



Tracing the Ontological Beliefs of Norwegian Educators Concerning Technology use in Early Childhood Education and Care

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Accepted: 27 March 2024
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Abstract

Nested in the socio-cultural theory and the related concepts of dialogue in thinking (Mercer & Littleton, 2007) and dialogic teaching in classrooms (Mercer & Howe, 2012), this study explored knowledge and technology as dynamic meaning-making processes in Norwegian early childhood education and care (ECEC) settings. Group-reflections from thirteen Norwegian early childhood educators and their ontological beliefs concerning digital technology in ECEC were analysed with a theory-driven thematic analysis. The analysis highlights two tensions between individual and collective reasons for using digital technology in ECEC: a tension between the educators' ontological beliefs about the need for children's collective experiences and children's individual use of digital technology, and another tension related to the educators' own individual learning and collective knowledge construction about technology. We derive time as the key reason for the individual-collective tensions. Educators need time to develop good experiences with digital technology for all children, and they need time to develop their own learning, individually and collectively. Given the urgent demand to support technology use in Norwegian ECEC for young children, we underscore time constraints as a key factor influencing individual-collective tensions, impacting educators' capacity for effective implementation and professional development.

Keywords Educators · Digital Technology · Dialogue · Young Children · Ontological Beliefs · Early Childhood Education and care (ECEC)

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1 Introduction

Digital technologies, such as tablets and PCs, and various apps and platforms accommodated by these, influence young children's everyday lives, directly and indirectly, both at home and in early childhood education and care (ECEC) settings (Pettersen et al., 2022; Säljö, 2022). Children growing up in Western societies have access to various technologies from an early age and they experience everyday use of technology by their parents and siblings (Dardanou et al., 2020; Palaiologou et al., 2021). In Norway, which is the context for this study, a recent survey showed that 65% of 4–5-year-olds have access to tablets at home, and many of these children started using tablets before the age of three (Medietilsynet, 2022, p. 11). Children's experiences with digital technologies can be gauged from various sources of data and we were interested in literature concerned with educators' views.

1.1 Digital Technology in ECEC

In the past twenty years, the definition of digital technology has evolved to include multimedia devices such as tablets, mobile phones, mobile toys or digital books, content of which is designed to support a variety of children's skills, in many subject areas, including literacy (e.g. Hoel & Tønnessen, 2019), math, science or citizenship (e.g. Gardner-McTaggart & Palmer, 2018), both at primary, secondary and university levels. In the case of early use of digital technology by young children aged 1–5 years, the importance of analogue, non-digital interactions continue to be emphasized for children's holistic development (Palaiologou et al., 2021). The international consensus is that for children under the age of two, digital technology adds little value to their learning (Lawrence & Choe, 2021). However, for children aged two and older, digital technology can add value as long as it is used together with the caregiver (parent or educator) and as long as the design of the digital technology is developmentally appropriate (Radesky & Hiniker, 2021).

Building on the rich literature on children's everyday play experiences with diverse technologies, both at home and in ECEC (e.g. Alvestad et al., 2017; Arnott et al., 2020; Kewalramani et al., 2020; Kewalramani et al., 2023; Lafton, 2019), the affordances of specific technologies for pedagogy have been highlighted by studies of ECEC pre-service and in-service educators (e.g. McKenney & Voogt, 2017; Zipke et al., 2019). Spiteri and Rundgren's (2020) review of 27 articles on the status quo of technology use in ECEC established the importance of educators' professional development in digital technology use, as well as its further development during classroom practices. Their findings replicated earlier studies that established the need for educators' training in digital technology use and the importance of capitalizing on educators' interest in using digital technology for information management, communication, content creation and problem solving (Spiteri & Rundgren, 2020). In particular, children's everyday experiences with technology at home need to be bridged with effective pedagogical use of technology in ECEC (e.g. Alvestad et al., 2017; Edwards et al., 2020).

These findings have been echoed in several other studies. For example, in Austria, Pözl-Stefanec (2021) showed that early childhood educators require effective instruction in using online professional development program to address compelling topics in early childhood education relevant to the educators' practices (Pözl-Stefanec, 2021). The barriers for effective professional development have been traced back to a disconnect between the

educational contexts and educators' knowledge and beliefs (Undheim, 2022). Educators' knowledge is often recognized as an important ingredient in technology integration into a play-based pedagogy such as in ECEC, however, according to Edwards et al. (2020) and Vidal-Hall et al. (2020), the educators' pedagogical beliefs and practices are as important as their knowledge.

Various policy documents show that there is a notable absence of guidance on effective pedagogy concerning technology use and ECEC professionals' digital competence development and related professional learning opportunities (Dardanou et al., 2023; Erstad et al., 2021; Thorpe et al., 2015). And yet, ECEC educators are the primary gatekeepers when it comes to providing access to children's use of resources, including digital media. Their attitudes towards digital technology use and their facilitation of children's learning and play with digital technology are therefore crucial (Fotakopoulou et al., 2020).

In particular, it is important to understand the factors that support educators' focus on an active and creative use of digital technology, and follow an age-appropriate educational approach, which positions children as active participants in their own knowledge development (Dardanou et al., 2023; Palaiologou et al., 2021; Radesky & Hiniker, 2021). Research also shows that effective early childhood educators use the concept digital resilience, which can be developed through an active use of digital technology together with vulnerable populations (see OECD, 2023). Indeed, the latest OECD report highlights both the opportunities and risks associated with digital technology and acknowledges that while it is not possible to eliminate risk completely, it can be reduced with appropriate support for developing digital competence and providing children with varied experiences, in a social community (OECD, 2023). These ideas informed our initial understanding of possible ontological beliefs among the Norwegian ECEC educators, which we probed in an empirical study.

1.2 Study Aims

While the links between young children's use of technology and learning effects are relatively well-established in the international literature, less is known about educators' perceptions and beliefs regarding young children's technology use in specific contexts. We aimed to explore the perceptions of educators working in ECEC in Norway, guided by the following research questions:

- Which ontological beliefs do educators hold about using technology in ECEC?
- What are the possible reasons for these ontological beliefs?

By ontological beliefs we mean attitudes, perceptions and views that are bound by a knowledge-based stance on understanding a phenomenon (Chandrasekaran et al., 1999). We focused on ontological beliefs because they provide valuable knowledge that can contribute to a more comprehensive understanding of the professionals' perspectives and practices in ECEC. Ontologies offer concepts for describing knowledge and enable knowledge-sharing (Chandrasekaran et al., 1999, p. 20). As such, ontological beliefs are different from epistemology, which is concerned with legitimate knowledge and how knowledge is created (Bartlett & Burton, 2016, p. 37). By understanding the ontological beliefs of a group of professionals in a specific context, we can derive broader understandings of perceptions present in the ECEC field.

Even though most Norwegian ECEC have implemented a variety of technological tools for their practice, the actual digital practice varies from setting to setting (Naper et al., 2022). Furthermore, there is a need for greater pedagogical competence concerning technology integration amongst Norwegian educators (Naper et al., 2021). Our research aims were thus driven by the need to support existing practice as well as to develop insights that could be used for future professional development training for educators.

1.3 The Norwegian ECEC Context

Norwegian ECEC settings (kindergartens) cater for children from birth to age five. Norwegian kindergartens are characterized by a socio-cultural perspective on learning and play and child-centred pedagogy (Directorate for Education and Training, 2017). The attendance of kindergartens is not compulsory for Norwegian children but has since 2006 been described as the first step in the educational process (Kunnskapsdepartementet, 2008)¹. Approximately 88% of children in Norway attend an ECEC setting before the age of two (Statistics Norway, 2024). Most children are therefore influenced by the pedagogy and practices they encounter in ECEC settings, and this includes practices linked to technology use. The current government strategy for ECEC quality emphasizes high-quality educational digital practice (Kunnskapsdepartementet, 2023), although it does not, as yet, specify how such a high-quality practice should be achieved.

Norwegian ECEC position the unique worth of childhood, children's active participation in society, group activity, and democracy as its core values (Directorate for Education and Training, 2017). The *Framework plan for the content and tasks of kindergartens* (Directorate for Education and Training, 2017) outlines various ways in which educators can support children's development and promote learning through play and everyday group activities, based on the children's interests and previous experiences. The Framework Plan does not have specific learning goals or outcomes for the children and purposefully avoids the use of words *teach* or *educate*. Learning is understood as something that happens in everyday situations, through communication, interactions, and play: 'Care, formative development, play, learning, social skills and communication and language processes shall be seen in context, and together they shall contribute to the children's all-round development' (Directorate for Education and Training, 2017, p. 19). The use of digital technology is described as an active engagement with the tools aligned with the playful pedagogy where emphasis is placed on children's choices and play rather than a didactic management of learning (Løndal & Greve, 2015): 'Digital practices in kindergarten shall encourage the children to play, be creative and learn' (Directorate for Education and Training, 2017, p. 44). The approach requires educators to be able to use digital technologies with children actively and based on children's premises, while contributing to children's holistic development. It is against this backdrop that we explored what educators working in Norwegian ECEC believe about the value of using technology with young children.

Previous research showed that Norwegian ECEC educators describe children's learning as a complex process, which should stimulate the children's individual development during different activities so that the children continuously develop new knowledge and master various challenges (Alvestad, 2012). This child-centred 'here-and-now' perspective exposed by the ECEC educators stands in contrast to a more future-oriented perspective on

¹ Children in Norway start in compulsory school at the age of six.

early learning that emphasizes academic progress and is pursued in many non-Scandinavian countries (see e.g. Berge, 2012; Säljö, 2022). The ‘here-and-now’ and future-oriented perspectives are not mutually exclusive and can be combined through a focus on lifelong learning, where both present and future horizons are central (Berge, 2012). We consider children’s experiences with well-designed technologies (Radesky & Hiniker, 2021) to be important ‘here-and-now’, as they are embedded in everyday contexts now, and are also crucial for children’s future interactions and meaning-making in the world.

1.4 Socio-cultural Perspectives

Nested in socio-cultural perspectives (Vygotsky, 1987) and the related concepts of dialogue in thinking (Mercer & Littleton, 2007) and dialogic teaching in classrooms (Mercer & Howe, 2012), we understand knowledge construction as a dynamic process of meaning-making in dialogue with others. This relates to individual meaning-making and collective learning and the development of ideas through collective as well as individual efforts (Mercer & Littleton, 2007).

Drawing on socio-cultural perspectives, interaction with other people serves as a key resource to support development and learning (Dysthe, 2001; Säljö, 2016). What is learned and the knowledge constructed depend on the context in which the learning takes place. Language and communication play a pivotal role in the cognitive development of learners, transforming them into critical problem-solvers as they actively engage in various forms of communication within their communities (Dysthe, 2001; Säljö, 2016). It is this theoretical understanding of learning that guided the conceptualisation of our study and its implementation in the Norwegian ECEC context.

2 Methodology

2.1 Research Design

Based on the socio-cultural theory (Vygotsky, 1987) and dialogical learning frameworks (Mercer & Howe, 2012; Mercer & Littleton, 2007), we understand knowledge as a dynamic process of meaning-making in dialogue with others. Applied to our context of ECEC educators and their beliefs concerning technology use, socio-cultural dialogic theories foreground the principle of a learning network (Mercer & Howe, 2012), where individual professionals draw on collective knowledge and expertise-sharing in building their ontological beliefs. Inspired by previous investigations of learning networks that draw on a dialogic knowledge exchange (e.g. Comeaux, 1995), we initiated a workshop-based qualitative workforce development network. This network connected researchers, educators and future classroom labs in the south and north of Norway for two years. The participants were recruited through established regional workforce-development networks, in line with the focus of the Norwegian Ministry of Education and Research (Kunnskapsdepartementet, 2017, 2022) on ECEC-based collective competence development. So that the educators’ professional development in digital technology use remains sustainable, there needs to be communication and collaboration at several levels of the ECEC system. We therefore adopted a holistic approach to the workshop-based qualitative workforce development network and in addition to ECEC

educators, invited administrators, leaders, coordinators and policy-makers. This inclusive strategy recognizes the collaborative effort required from all stakeholders for successful integrated technology implementation in early childhood settings (Howard, 2019).

We conceptualized the workshops as encompassing tasks to be carried out by the educators alone, as well as in conversation with their colleagues and leadership teams. The program centred around four workshops, supplemented by continuous communication with educators in between each session. The workshops followed the enquiry-oriented model originally put forward by Siegel (1995) as a means of involving learners in perceiving themselves as knowledge makers and problem solvers. In this model, the learners' active role is driven by an enquiry approach and is supported with multiple and multimedia ways of knowledge representation. Our focus was on understanding what the ECEC educators in their settings currently do and what they could do with digital technology. We aimed to inspire them with innovative approaches, both in theory and by providing access to cutting-edge technologies available through our future classroom labs at universities. The content for the workshops was based on our understanding of latest research but was supplemented with the educators' own requests for specific content. Unlike previous research (e.g. Kaliisa & Dolonen, 2022), we did not follow a co-design process or observation of use of a specific technology but instead focused on a variety of possible technologies that the educators had, or wished to have, experience with.

2.2 Data Collection and Analysis

In this article we draw on data collected in the southern region of the learning network during the first workshop in the network. During the first workshop, we conducted group-reflections with four to five participants in each group (see Table 1 for participants' details). The group-reflections, which lasted approximately 40 min each, were recorded and transcribed. In these group-reflections, the educators discussed enabling and hindering factors in using digital technology in ECEC.

We understand group discussions as a multidimensional construct in studying educators' perspectives and actions (Moore-Russo & Wilsey, 2014). Inspired by Braun and Clarke (2022), we conducted a theory-driven thematic analysis of transcripts from the audio-recorded group discussions (Mercer & Howe, 2012; Mercer & Littleton, 2007). This consisted of paying attention to the values of individual meaning-making and collective

Table 1 Presentation of the participants in the group discussions

Group 1	Group 2	Group 3
Female teacher, ECEC2, municipality owned	Female teacher, ECEC1, municipality owned	Female teacher, ECEC2, municipality owned
Male teacher, ECEC3, municipality owned	Female assistant, ECEC2, municipality owned	Female assistant, ECEC3, municipality owned
Female teacher, ECEC5, private owned	Male teacher, ECEC5, private owned	Female teacher, ECEC4, municipality owned
Female teacher, ECEC6, private owned	Female teacher, ECEC6, private owned	Male teacher, ECEC6, private owned
		Male digitization consultant

learning in dialogic knowledge construction and the development of ideas through collective as well as individual efforts (Mercer & Littleton, 2007).

2.3 Ethics

The study was approved by the Norwegian Centre for Research Data (now Sikt) and was carried out in line with national guidelines for research ethics (NESH, 2022). All participants have given their informed consent to have their conversations recorded and analysed for publication purposes. Trust, loyalty and confidentiality are important for us; thus, all identifiers are anonymized, to ensure the participants' confidentiality. We shared preliminary data with the educators to ensure that our interpretation was in line with their intended meanings. No changes were suggested by the educators, and they expressed a strong desire to continue the network upon the study completion.

3 Findings

Our thematic analysis of transcribed group reflections in ECEC highlighted diverse ontological beliefs that educators hold about technology use with children. We further explored the underlying reasons for these beliefs, considering facilitating and inhibiting factors, drawing on the socio-cultural knowledge construction framework (Dysthe, 2001; Säljö, 2016) and principles of dialogue (Mercer & Howe, 2012; Mercer & Littleton, 2007; Vygotsky, 1987). We critically examine these reasons, paying attention to the participants' ontological backgrounds and assessing how these beliefs might have broader shared implications or be distinctive within the specific Norwegian child-centred curricular context.

3.1 Educators' Ontological Beliefs about Technology use with Children

The educators recognized the need for diversity and individualization of learning by citing several examples of how they themselves facilitate technology use in their ECEC setting. For example, they provide individual technologies tailored to each child's specific needs and interests. In Group 1, an educator commented that she uses various digital tools with various ages, as it is 'not the same thing to use technology with a one-year-old and with a preschooler' (teacher, ECEC6). In Group 2, a participant outlined how she uses Bee Bots² and Kubo³ with the youngest ones, two-year-olds, but not with other children, as it would not suit their interests (teacher, ECEC1).

This practice was set in contrast with the educators' reflection around the need to accommodate all children's experiences with digital technology and how educators should facilitate it. An educator from Group 1 offered that there should be some standards, so that all children get equal experiences with digital technology:

² Bee Bots and Blue Bots are programmable floor robots from TTS, aimed for kindergarten children. More information here: <https://www.tts-international.com/>.

³ KUBO is an educational coding solution from KUBO Robotics ApS, aimed for children from 4 to 10 years old. More information here: <https://kubo-robot.com/>.

Some standards so that, what is being offered to the children will not be very different depending on who you have your children with. So if they [the children] end up in that group, they get a load of challenges on the digital front but if they end up in another group, they get almost nothing. This is in a way something that is very challenging. (Group 1, teacher, ECEC3)

The educators clearly felt the responsibility of being a facilitator of shared and equal experiences for all children, particularly because not all children have equal access to technology at home. As one educator articulated it:

We can be a provider of healthy digital use and to something that is more productive than what often happens at home for the children. (...) In addition, we can be an equalization factor in the society, as it is stated in the ECEC's mandate. (Group 3, teacher, ECEC6)

This desire for equal experiences and the educators' perceived responsibility for facilitating it through their pedagogy, was somewhat challenged when technology had been introduced into the setting. The educators highlighted the individual learning possibilities, but at the same time they recognized that technology could increase differences between children.

The clear hindering factor were the daily routines in ECEC that had been designed to accommodate all children.

I think that in ECEC we are concerned with rhythm in a way and routines. At least I think like that, where in the daily rhythm could I put in the digital activity? (Group 2, teacher, ECEC6)

These hindering factors were contrasted with the unique way in which ECEC could incorporate digital technology to support all children, particularly in light of ECEC settings' focus on free play and the playful character of digital technology.

We should not be afraid of it, we must learn and wonder together with the children, we do not need to master everything at once... we are not superheroes... we can be a little open with the children, and tell them that this we will find out together. (Group 2, teacher, ECEC5)

3.2 Possible Reasons for the Educators' Ontological Beliefs

Our thematic analysis of group reflections unveiled various enabling and hindering factors related to technology use in ECEC. The educators expressed a clear understanding of the necessity for young children to be exposed to pedagogical experiences with digital technology. There was an agreement among the groups on multiple factors influencing both the facilitation and hindrance of technology use, including access to technology, material and resources, rapid technology development, financial aspects, infrastructure of support, competence, motivation to learn, confidence and system that is necessary for all to use the same technology. These factors were then grouped into two subthemes – individual and collective

reasons – that subsume nine meaning units, as summarized in Table 2. We illustrate each theme with representative quotes from the participants.

3.2.1 Individual Reasons

Competence, confidence and motivation were highlighted as important individual factors by the educators and were described as both hindering and enabling factors connected to the educators’ facilitation of digital technology use. There was consensus among the three groups that children and educators need to build competence and confidence by using digital technology, but that it can be hard to know what to do and how to do it at the beginning.

Not everyone knows digital stuff. (Group 1, teacher, ECEC6)

Knowledge, I think that is often what is needed, that you acquire some knowledge, and that you take the initiative for it on your own. (Group 1, teacher, ECEC3)

But it is clear that as time progresses, it really requires that everyone keeps up with the technological development, it is not just one person who has to keep up with it. (Group 1, teacher, ECEC3)

Most of the participants in this study commented positively on the use of digital technology and were interested and eager to learn more about it. Several of the participants talked about how they had used their private time to seek out information on how to use, for example, a robot or an app and learnt to do it by themselves. However, they also named age and lack of personal interest to learn something new as individual hindering factors for some of their colleagues’ lack of engagement with technology in the setting.

It varies a lot and depends in a way on which ECEC setting and which group and who the staff are... you can work with someone who wants to try, and then you can meet someone who has worked there for 30–40 years and who does not want to learn something new. (Group 2, teacher, ECEC2)

That inner motivation, if that is not in place then it is hard. (Group 1, teacher, ECEC3)

Not everyone would have bothered to seek it out either. (Group 2, teacher, ECEC6)

Some participants also saw digital technology as a possibility to get access to greater choice of content, such as a larger variety of children’s digital books.

Table 2 Educators’ perceptions of enabling and hindering factors for technology use in ECEC

Individual reasons	Collective reasons
Age and flexibility	System – infrastructure of support
Competence	Access
Motivation	Time
Confidence	Rapid technology development
	Financial aspects

So it is much easier for an ECEC setting that, for example, does not have room for a large library of books that you can have them on an iPad. You save space, and, yes, if you send digital drawings home, you save a few piles of paper. (Group 1, teacher, ECEC5)

The ease of documentation was emphasized, particularly in digital formats, facilitating tasks such as digitally sharing children's artwork with parents. Both digital communication with parents and internal digital communication within the ECEC settings were underscored as enabling factors, recognized for their associated benefits. All these reasons can be thematically summarized as centring on the individual and individual learning. In contrast, when discussing time and system related to technology use, the educators saw them as hindering factors that can be traced back to collective learning.

3.2.2 Collective Reasons

The educators acknowledged the time-consuming nature of facilitating sufficient learning activities with digital technology. Recognizing that learning and knowledge construction require time, individual educators interested in digital technology can and should allocate the necessary time for learning. Additionally, the process of transferring knowledge from an individual to a group also demands considerable time.

It's about time again, but then we sat for an hour and a half and kept on practicing [with digital technology]. (Group 2, assistant, ECEC2)

I can't show how the technology works to the others [colleagues] because it is that time again. (Group 2, teacher, ECEC1)

To have someone who sets focus and sets an agenda, setting aside enough time [is important]. (Group 2, teacher, ECEC1)

Some of the educators indicated that they were able to practice and learn to use technology during working hours, while others explained that they had spent time at home. This illustrates that there was a mixed view of how to prioritize time to facilitate both individual and collective learning about technology use.

But I still think it illustrates the point, that you have decided to dedicate some hours [of your private time] to learn this, and if you had not done so, you probably would not have been able to use digital technology the way you do with the children in ECEC. (Group 3, teacher, ECEC6)

Some of the participants explained that they had used staff meetings to provide a playful learning experience with digital technology and thus develop the staff's own digital competence and confidence: 'We had a staff meeting, in which we set aside time to play with the technology' (Group 3, teacher, ECEC4). There was consensus among the groups that it is important also for the educators to play with the technology, to learn how it works and how it can be used.

Some of the educators saw the solution to limited time in appointing one person responsible for technology in each setting. However, this idea was also problematized, as highlighted in this extract:

But he alone who is in charge then, he is engaged and busy with his group, he does not necessarily have the capacity to walk around the whole ECEC and help another group. (Group 3, teacher, ECEC6)

A support team was seen as a systemic solution to building each staff member's competence and confidence but also to being able to maintain the administration tasks connected to technology use in ECEC settings.

Administrative tasks related to technology, yes, that is demanding, either to create a structure that **everyone** in the ECEC setting can use, and also, who is responsible for it. (Group 3, teacher, ECEC6)

The groups also highlighted hindering factors related to charging the equipment and making sure it was ready to use for the next activity. Several participants highlighted the need for the development of a rigorous support system that would rely on collective expertise to manage, maintain and use the technology.

Another collective factor was the financial aspect: most of the participants described access to technology as a factor constrained by limited funds in ECEC. According to some of the participants, they hardly have access to any digital technology in their setting and this was a clear hindrance.

I kind of feel already the first challenge is that we have nothing. We have an iPhone for my group [of children] to use. And we have an iPad, but it has not been used. (Group 2, teacher, ECEC6)

It is that... that things cost, technology is not free. (Group 1, teacher, ECEC5)

The dilemma about what equipment you should have, how often you should buy new, and how much you should have. And then you have the challenge of whether it is charged, whether it will be prepared for the next activity and stuff like that. (Group 3, teacher, ECEC6)

In one municipality, however, the educators mentioned having access to various digital technologies in their settings as well as a functioning infrastructure of support from pedagogical IT personnel. They described the infrastructure of support as helpful, both technological and pedagogical, for example, when deciding what equipment to buy.

4 Discussion

The analysis of the participants' group reflections highlights two tensions between individual and collective reasons for using digital technology in ECEC. We see a tension between the educators' ontological beliefs of children's individual use and collective experiences with digital technology. We also see a tension between the educators' own individual and collective learning and knowledge construction. The theoretically-driven subthemes – the individual and collective reasons – are nested within broader socio-cultural themes or perspectives, which are the educators' ontological understandings of how knowledge is made through learning with others (Mercer & Howe, 2012; Mercer & Littleton, 2007; Vygotsky, 1987). We propose that the reasons for these views can be traced back to the ontology of individualization/standardization and technology as a tool for play and learning. Here we see a direct link between the values embedded in the Norwegian Framework Plan (Directorate for Education and Training, 2017) and the special role of ECEC in supporting holistic learning, collective experiences and achievement of *all* children. We elaborate on these reasons below, together with some links on recently published literature on the topics of early childhood and use of technologies.

The educators acknowledged that technology enhances children's learning and provides access to diverse experiences when used effectively, aligning with findings from other studies (Fotakopoulou et al., 2020; Radesky & Hiniker, 2021; Spiteri & Rundgren, 2020). The educators perceived technology use as most positive when they could identify special moments for individual children to use technology in small chunks of time (for example a bit of coding in the morning). They also saw it as being especially relevant for children above the age of two, which connects to international research on infants' technology use (Kucirkova & Zuckerman, 2017). These benefits of technology use in early childhood are not always visible in the public debate about children and technology, especially not when considering the most recent national policies in Sweden and Denmark, which advocate for limited technology use by young children (Viner, 2023).

Yet, at the same time, the educators also saw the individualization as a potential threat to the way collective learning and experiences is promoted in the Norwegian Framework Plan (Directorate for Education and Training, 2017). The role of ECEC is to ensure there are equal opportunities and no big differences for individual children and offer a standardized experience of high-quality to all (Directorate for Education and Training, 2017; Kunnskapsdepartementet, 2023). This mission is difficult when the educators have varied levels of technological competence and when ECEC have varied access to technology – factors recognized also in previous international studies (e.g. Naper et al., 2022; Naper et al., 2021; Radesky & Hiniker, 2021; Thorpe et al., 2015), and in analyses looking at digital inequity globally (e.g. Murriss et al., 2023).

The analysis of the group reflections also shows that there was a synergy across the groups in terms of the enabling and hindering factors they identified for technology use in early childhood, summarized as individual reasons (age and flexibility, competence, motivation, confidence) and collective reasons (systematic, access, time, technology development, financial aspects) (Table 2). However, the analysis shows that the enabling factors were to a great degree overshadowed by the hindering factors, and we identified *time* as the key reason for the individual-collective tensions. Developing high-quality pedagogical experiences for children takes time and the educators fear they do it wrong. It takes time to con-

stantly learn new things with rapidly evolving technology and the time to learn is different for older and younger members of society. In an evaluation report of the implementation of the Norwegian Framework Plan, time was recognized as the most important factor that could limit implementation; 60% of Norwegian ECEC directors reported that time limited the possibilities for implementation to a large or very large extent (Lotsberg et al., 2020, p. 163). Moreover, for individualized learning to become collective it takes time to build relationships in various contexts. Educators who are early adopters need time to share their competence with others and they expect time to push others to adopt digital technology too. According to the participants, it is hard to find time to develop the knowledge among the educators so that they are competent and confident in using digital technology with the children, but it is also hard to find time to use digital technology directly with the children: ‘Where in the daily rhythm could I put in the digital activity?’ (Group 2, teacher, ECEC6).

While the participants recognized and celebrated individualized use of technology with the children, they did not see that for themselves and expected systematic changes to ensure everyone was digitally competent. They talked about the need for systematic systems of modelling examples of pedagogical activities with digital technology; a finding also noticed by other researchers (e.g. Zipke et al., 2019). This might have to do with a longtime focus on ECEC-based collective competence development through national competence development strategies in Norway (Kunnskapsdepartementet, 2013, 2017, 2022). There has been some literature about the importance of introspection for ongoing digital competence development, but the focus has been on students (e.g. Perry et al., 2015) rather than educators. Our study adds some new insights into this literature as it suggests that ECEC educators perceive the system as an important support mechanism for their development of digital competence.

Following our theoretical framework, we propose that the ECEC context is subject to a tension between individual and collective reasons for using digital technology with children, because of the focus on children’s play and holistic view of children’s learning and development (Directorate for Education and Training, 2017), and the contrasting future-oriented view and more narrowly defined focus on skills, of digital technology (Williamson & Komljenovic, 2023). Many educators regard technology as a tool for play, emphasizing a hybrid or converged view of children’s contemporary play (Edwards et al., 2020; Vidal-Hall et al., 2020). However, the frequently routinized everyday activities in ECEC conflict with the time required for learning and experimenting with digital technology, particularly regarding the educators’ development of competence in using digital technology with children.

5 Conclusion

In this article we analysed the reflections of a group of Norwegian ECEC educators regarding: (1) the ontological beliefs they hold about using technology in ECEC and (2) the possible reasons for these ontological beliefs. Nested in the socio-cultural theory and the related concepts of dialogue in thinking (Mercer & Littleton, 2007) and dialogic teaching in classrooms (Mercer & Howe, 2012), this study positioned knowledge and technology as dynamic meaning-making processes in Norwegian ECEC settings.

The analysis showed that the educators highlighted the need for young children to be offered pedagogical experiences of high quality with digital technology, by drawing on both

individual and collective reasons. Furthermore, the analysis showed that these subthemes intersect and are embedded into the educators' ontological understandings of using digital technology at a young age. On the one hand, the educators recognized that technology enriches children's learning and offers access to diverse experiences, when used well. On the other hand, the educators also saw individualization as a potential threat to collective experiences.

In this study, we contribute to current literature through a qualitative exploration of the ontological beliefs held by Norwegian early childhood educators engaged with technology and young children on a daily basis. By comprehending the ontological beliefs within this specific group of professionals, we aim to derive broader insights into perceptions prevalent in the ECEC field. Our study is limited by focusing on one context – the Norwegian ECEC – and the views of educators working within that context. While we tried to mitigate this limitation by involving educators from two regions in Norway and working at various levels within the kindergarten context, our findings are constrained to this specific group of participants. Future research could extend our study to include more diverse participants, encompassing perspectives from within Norway, the broader Scandinavian context, and internationally, where diverse approaches to early childhood education exist.

Considering the urgent need to bolster current practices and facilitate future professional development in the use of technology for young children (1–5-year-olds) in Norwegian ECEC, we highlight *time* as a critical factor contributing to the individual-collective tensions identified in participants' accounts. Educators require time to create meaningful experiences with digital technology for all children, as well as time for their individual and collective learning. The constrained availability of time might jeopardise educators' ability to perform these tasks effectively.

Abbreviations

ECEC Early childhood education and care

Acknowledgements We thank the educators who participated in this study and so willingly shared their knowledge and thoughts with us.

Funding The research reported in this article was supported by the FILIORUM Centre for Research in Early Childhood Education and Care at University of Stavanger (<https://www.uis.no/en/research/filiorum-centre-for-research-in-early-childhood-education-and-care>), project grant no. 275576.

Open access funding provided by University of Stavanger & Stavanger University Hospital

Declarations

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

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References

- Alvestad, M. (2012). Førskolelærere om læring i barnehagen – spor av læringskulturer [Preschool teachers about learning in kindergarten – traces of learning cultures]. In T. Vist & M. Alvestad (Eds.), *Læringskulturer i barnehagen: Flerfaglige forskningsperspektiver* (pp. 67–89). Cappelen Damm Akademisk.
- Alvestad, M., Jernes, M., Knaben, A. D., & Berner, K. (2017). Barns fortellinger om lek i barnehagen i en tid preget av moderne medier [Children's stories about play in kindergarten in a time characterised by modern media]. *Norsk Pedagogisk Tidsskrift*, *101*(01), 31–44. <https://doi.org/10.18261/issn.1504-2987-2017-01-04>
- Arnott, L., Kewalramani, S., Gray, C., & Dardanou, M. (2020). Role-play and technologies in early childhood. In Z. Kingdon (Ed.), *A Vygotskian analysis of children's play behaviours: Beyond the home corner* (pp. 76–92). Routledge.
- Bartlett, S., & Burton, D. (2016). *Introduction to education studies* (4th ed.). Sage.
- Berge, A. (2012). Barnehagens læringskulturer – underveis mot vekslende læringshorisonter [Kindergarten's learning cultures: Towards changing learning horizons]. In T. Vist, & M. Alvestad (Eds.), *Læringskulturer i barnehagen: Flerfaglige forskningsperspektiver* (pp. 44–66). Cappelen Damm Akademisk.
- Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE.
- Chandrasekaran, B., Josephson, J. R., & Benjamins, V. R. (1999). What are ontologies, and why do we need them? *IEEE Intelligent Systems and Their Applications*, *14*(1), 20–26. <https://doi.org/10.1109/5254.747902>
- Comeaux, P. (1995). The impact of an interactive distance learning network on classroom communication. *Communication Education*, *44*(4), 353–361. <https://doi.org/10.1080/03634529509379024>
- Dardanou, M., Unstad, T., Brito, R., Dias, P., Fotakopoulou, O., Sakata, Y., & O'Connor, J. (2020). Use of touchscreen technology by 0–3-year-old children: Parents' practices and perspectives in Norway, Portugal and Japan. *Journal of Early Childhood Literacy*, *20*(3), 551–573. <https://doi.org/10.1177/1468798420938445>
- Dardanou, M., Hatzigianni, M., Kewalramani, S., & Palaiologou, I. (2023). Professional development for digital competencies in early childhood education and care: A systematic review. *OECD Education Working Papers*, *295*. <https://doi.org/10.1787/a7c0a464-en>
- Directorate for Education and Training (2017). *Framework plan for kindergartens: Regulations on the Framework plan for the content and tasks of kindergartens*<https://www.udir.no/contentassets/5d0f4d947b244cfe90be8e6d475ba1b4/framework-plan-for-kindergartens--rammeplan-engelsk-pdf.pdf>
- Dysthe, O. (2001). Sosiokulturelle teorperspektiv på kunnskap og læring [Socio-cultural theory perspectives on knowledge and learning]. In O. Dysthe (Ed.), *Dialog, samspel og læring* (pp. 33–72). Abstrakt forlag.
- Edwards, S., Mantilla, A., Grieshaber, S., Nuttall, J., & Wood, E. (2020). Converged play characteristics for early childhood education: Multi-modal, global-local, and traditional-digital. *Oxford Review of Education*, *46*(5), 637–660. <https://doi.org/10.1080/03054985.2020.1750358>
- Erstad, O., Kjällander, S., & Järvelä, S. (2021). Facing the challenges of 'digital competence'. *Nordic Journal of Digital Literacy*, *16*(2), 77–87. <https://doi.org/10.18261/issn.1891-943x-2021-02-04>
- Fotakopoulou, O., Hatzigianni, M., Dardanou, M., Unstad, T., & O'Connor, J. (2020). A cross-cultural exploration of early childhood educators' beliefs and experiences around the use of touchscreen technologies with children under 3 years of age. *European Early Childhood Education Research Journal*, *28*(2), 272–285. <https://doi.org/10.1080/1350293X.2020.1735744>
- Gardner-McTaggart, A., & Palmer, N. (2018). Global citizenship education, technology, and being. *Globalisation, Societies and Education*, *16*(2), 268–281. <https://doi.org/10.1080/14767724.2017.1405342>
- Hoel, T., & Tønnessen, E. S. (2019). Organizing shared digital reading in groups: Optimising the affordances of text and medium. *AERA Open*, *5*(4), 1–14. <https://doi.org/10.1177/2332858419883822>
- Howard, N. R. (2019). EdTech leaders' beliefs: How are K-5 teachers supported with the integration of computer science in K-5 classrooms? *Technology, Knowledge and Learning*, *24*, 203–217. <https://doi.org/10.1007/s10758-018-9371-2>
- Kaliisa, R., & Dolonen, J. A. (2022). CADA: A teacher-facing learning analytics dashboard to foster teachers' awareness of students' participation and discourse patterns in online discussions. *Technology, Knowledge and Learning*, 1–22. <https://doi.org/10.1007/s10758-022-09598-7>
- Kewalramani, S., Palaiologou, I., Arnott, L., & Dardanou, M. (2020). The integration of the internet of toys in early childhood education: A platform for multi-layered interactions. *European Early Childhood Education Research Journal*, *28*(2), 197–213. <https://doi.org/10.1080/1350293X.2020.1735738>
- Kewalramani, S., Palaiologou, I., & Dardanou, M. (2023). *The integration of internet of toys in early childhood education: Research from Australia, England and Norway*. Routledge. <https://doi.org/10.4324/9781003185840>

- Kucirkova, N., & Zuckerman, B. (2017). A guiding framework for considering touchscreens in children under two. *International Journal of Child-Computer Interaction*, 12, 46–49. <https://doi.org/10.1016/j.ijcci.2017.03.001>
- Kunnskapsdepartementet (2013). *Kompetanse for framtidens barnehage: Strategi for kompetanse og rekruttering 2014–2020* [Competence for the kindergarten of the future: Strategy for competence and recruitment 2014–2020]. Ministry of Education and Research.
- Kunnskapsdepartementet (2017). *Kompetanse for framtidens barnehage: Revidert strategi for kompetanse og rekruttering 2018–2022* [Competence for the kindergarten of the future: Revised strategy for competence and recruitment 2018–2022]. Ministry of Education and Research. https://www.regjeringen.no/contentassets/7e72a90a6b884d0399d9537cce8b801e/kompetansestrategi-for-barnehage-2018_2022.pdf
- Kunnskapsdepartementet (2022). *Kompetanse for framtidens barnehage: Revidert strategi for kompetanse og rekruttering 2023–2025* [Competence for the kindergarten of the future: Revised strategy for competence and recruitment 2023–2025]. Ministry of Education and Research. <https://www.regjeringen.no/contentassets/60cb8cea7014464a9cbd22bbb2e3664e/no/pdfs/kompetansestrategi-barnehage.pdf>
- Kunnskapsdepartementet (2023). *Strategi for digital kompetanse og infrastruktur i barnehage og skole: 2023–2030* [Strategy for digital competence and infrastructure in kindergartens and schools: 2023–2030]. Ministry of Education and Research. <https://www.regjeringen.no/contentassets/3fc31c3d9df14c4a91db85d3421501e/no/pdfs/strategi-for-digital-kompetanse-og-infrastruktur.pdf>
- Kunnskapsdepartementet (2008). *St.meld nr. 41 (2008–2009) Kvalitet i barnehagen* [White paper no 41 (2008–2009) Quality in kindergarten]. Ministry of Education and Research. <https://www.regjeringen.no/contentassets/78fde92c225840f68bce2ac2715b3def/no/pdfs/stm200820090041000dddpdfs.pdf>
- Lafton, T. (2019). Becoming clowns: How do digital technologies contribute to young children’s play? *Contemporary Issues in Early Childhood*. <https://doi.org/10.1177/1463949119864207>
- Lawrence, A., & Choe, D. E. (2021). Mobile media and young children’s cognitive skills: A review. *Academic Pediatrics*, 21(6), 996–1000. <https://doi.org/10.1016/j.acap.2021.01.007>
- Løndal, K., & Greve, A. (2015). Didactic approaches to child-managed play: Analyses of teacher’s interaction styles in kindergartens and after-school programmes in Norway. *International Journal of Early Childhood*, 47, 461–479. <https://doi.org/10.1007/s13158-015-0142-0>
- Lotsberg, D. Ø., Ludvigsen, K., Nordø, Å. D., & Homme, A. (2020). Barnehagestyrenes erfaring og arbeid med implementering av rammeplanen [Kindergarten managers’ experience and work with implementation of the framework plan]. In A. Homme, H. Danielsen, & K. Ludvigsen (Eds.), *Implementeringen av rammeplan for barnehagen: Undervisningsrapport fra prosjektet Evaluering av implementering av rammeplan for barnehagen* (pp. 143–198). NORCE Samfunn. https://norce-research.brage.unit.no/norce-research-xmlui/bitstream/handle/11250/2736721/Implementeringen_av_rammeplan_for_barnehagen_undervisningsrapport.pdf?sequence=6/isAllowed=y
- McKenney, S., & Voogt, J. (2017). Expert views on TPACK for early literacy: Priorities for teacher education. *Australasian Journal of Educational Technology*, 33(5). <https://doi.org/10.14742/ajet.2502>
- Medietilsynet (2022). *Småbarn og medier – en undersøkelse om 1–5-åringers medievaner* [Young children and media – a survey regarding 1–5-year-olds’ media habits] https://www.medietilsynet.no/globalassets/publikasjoner/barn-og-medier-undersokelser/2022/230629_smabarn-og-medier.pdf
- Mercer, N., & Howe, C. (2012). Explaining the dialogic processes of teaching and learning: The value and potential of sociocultural theory. *Learning, Culture and Social Interaction*, 1, 12–21. <https://doi.org/10.1016/j.lcsi.2012.03.001>
- Mercer, N., & Littleton, K. (2007). *Dialogue and the development of childrens thinking*. Routledge.
- Moore-Russo, D. A., & Wilsey, J. N. (2014). Delving into the meaning of productive reflection: A study of future teachers’ reflections on representations of teaching. *Teaching and Teacher Education*, 37, 76–90. <https://doi.org/10.1016/j.tate.2013.10.002>
- Murris, K., Scott, F., Thomsen, B. S., Dixon, K., Giorza, T., Peers, J., & Lawrence, C. (2023). Researching digital inequalities in children’s play with technology in South Africa. *Learning, Media and Technology*, 48(3), 542–555. <https://doi.org/10.1080/17439884.2022.2095570>
- Naper, L. R., Myhr, A., Janning, L., & Løe, I. (2021). *Spørsmål til Barnehage-Norge 2020: Analyse og resultater fra Utdanningsdirektoratets spørreundersøkelse til barnehagesektoren* [Questions to Norwegian kindergartens 2020: Analysis and results from the Norwegian Directorate for Education and Training’s survey to the kindergarten sector] [Report 2021:00076]. Sintef Digital. https://sintef.brage.unit.no/sintef-xmlui/bitstream/handle/11250/3012953/Barnehagedata_2020.pdf
- Naper, L. R., Myhr, A., & Haugset, A. S. (2022). *Spørsmål til Barnehage-Norge 2022* [Questions to Norwegian kindergartens 2022] [Report 2022:01387]. Sintef. <https://www.udir.no/contentassets/d87e064df76b454ba6948d926bd39b20/rapport-sporsmal-til-barnehage-norge-2022.pdf>

- NESH (2022). *Guidelines for research ethics in the social sciences and the humanities* (5th ed.). The Norwegian National Research Ethics Committees. <https://www.forskningsetikk.no/en/guidelines/social-sciences-and-humanities/guidelines-for-research-ethics-in-the-social-sciences-and-the-humanities/>
- OECD (2023). Starting strong VII: Empowering Young children in the Digital Age. *OECD Publishing*. <https://doi.org/10.1787/50967622-en>
- Palaiologou, I., Kewalramani, S., & Dardanou, M. (2021). Make-believe play with the internet of toys: A case for multimodal playscapes. *British Journal of Educational Technology*, 52, 2100–2117. <https://doi.org/10.1111/bjet.13110>
- Perry, L., Stoner, L., Schleser, M., Stoner, K. R., Wadsworth, D., Page, R., & Tarrant, M. A. (2015). Digital media as a reflective tool: Creating appropriate spaces for students to become introspective. *Compare: A Journal of Comparative and International Education*, 45(2), 323–330. <https://doi.org/10.1080/03057925.2014.993237>
- Petterson, K., Silseth, K., & Arnseth, H. C. (2022). Rethinking boundaries: Sociomaterial perspectives on digital technologies and early childhoods. In K. Kumpulainen, A. Kajamaa, O. Erstad, Å. Mäkitalo, K. Drotner, & S. Jakobsdóttir (Eds.), *Nordic childhoods in the digital age: Insights into contemporary research on communication, learning and education* (pp. 181–192). Routledge. <https://doi.org/10.4324/9781003145257-19>
- Pözl-Stefanec, E. (2021). Challenges and barriers to Austrian early childhood educators' participation in online professional development programmes. *British Journal of Educational Technology*, 52(6), 2192–2208. <https://doi.org/10.1111/bjet.13124>
- Radesky, J., & Hiniker, A. (2021). From moral panic to systemic change: Making child-centered design the default. *International Journal of Child-Computer Interaction*, 31. <https://doi.org/10.1016/j.ijcci.2021.100351>
- Säljö, R. (2016). *Læring – en introduksjon til perspektiver og metaforer [Learning: An introduction to perspectives and metaphors]*. Cappelen Damm akademisk.
- Säljö, R. (2022). Child development in a digital age: Epistemic practices in media societies. In K. Kumpulainen, A. Kajamaa, O. Erstad, Å. Mäkitalo, K. Drotner, & S. Jakobsdóttir (Eds.), *Nordic childhoods in the digital age: Insights into contemporary research on communication, learning and education* (pp. 11–20). Routledge. <https://doi.org/10.4324/9781003145257-3>
- Siegel, M. (1995). More than words: The generative power of transmediation for learning. *Canadian Journal of Education*, 20(4), 455–475. <https://doi.org/10.2307/1495082>
- Spiteri, M., & Rundgren, S. N. C. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning*, 25, 115–128. <https://doi.org/10.1007/s10758-018-9376-x>
- Statistics Norway (2024). *Kindergartens*. Statistisk Sentralbyrå (Updated 1 March 2024). <https://www.ssb.no/en/utdanning/statistikker/barnehager>
- Thorpe, K., Hansen, J., Danby, S., Zaki, F. M., Grant, S., Houen, S., Davidson, C., & Given, L. M. (2015). Digital access to knowledge in the preschool classroom: Reports from Australia. *Early Childhood Research Quarterly*, 32, 174–182. <https://doi.org/10.1016/j.ecresq.2015.04.001>
- Undheim, M. (2022). Children and teachers engaging together with digital technology in early childhood education and care institutions: A literature review. *European Early Childhood Education Research Journal*, 30(3), 472–489. <https://doi.org/10.1080/1350293X.2021.1971730>
- Vidal-Hall, C., Flewitt, R., & Wyse, D. (2020). Early childhood practitioner beliefs about digital media: Integrating technology into a child-centred classroom environment. *European Early Childhood Education Research Journal*, 28(2), 167–181. <https://doi.org/10.1080/1350293X.2020.1735727>
- Viner, J. (2023). Nordic EdTech Trends. Presented at Nordic EdTech Bootcamp, December 2023, Online.
- Vygotsky, L. S. (1987). *Mind in society: Development of higher psychological processes*. Harvard university.
- Williamson, B., & Komljenovic, J. (2023). Investing in imagined digital futures: The techno-financial 'futuring' of edtech investors in higher education. *Critical Studies in Education*, 64(3), 234–249. <https://doi.org/10.1080/17508487.2022.2081587>
- Zipke, M., Ingle, J. C., & Moorehead, T. (2019). The effects of modeling the use of technology with pre-service teachers. *Computers in the Schools*, 36(3), 205–221. <https://doi.org/10.1080/07380569.2019.1640038>