play by allowing the children to make the rules, roles and actions visible to themselves, each other and their teachers (Fleer 2020). These new possibilities inspired the children to re-imagine and re-create stories in their imaginary play by using a mix of artefacts and playful practices; further, it became impossible to separate the activities into 'real' play and digital play (Fleer 2019, 2020).

A similar finding is related to the IoToys (Kewalramani et al. 2020). When the IoToys were included in children's play, mutual multilayer interactions among the teachers, the children and the IoToys emerged; this created new experiences and sparked children's creative, communicative and problem-solving dispositions. The key is to understand the multiplicity of these interactions, according to Kewalramani et al. (2020).

To meet these new and transformative conditions for children's play, Edwards et al. (2020) introduced the concept of converged play. As highlighted by several researchers (e.g. Edwards et al. 2020; Fleer 2019, 2020; Lafton 2019), it has become almost impossible to distinguish between 'real' play and digital play today because children's various play practices are so interrelated with each other and continuously moving towards each other. According to Lafton (2019), the spheres where technology and traditional toys are present overlap with each other in children's play. Fleer (2019, 214) describes these practices as a 'coalition of practices' that create new transformative conditions for children in a play-based learning environment. Converged play can be seen as the starting point of a movement towards helping teachers understand teaching and learning in the digital age – an age in which children's experiences of digital technologies, media, and popular culture within their homes also must be taken into account (Edwards et al. 2020).

Disconnected contexts

Several researchers point to a gap – or a disconnect – between children's access to and experiences with digital technology at home and that in ECEC (e.g. Aldhafeeri, Palaiologou, and Folorunsho 2016; Alvestad et al. 2017; Aubrey and Dahl 2014). Alvestad et al. (2017), for example, found a gap between the children's and teachers' everyday experiences; when the children talked about games they played and TV programmes they watched at home, it was hard for the teachers to understand what the children were talking about. According to Aubrey and Dahl (2014), many teachers express a poor awareness and understanding of the contribution that digital technology plays in young children's lives outside of ECEC. Supporting children today is a diverse and complex issue that requires connections between the home and ECEC settings (Aldhafeeri, Palaiologou, and Folorunsho 2016). Further, it is important that EC teachers recognise that there is a 'digital difference' between these contexts (Aldhafeeri, Palaiologou, and Folorunsho 2016) and acknowledge children's home experiences of digital technology, media, and popular culture (Edwards et al. 2020).

Teachers' knowledge and beliefs

Several of the reviewed studies point to a lack of knowledge among the teachers of how to integrate technology into play-based pedagogy (Aubrey and Dahl 2014; Jack and Higgins 2019; Johnston, Hadley, and Waniganayake 2020; McGlynn-Stewart et al. 2017; Vidal-Hall, Flewitt, and Wyse 2020). In some of the studies, the teachers reported that they would like more professional support regarding the pedagogical uses of digital technology in ECEC (Aubrey and Dahl 2014; Jack and Higgins 2019). In some of the reviewed studies, the teachers were supported during the research in learning how to use certain technologies and how to integrate them into their practice; the teachers in these studies repeatedly expressed that these discussions and reflections were essential for their technological and pedagogical professional development (Johnston, Hadley, and Waniganayake 2020; McGlynn-Stewart et al. 2017; Vidal-Hall, Flewitt, and Wyse 2020).

On the one hand, teachers' knowledge of digital equipment and resources impacted how the technology was integrated as a pedagogical resource (Jack and Higgins 2019). On the other hand, the integration of digital media was not constrained by a lack of knowledge alone, according to Vidal-Hall, Flewitt, and Wyse (2020), but rather by how the teachers' pedagogical beliefs and practices interacted with their beliefs about digital technology and young children. Some teachers' beliefs about digital technology conflicted with their pedagogic principles of child-initiated play, which shaped their decisions about integrating digital technology into ECEC (Edwards et al. 2020; Vidal-Hall, Flewitt, and Wyse 2020). However, as shown in several articles, the teachers' beliefs that do hinder technology use can be replaced with 'new' beliefs that support the use of digital technology through professional development, discussions and critical reflections (Johnston, Hadley, and Waniganayake 2020; McGlynn-Stewart et al. 2017; Vidal-Hall, Flewitt, and Wyse 2020).

According to several researchers, assumptions about the nature of play-based pedagogy and the potential uses of digital technology have created tensions and confusion among teachers in ECEC (Aldhafeeri, Palaiologou, and Folorunsho 2016; Palaiologou

2016; Sulaymani, Fleer, and Chapman 2018). While the teachers in some studies demonstrated fears about digital technology having a negative impact on children in terms of their well-being, social development and health (e.g. Vidal-Hall, Flewitt, and Wyse 2020), other studies observed that the teachers showed a positive attitude towards the use of digital technology (e.g. Aubrey and Dahl 2014; Jack and Higgins 2019).

Learning with and from technology

In several of the reviewed studies, the technology was seen as a useful resource in mathematical learning, literacy learning, and exploratory learning, to follow up on children's interests in meaningful ways (Johnston, Highfield, and Hadley 2018). In an interview study (Dunn et al. 2018), the children highlighted the play possibilities when tablets were used. For the children, it was important to have a choice – not necessarily of which app to use, but the choices within the app were important for the children; for example, in open-ended apps, they could create their own content, unlike in closed apps that focused on drills and practice (Dunn et al. 2018). In some of the studies, technology is seen as a useful resource to *learn from*, but most of the studies focus on children's *learning with* the technology, for example, in mathematical learning.

Mathematical learning

Three of the reviewed studies focus on the use of digital technology in children's early mathematical learning (Bourbour and Masoumi 2017; Carlsen 2013; Carlsen et al. 2016), which can be described as learning with technology. However, digital technology carries both affordances and constraints with respect to participants' collaboration (Carlsen et al. 2016). Some mathematical apps focus on *doing* something with mathematical objects, such as moving them. According to Carlsen, the technology has limitations with respect to actively engaging two children at the same time, especially when an app is used on a computer with a mouse – in contrast to an interactive whiteboard, which potentially allows more collaboration between the children. Hence, it is difficult to know how and if the app supports the children's mathematical development because the digital equipment that is used may affect how difficult it is for the children to use the app (Carlsen 2013; Carlsen et al. 2016). Further, the mere fact of having or using an interactive whiteboard does not create a dynamic and rewarding learning environment – that depends on how the whiteboard is embedded into the pedagogical practice by the teachers (Bourbour and Masoumi 2017, 1829).

Literacy learning

Seven of the reviewed studies focus on children's literacy learning or development with technology (Hoel and Jernes 2020; Ljunggren 2016; McGlynn-Stewart et al. 2017, 2018; Sandvik, Smørdal, and Østerud 2012; Skantz Åberg, Lantz-Andersson, and Pramling 2015; Yelland 2018).

Some of these articles explored children using open-ended iPad apps to document their work (McGlynn-Stewart et al. 2017, 2018; Yelland 2018). The multimodal affordances of the open-ended apps, such as photos, videos, drawings, texts and audio recordings, allowed the children to communicate, collaborate, explore and create products that were meaningful to them. The apps could be used in any way that the teachers or children

chose and provided various learning scenarios (Yelland 2018). Several of the children integrated the apps with other resources, such as books, cards, pencils, crayons and sand, which enabled the children to experience early literacy concepts in dynamic interactive and multimodal contexts that built on and extended their 'real-world' play experiences (McGlynn-Stewart et al. 2017, 2018; Yelland 2018). Everything the children made could be saved, which scaffolded their reflection and encouraged them to continue to explore their interests over time (McGlynn-Stewart et al. 2018).

However, the technology may not always provide good learning opportunities. Hoel and Jernes (2020) found that when digital picture book apps were used in shared dialogue-based reading activities with groups of children, the interactive affordances within the app limited the dialogue between the children and the teachers, especially during the first reading. The children were mostly engaged with the hotpots and concerned with who was next for clicking on the hotspots; the researchers observed a tension between the teachers' didactical intension and the interactive picture book app. During the second reading, however, the teachers were more prepared and took more control of the situation. This study indicates that when reading digital books with groups of children, the less interactive the book is, the better – if the aim is shared dialogue around the book and the narrative (Hoel and Jernes 2020).

Exploratory learning

Another way digital technology is used in ECEC is in exploratory learning. Fleer (2020) and Vartiainen, Leinonen, and Nissinen (2019) describe projects where the teachers encouraged the children to observe and discover their surroundings by using tablets, digital microscopes and trail cameras, as well as to engage in collaborative meaning-making with their peers. The digital microscope enabled the children to look closely at soil samples from the compost bin and water samples from their outdoor play area (Fleer 2020), while the trail camera enabled the children to capture images of the wildlife in the local forest (Vartiainen, Leinonen, and Nissinen 2019). Through the use of digital technology, the teachers empowered the children to be actors in their inquiry by giving them time and room to explore (Fleer 2020; Vartiainen, Leinonen, and Nissinen 2019). In these studies, the children were learning with the technology.

In Johnston's (2019) study, however, the technology was used to support co-learning about a topic that was new and unfamiliar for both the teachers and the children. This study can be described as an example of learning from technology, in which the technology provided important information in terms of scientific concepts and enabled the teachers' and children's inquiry skills to be fostered (Johnston 2019).

Learning to use technology

During my search for previous research, I also found two articles focusing on how children learn to use digital technology (Bird and Edwards 2015; Edwards and Bird 2017). In these articles, a movement from epistemic play to ludic play with digital technology is described. In the children's epistemic play, the researchers saw exploration, problem solving and skill acquisition, such as framing images when using the camera or tapping on the iPad screen. Ludic behaviours were more strongly associated with using technology in symbolic play, such as creating pretend play scenarios and then using the technology to record the play, for example, recording a puppet show or a

movie with Lego cars with an iPad. According to Bird and Edwards, the children's initial activities with the technology can be understood as 'exploratory' when the children are learning the functions. Then, when they 'master' the functions, the activities change into ludic or 'true' play, and the activities become 'innovative' (Bird and Edwards 2015; Edwards and Bird 2017). This shows that it is important for children to learn to use a tool before they can use it creatively. Instead of limiting imaginative play, digital technology can be seen as supporting children's achievement and engagement in complex activities (Bird and Edwards 2015; Edwards and Bird 2017; Yelland 2017).

Children as creators

Seven of the reviewed studies focus on digital technology used in creation processes (Fleer 2020; Hatzigianni et al. 2020; Leinonen and Sintonen 2014; Skantz Åberg, Lantz-Andersson, and Pramling 2014, 2015; Undheim 2020; Undheim and Jernes 2020). In all these studies, the children are positioned as the creators of products that they can share with others; the children shift from being 'consumers' of digital technology to being 'producers'. In Fleer's (2020) study, the making of an animation seemed to generate the need for the children to be simultaneously inside the narrative as the actors and outside the narrative as the audience. The idea of being part of an audience placed a new type of demand on the children, which Fleer describes as 'psychological characteristics of digital play' (Fleer 2020, 7). In Hatzigianni et al.'s (2020) study, the children even positioned themselves as future designers, innovators, engineers and scientists.

In one study, the technology provided the story-creation process with new possibilities, such as editing, photographing, recording sound, and creating animations (Undheim 2020). In another study, the technology seemed to limit the children in their digital story-making activities; much effort was directed at operating the technology and conventions of writing to perform the task given by the teacher (Skantz Åberg, Lantz-Andersson, and Pramling 2014). However, as I have pointed out earlier, it is difficult to know if this is related to the technology itself, to how the technology is used, to the task given to the children by their teacher, or maybe even to a combination of all these factors.

Discussion

Through an inductive thematic analysis of the empirical studies, five key perspectives emerge, themes that in various ways are concerned with the 'state-of-the-actual' by focusing on children's and teachers' collaborative and active engagement with digital technology in ECEC (Selwyn 2010): 1) digital play is real play; 2) disconnected contexts; 3) teachers' knowledge and beliefs; 4) learning with and from technology; and 5) children as creators.

On the one hand, the reviewed studies show various ways in which digital technology can open up new possibilities for children (e.g. Fleer 2020; Hatzigianni et al. 2020; Kewalramani et al. 2020; Vartiainen, Leinonen, and Nissinen 2019; Yelland 2018). On the other hand, the studies also highlight multiple concerns regarding the suitability of digital technology for young children (e.g. Aldhafeeri, Palaiologou, and Folorunsho 2016; Vidal-Hall, Flewitt, and Wyse 2020). However, the suitability depends on how the technology

is used in the pedagogical practice, in which teachers play a significant role (e.g. Bourbour and Masoumi 2017; Hoel and Jernes 2020; Jernes and Engelsen 2012). Teachers' role is an aspect also discussed and highlighted previously by several researchers (e.g. Belo et al. 2016; Gibbons 2010; Selwyn 2010; Stephen and Edwards 2018; Stephen and Plowman 2003). Nevertheless, several of the reviewed studies highlight the need for more professional learning opportunities for teachers to support a broader understanding of children's experiences with technology (e.g. Aubrey and Dahl 2014; Jack and Higgins 2019; Vidal-Hall, Flewitt, and Wyse 2020).

Young children's contemporary play practices are characterised as a mixture of overlapping 'real' and digital play practices, in which non-digital and digital toys and tools are combined in various ways in their play (e.g. Edwards et al. 2020; Fleer 2019, 2020; Lafton 2019). Hence, it has become almost impossible to make a distinction between 'real' play and digital play (Edwards et al. 2020). Despite this, several researchers point to a disconnect between children's home contexts and ECEC in relation to digital technology (e.g. Aldhafeeri, Palaiologou, and Folorunsho 2016; Alvestad et al. 2017; Aubrey and Dahl 2014). Research shows that teachers' knowledge and beliefs about digital technology in ECEC influence how it is implemented and embedded in the pedagogical practice (Edwards et al. 2020; Vidal-Hall, Flewitt, and Wyse 2020). Several researchers call for a need to review and challenge the traditional ideology of play-based pedagogy (e.g. Edwards 2013; Edwards et al. 2020; Palaiologou 2016). It seems like a narrow definition of digital technology only as screens has created a gap between 'real' play and digital play. However, the empirical research presented in this literature review demonstrates that the use of digital technology in ECEC is not the same as sitting quietly in front of a screen (e.g. Edwards et al. 2020; Fleer 2020; Hatzigianni et al. 2020; Kewalramani et al. 2020; Undheim and Jernes 2020; Vartiainen, Leinonen, and Nissinen 2019). Through play, exploration, inquiry activities and creation processes, children and teachers collaboratively use digital technology in various ways. By drawing on these findings, I want to highlight the importance of defining digital technology in a broad way, which means including various kinds of digital technology, including children's imaginary technology, in the definition. Further, I want to emphasise a play-based and child-centred practice where the teachers have knowledge of and acknowledge the children's varying experiences with digital technology but, at the same time, provide proximal support and guidance when children explore, create, play and learn with the technology (e.g. Gibbons 2010; Jernes and Engelsen 2012; Mantilla and Edwards 2019; Stephen and Edwards 2018; Stephen and Plowman 2003).

Conclusion

Drawing on the findings from this literature review of young children's (age 0–6 years) and teachers' engagement with digital technology in ECEC, I call for more research focusing on how the technology is used by teachers and children together in their everyday life in ECEC, especially research drawing on children's views, including the youngest children; for example, research focusing on social interactions as they unfold to capture moment-by-moment interactions, as suggested by Miller et al. (2017). Further, in most of the reviewed studies, the researchers describe the use of technology in a positive way;

hence, there is a need for more studies with a critical focus, to include more perspectives in the discussion.

Although the reviewed studies were conducted through a broad search in several databases, there are some limitations. First, to review previous research is essentially an act of interpretation; to ensure transparency, the inclusion and exclusion criteria as well as the analytical steps are clearly described. Second, only peer-reviewed research articles found through searches performed in October 2020 are included (Table 1), mostly from educational journals. Third, because this review uses only English and Norwegian search terms, the findings are limited to studies presented in these languages. Fourth, given the focus on children and teachers engaging together with digital technology in ECEC institutions, research articles focusing on teachers' use of digital technology without including children and children's use of digital technology at home are excluded. Nevertheless, this literature review highlights and discusses five key perspectives from a sample of 35 empirical peer-reviewed studies published in the last decade.

Based on the findings and the discussion in this paper, I want to present some recommendations and implications for practice and policy. First, it is important for policymakers and teachers to define digital technology in a broad way and acknowledge children's varying experiences with digital technology. Second, even though many children are familiar to digital technology, it is important that teachers provide proximal support and guidance when children explore, create, play, and learn with the technology. Consequently, teachers need time and opportunities to reflect on and discuss how they can implement and embed digital technology into their pedagogical practice and how they can use it to support their own professional development in ECEC institutions and EC teacher education. Finally, I suggest a more explicit focus on digital technology embedded into pedagogical practice in national ECEC curricula, as well as in national guidelines for EC teacher education; such as the Norwegian *Framework plan for kindergartens* (Norwegian Directorate for Education and Training 2017, 45) in which it is stated that the teachers shall 'enable the children to explore, play, learn and create using digital forms of expression' and 'explore the creative and inventive use of digital tools together with the children'.

Note

1. Idunn is a Norwegian database for research articles: https://www.idunn.no

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