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Digital Competence in Early Childhood Formal and Informal Education: Findings from a Systematized Review

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ABSTRACT

This article reports on findings from a systematized literature review on digital competence in early childhood (age range, 0-6). Through a quantitative and qualitative analysis of 31 empirical studies, the article provides: 1) a mapping of key information contained in the dataset based on relevant variables inductively and deductively identified (i.e., children's age, type of educational context, type of digital skill, caregiving actors, description of relevant activities, screen time discourse, risks and opportunities discourse, reference to wellbeing); and 2) a narrative in-depth account of digital competence in early childhood in relation to the type of educational context investigated, i.e., formal (nursery and kindergarten) and informal (the home environment). In the conclusion, we argue for the relevance of a Media Literacy approach in formal and informal educational contexts to inform and train significant adults to conscious uses of digital tools and to foster interactive, critical, and creative uses with children.

Keywords: Digital competence; Early childhood; Media Literacy Education; Systematized Literature Review

INTRODUCTION

This article aims to review a corpus of research findings on the relationship between digital media and early childhood specifically in the age range 0-6. Our primary objective is to deepen the understanding and theoretical framing of digital competence in early childhood: how it is defined and what are the core elements considered in the literature, particularly concerning the two significant environments wherein young children can experience relevant opportunities for the acquisition of digital competence, namely formal (nursery and kindergarten) and informal (the home environment) educational contexts. Through a quantitative and qualitative analysis of 31 empirical studies published from 2015 to 2024, this review contributes to the literature on Media Literacy education (see, among others, Hobbs, 2010; Hobbs & Jensen, 2013). By stressing the crucial role of parents as well as nursery and school teachers in supporting the development of young children's critical and creative uses of digital media, insights from this study are relevant not only to families and professionals working with young children, but also to policymakers and researchers.

This article, reporting on findings from a systematized literature review, represents the first step of a broader research project on digital competence in early childhood entitled "Di.Co.Each" and funded by the Next Generation Europe and the Italian Ministry of the University and Research[1] . Relying on a convergent-parallel approach (Creswell, 2014), the project collects new data on young children's experiences with digital media in Italy through focus groups with parents, educators, and paediatricians, and surveys with parents and teachers. Findings from these sources will be compared and triangulated with the present review to promote creative, reflective, and informed uses of digital media at home and in early education.

The following section provides the background and the rationale guiding this review.

BACKGROUND

Over the last few decades, digital technologies have increasingly permeated children's everyday lives. According to a Common Sense Census, nearly all (98%) of US children between the ages of 0 and 8 have access to a mobile device (Rideout, 2017). Recent evidence underscores both the pervasiveness and the evolving nature of young children's digital ecologies. The 2025 Common Sense Census (Mann et al., 2025) reports that by age two, around four in ten children in the United States already own a tablet, and that daily screen use among 0-8-year-olds averages around 2.5 hours, with a growing shift from live televisions to app-based short videos and interactive content. Data from EU Kids Online depicted a similar scenario in Europe, revealing that children ages 9-16 grow up in media-saturated environments, where smartphone use is predominant compared to other media (Smahel et al., 2020). Research in the United Kingdom, such as the Toddlers, Tech & Talk study (Flewitt et al., 2024), shows that 41% of children aged 0–36 months are reported to "own" a tablet, 12% a smartphone, and 8% an internet-connected toy, although interviews reveal that these devices are typically handed down from parents rather than bought specifically for them. This finding complicates simplistic notions of "ownership" and instead points to young children's embedded participation in family media ecologies, where digital tools are shared artefacts circulating within caregiving routines. Across

[1] The project involves 3 partners: the University of Firenze (PI), the University of Bologna, and the University of Rome "La Sapienza".

contexts such as the home, car, restaurants, or public spaces, children engage with digital media through joint activities (e.g., taking photos, co-viewing family videos, video-calling relatives, or playing music) often supported by parents acting as gatekeepers and enablers. These practices suggest that technology use among very young children tends to be relational, situated, and woven into everyday play, communication, and care, rather than a solitary or isolating activity. In Italy, research highlights how early childhood services are increasingly engaging with digital innovation to connect educational and family environments, although to different degrees. Nardone (2025) emphasizes the need to overcome the educational paradox between domestic overuse and institutional resistance to technology, calling for alliances between families and educational services that support children's right to digital media use through creative and critical mediation. Similarly, De Rossi and Ferranti (2025) emphasize the cooperative role of educators, showing that although digital tools are now widely used for documentation and communication with families, fostering transparency and participation, their integration into everyday pedagogical practices remains gradual. Taken together, these studies underscore the importance of an ecological approach, where families, educators, and services collaborate to nurture young children's reflective and developmentally appropriate digital competences.

Even though children's media consumption is by no means an utterly new phenomenon (see Wartella, 2019), the relationship between digital devices and childhood remains highly controversial. The public, as well as scientific debate, is overall polarized around two opposing discourses regarding whether and how children should interact with digital media, with supporters claiming an enthusiastic and optimistic view and opponents embracing a pessimistic stance that echoes moral panic (Drotner, 1999; Wartella & Jennings, 2000). This is particularly true for early childhood. In the late '90s, with the spread of infant-targeted contents, the American Academy of Pediatrics (AAP, 1999) developed screen time guidelines recommending that children under 2 years old should not be exposed to screens at all, and children aged 2 to 5 should have no more than two hours of screen time a day. However, as this warning rarely reflected the daily reality of many families, the AAP (2015) revised its guidelines, acknowledging the impracticability of such strict screen time rules in contemporary media-saturated contexts. In line with studies emphasizing the crucial roles of media content and the contextual features in which child-media interaction occurs (Cino et al., 2020; Lauricella et al., 2017; Su & Yang, 2024), the latest AAP guidelines stress that high-quality educational content can promote young children's learning and development if appropriately scaffolded by parents and teachers as primary caregivers.

The promotion of digital competence in early childhood is also at the core of the European framework DigComp (Ferrari, 2013; Vuorikari, 2022). Within this policy framework, digital competence is defined as a key life skill: the "confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society" (European Commission, 2019, p. 10). While DigComp provides an operational vocabulary for mapping knowledge, skills, and attitudes relevant to digital citizenship, we also draw on the Media Literacy in Early Childhood Framework developed by Herdzina and Lauricella (2020), which offers a pedagogical and developmental orientation focused on inquiry, creativity, and participatory engagement with media. Specifically, the authors define media literacy in early childhood as "the emerging ability to access, engage, explore, comprehend, critically inquire, evaluate, and create with developmentally appropriate media" (p. 8). Their framework advocates these fundamental actions be supported by

caregivers and educators who scaffold children's gradual acquisition of media literacy skills. Rather than alternative paradigms, we see these perspectives as complementary: DigComp delineates what constitutes competence, whereas Media Literacy Education and its early childhood declinations clarify how it can be meaningfully fostered in educational practice. Recent research illustrates this complementarity. In Sweden, early childhood teachers describe "adequate" digital competence as encompassing not only technical fluency but also critical stance, ethical awareness, and problem-solving (Masoumi & Bourbour, 2024). Further evidence from a scoping review indicates that digital pedagogy in early childhood is most effective when it integrates play-based and collaborative practices, encouraging children's creative production and reflective engagement under the guidance of educators (Li et al., 2024). Building on these insights, our review adopts an ecological perspective to interpret how digital competence is enacted in everyday educational contexts, while using DigComp as a structuring framework of reference.

Against this backdrop, the school and home environments are widely acknowledged as the two primary educational contexts for the development of digital competence in early childhood (e.g., Lindeman et al., 2021; Szabó et al., 2024). Despite the relevance of this issue, most reviews have mainly focused on digital competence in K-12 and higher education settings (e.g., Godaert et al., 2022; Zhao et al., 2021). While recent reviews have provided a more comprehensive understanding of digital pedagogy in early childhood settings (e.g., Li et al., 2024; Su & Yang, 2024), research remains fragmented regarding how competences are fostered across the formal (i.e., early childhood education) and informal (i.e., the family) contexts that jointly shape early learning ecologies.

Addressing this gap, this review aims to systematize findings from empirical research on digital competence in early childhood formal and informal education. More specifically, the review is guided by the following research questions:

RQ1: How is digital competence conceived in the studies included in the review?
RQ2: What are the key dimensions of digital competence in early childhood education emerging from the studies included in the review?
RQ3: What are the key dimensions of digital competence in early childhood formal and informal educational contexts emerging from the reviewed studies?

METHODOLOGY

Following Grant and Booth (2009), a systematized review can be understood as an approach positioned between the generic literature review and the systematic review, combining the transparency and procedural clarity of the latter with the interpretive flexibility of the former. Unlike traditional literature reviews, which typically provide limited information on dataset construction and analytical procedures, a systematized review offers a more structured and traceable process. At the same time, it borrows key principles from systematic reviews to document and justify each step of the research protocol, without claiming full representativeness or exhaustiveness. Findings derived from this type of review should be interpreted as context-dependent, in contrast to systematic reviews that aim for exhaustive searching and appraisal of evidence. Yet, as some scholars have argued, this aspiration is epistemologically problematic in itself, since even systematic reviews inevitably entail

contextual and interpretive decisions (Haddon et al., 2023). Because our review was not part of a sequential design, where a first step informs the next, and in line with previous studies conducting systematized reviews (see, among others, Barr-Walker, 2017; Cino, 2021; Mandracchia et al., 2019; Sawka et al., 2013), in order to still provide detailed information about the choices and analysis made compared to a more generic review, we decided to opt for a systematized approach. Our goal was to deepen our understanding and theoretical framing of digital competence in early childhood to develop new questions, ideas, and insights. Our systematization effort aims to provide the reader with information about the generation of our dataset, our inclusion and exclusion criteria, data organization, and analysis while "fostering a commitment to transparency and accountability" (Cino, 2021, p. 856).

Dataset generation

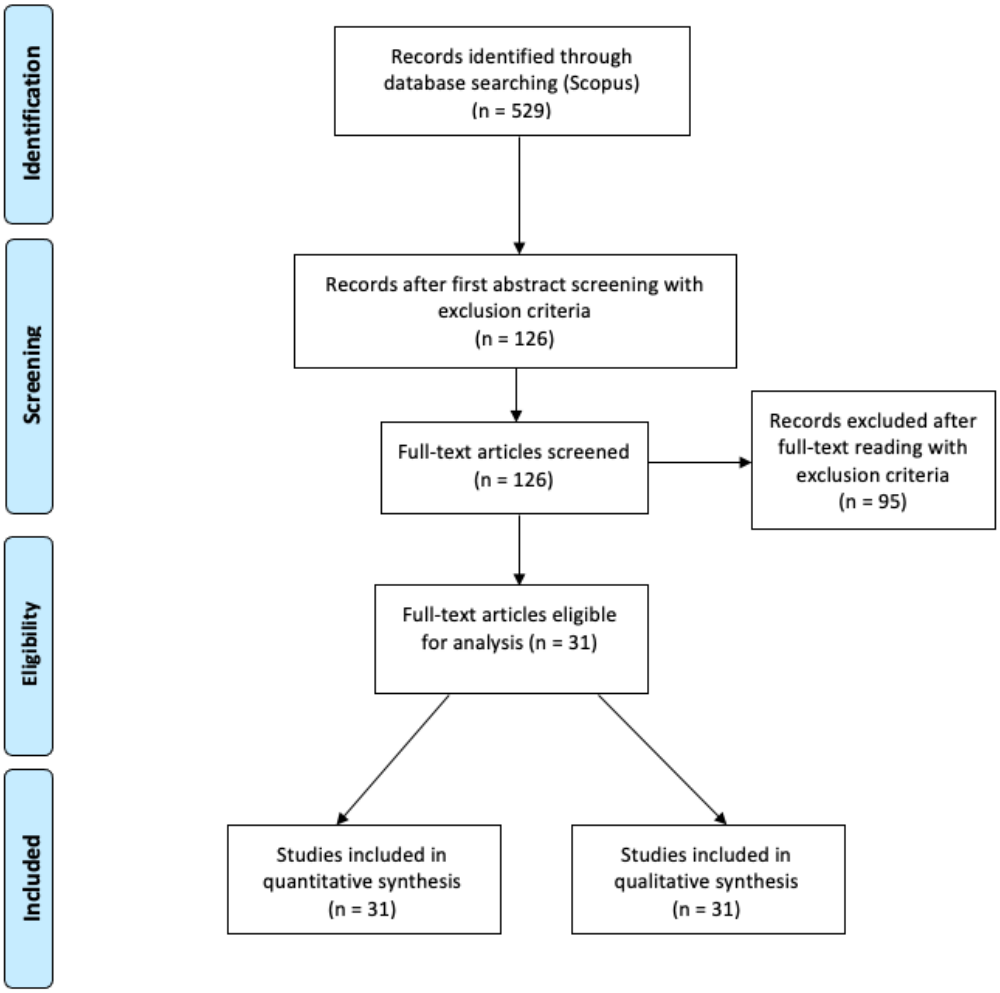
In November 2023, we conducted our search on Scopus, mindful of both the opportunities of our choice (i.e., retrieving good quality peer-reviewed scientific literature within a database allowing for fine-grained filtering) and its limits (e.g., missing pieces of innovative research not indexed in Scopus). Informed by the ySKILLS project (Haddon et al., 2020), we constructed a string of keywords related to relevant semantic areas, using child terms (early AND childhood OR baby OR babies OR toddler* OR preschooler*), parents terms (parent* OR famil*), education terms (education OR educator* OR early childhood education OR media education OR kindergarten OR preschool* OR nursery), methods terms (survey* OR questionnaire* OR meta-analyis* OR quantitative OR empirical OR study OR studies OR finding* OR interview* OR focus group* OR action research OR qualitative OR observation* OR case study), and digital skills terms (digital* skill* OR mobile* skill* OR digital* competen* OR mobile* competen* OR digital* literac* OR mobile* literac* OR media literac*).

A second layer of filters was applied through the Scopus advanced search engine, limiting our search to European countries (to explore what has been done in this specific geographic area), only published materials in English or Italian (in line with our group's language skills), and to disciplines within the human and social sciences field, excluding medical sciences (to have a more grounded educational perspective). This was an iterative process where the research team made several attempts to reach a sample that would align with our epistemic goals and disciplinary background and, simultaneously, manageable.

Figure 1 reports the process following the PRISMA flow diagram (Moher et al., 2009). A total of 529 items were retrieved, and the first filtering was performed. In line with the broader projects' focus on the relationship between digital competence and early childhood in ordinary situations, we left out contributions that a) did not concern the 0-6 age range, b) did not focus on digital competence, c) were merely theoretical/speculative, with no empirical data, d) concerned disabilities, special needs, and special education, e) concerned clinical and not-ordinary situations, f) were deemed out of focus for other inductive reasons. We recognize our criteria define a particular area of knowledge that was, however, the closest to our epistemic goals.

After a first screening of the abstracts, where entries blatantly incompatible with the points above were removed, we were left with 126 entries whose full texts were downloaded, read, and further filtered to ensure they met our criteria. This step led to removing 95 records for a final sample of 31 articles eligible for analysis.

Figure 1 – Prisma flow diagram



Data analysis

In addressing our research questions, we employed both quantitative content analysis and qualitative thematic analysis (Neuendorf, 2019), combining the mapping of key variables with an interpretive, narrative examination of emerging patterns. For the content analysis, we developed a mixed inductive–deductive codebook, refining it iteratively to achieve discursive intercoder agreement through the convergence of multiple perspectives (Cornish et al., 2013). Variables included were:

- *Children's age*: since this variable was reported differently across studies, some of which also included data on older children, yet still provided information relevant to our target range, it was recoded to ensure comparability. We therefore classified each study according to the age group that best aligned with our scope: 0–2, 3–6, or 0–6, treated as mutually exclusive values.
- *Type of educational context the paper focused on*: formal, informal, non-formal (non-mutually exclusive values).
- *Type of digital skills described*: this variable was coded through a mixed deductive–inductive approach, initially drawing on the ySKILLS classification of technical and operational skills, content creation and production skills, communication and interaction skills, and information

and navigation skills (Helsper et al., 2021). The framework was then iteratively adjusted to capture conceptual nuances that emerged inductively from the reviewed literature, reflecting diverse understandings of digital competence in early childhood (non-mutually exclusive).

- *Caregiving actors involved in the study*: parents, educators/teachers, paediatricians, and others (non-mutually exclusive).
- *Description of educational activities*: present, absent (mutually exclusive). If present, a note specifying the type of activity was added.
- *Screen time discourse*: included given the relevance it has on mediation strategies (Cino et al., 2020; Livingstone & Pothong, 2022) and coded as either "present" or "absent" (mutually exclusive).
- *Risks and opportunities discourse*: included because of the relevance the broader imaginaries on risks and opportunities have on mediation strategies (Livingstone et al., 2017), and coded as: "risks", "opportunities", or "both" (mutually exclusive).
- *Reference to wellbeing associated to technology use*: included because of the relationship between digital skills and wellbeing (Livingstone et al., 2023), coded as "present" or "absent" (mutually exclusive).

We used descriptive statistics to explore the frequency distributions of these variables and to identify potential age-related patterns in the data.

For the thematic analysis, we undertook an in-depth examination of how digital skills in early childhood are represented across different educational contexts, identifying and constructing key themes that illuminate the relationship between digital competence, setting, and caregiving practices within our corpus of literature.

Analytical scope and positionality

Our focus on European studies sought to ensure comparability within a shared policy and cultural landscape informed by DigComp 2.2 (Vuorikari et al., 2022), which provides a common framework for defining and promoting digital competence in Europe. We acknowledge, however, that this scope inevitably limits the breadth of our findings, as digital practices and educational priorities may vary across different cultural, infrastructural, and policy contexts. Similarly, relying exclusively on *Scopus* ensured the inclusion of peer-reviewed and traceable research but may have excluded innovative or practice-based studies published in other databases or national journals.

These boundaries, however, are consistent with the rationale of a *systematized review*, that, as previously stated, unlike systematic reviews does not aim for exhaustiveness or replicability but for transparency, methodological rigor, and theoretical insight (Grant & Booth, 2009). Our approach therefore privileges interpretive depth and contextual understanding over comprehensive coverage, providing a structured and reflexive synthesis of empirical evidence. We see this as a strength rather than a limitation: by embracing contextual specificity and analytical reflexivity, our systematized

review contributes to a situated understanding of how digital competence is conceptualized and enacted in early childhood education within the European landscape.

This strategy was also aligned with the broader goals of the Italian Di.Co.Each research project of which this review is part. The review was conceived as part of a broader knowledge base built through the project's empirical and theoretical work on how digital competence is framed, taught, and learned in early childhood within European contexts. In this sense, focusing on Europe enabled us to examine the interplay between policy orientations and pedagogical practices, providing a situated understanding that grounds subsequent analyses of Italian early childhood education in a wider comparative framework.

QUANTITATIVE FINDINGS

Table 1 summarizes our findings, indicating how each record was coded concerning our main variables of interest. Publication years ranged from 2015 to 2024.

Table 1 – Literature review summary table

	Reference	Ed. context	Digital skills	Caregivers	Ed. activities	Screen time	Risks/opportunities	Wellbeing
1	Stamatios (2024)	1	1, 2	2	0	0	3	0
2	Wald et al. (2023)	2	1	1	0	0		0
3	Baltzaki & Chlapana (2023)	1	1	2	1	0	2	0
4	Swider-Cios et al. (2023)	2	1	1, 3	1	1	3	1
5	Meoded Karabanov et al. (2023)	2	1	1	0	1		0
6	Bustamante et al. (2023)	2	1		0	1	3	0
7	Arabiat et al. (2023)	1, 2	1, 4, 6		0	1		0
8	Haas et al. (2022)	1, 2	1	1, 2	1	0	2	0
9	Montuori et al. (2022)	1	1, 3		1	0	2	0
10	Papadakis, S. (2021)	1	2, 3	2	1	0	2	0
11	Undheim (2022).	1	1, 2	2	1	0	3	1
12	Kalabina & Progackaya (2021)	1	7	1, 2	1	1	3	0
13	Cruz et al. (2020)	2	7	1	1	1	3	0
14	Operto et al. (2020)	2	1	1, 3	0	1	1	1
15	Burnett et al. (2020)	1	1		0	0		0
16	Dardanou et al. (2020)	2	7	1	0	1	3	0
17	Kumpulainen et al. (2020)	2	1, 2, 6	1	1	1	3	1
18	Rek & Kovačič (2018)	2	7	1	0	1	3	1
19	Demetriou & Nikiforidou (2019)	1	1	2	0	0	3	1
20	Arnott et al. (2019)	1, 2	1	1, 2	0	0	3	0
21	Read et al.. (2018)	2	1	1	0	1	3	1
22	Mertala (2019)	1	1, 6	2	0	0		1
23	Kucirkova et al. (2018)	2	1	1	0	1	3	1
24	Nacher et al. (2019)	1	1		1	0		0
25	Sakr, M. (2018)	1	1, 2	2	1	0	2	0
26	Bentley et al. (2016)	2	1	1	1	1	3	0
27	Hatzigianni et al. (2018)	1	1, 4	1, 2	1	1	2	0
28	Herodotou (2018)	1	4	1, 2	1	1	2	0
29	Dolgova et al. (2019)	1	1, 2, 5, 6	1, 2	0	1	2	0
30	Lanna & Oro (2019)	1	2	1, 2	1	1	2	0
31	Nikken & Schols (2015)	2	1, 2, 5	1	0	1	3	1

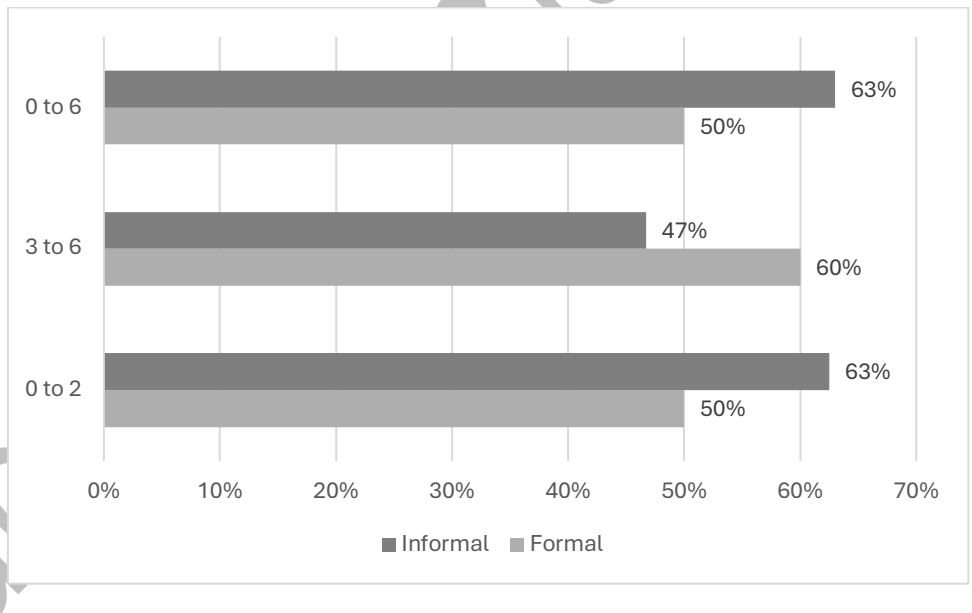
Legend *- Educational context: 1= formal, 2= informal; Digital Skills: 1= technological and operational, 2= content creation and production, 3= programming, 4= recreational, 5= information and navigation, 6= social, 7= not specified; Caregivers: 1= parents, 2= educators/teachers, 3= pediatrician; Educational activities: 0= absent, 1= present; Screen time discourse: 0= absent, 1= present; Risk/opportunity discourse: 1= risks, 2= opportunities, 3= both; Wellbeing: 0= absent, 1= present. Empty spaces stand for "not present/not applicable".*

Concerning the age range considered in these publications, 48.4% focused on the 3-6 range, 25.8% on the 0-2 range, and 25.8% on the whole 0-6 range.

There was an equal distribution of focus on formal (55% – e.g., educational services) and informal settings (55% – e.g., the family), with three occurrences of papers focusing on both (Arabiat et al., 2023; Arnott et al., 2019; Haas et al., 2019) – values of this variable were not mutually exclusive. Although non-formal contexts provide activities for promoting digital competence, these were not present in our dataset, suggesting they may occur with older children (e.g., Cino et al., 2023).

As per figure 2 (Fig.2) below, papers focused on the 0-2 and 0-6 age ranges were more likely to focus on informal settings, while those focused on the 3-6 range focused more often on formal environments.

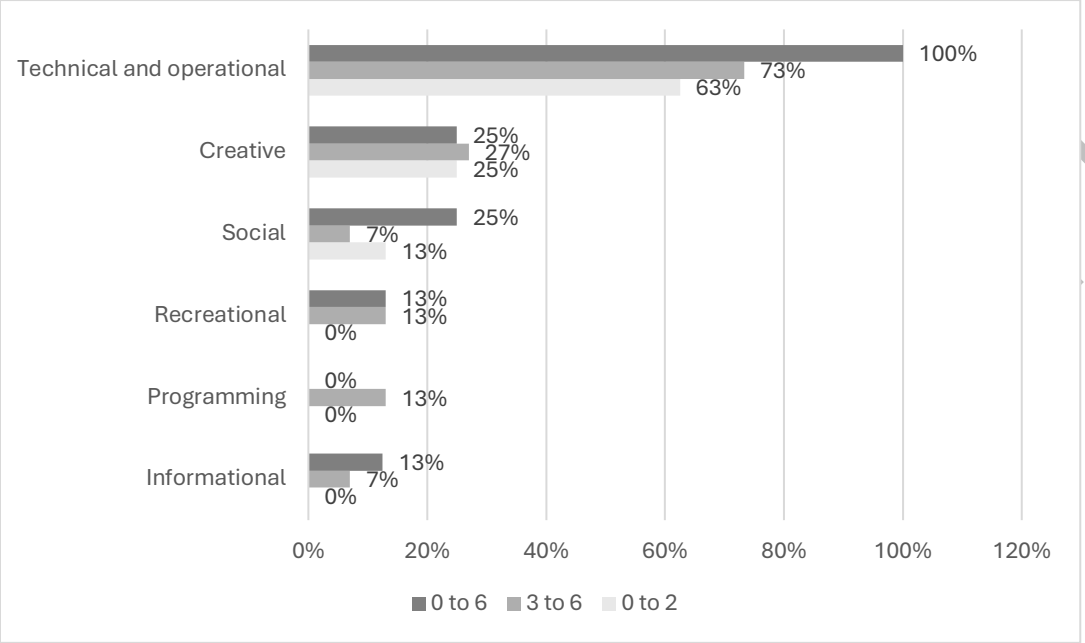
Figure 2 – Relationship between educational context and age group



For the type of digital skills, 77% of the papers focused on technical and operational skills (i.e., knowing how to operate a digital device), 26% on creative skills (e.g., producing content through digital media), 13% on social skills (in this context, using digital media socially and collaboratively), 10% on recreational skills (e.g., gaming, playing), 7% on programming skills (e.g., knowing how to code and use programming languages), 7% on informational skills (e.g., using digital devices to look for information), while 12% did not focus on a specific typology of skills. Such a differentiation speaks for the heterogeneity of research on digital skills in early childhood, showing more represented and underrepresented areas.

Figure 3 (Fig. 3) shows that technical and operational, social, and informational skills tend to be more considered in papers focused on the 0-6 range, while creative skills are more evenly distributed. Recreational, programming, and informational skills, in turn, are not at all covered in papers focused on the 0-2 range, suggesting these skills are mainly studied with older children.

Figure 3 – Relationship between type of digital skills and age group



Concerning the figures of care, parents tend to be the most mentioned (61%), followed by educators/teachers (45%), while paediatricians were less frequently considered (7%), possibly due to our sampling strategies excluding publications from medical sciences. No other care figures were identified in the papers, although some other actors were cited sporadically, such as educational app designers (Herodotou, 2018; Lanna & Oro, 2019; Nacher et al., 2019). Parents were most frequently present in papers concerning children aged 0-2 (75%), educators/teachers in papers relating to children aged 3-6, and paediatricians in papers concerning children aged 0-2 (13%) and 0-6 (13%).

Educational activities put in place to promote or facilitate digital skills acquisition were specified in 48% of papers, with some examples of that being robot modelling (Haas et al., 2022), coding games (Papadakis, 2021), collaborative digital drawing (Sakr, 2018), etc.

Matters concerning screen time were present in 58% of the papers, fairly distributed across the age range (63% for 0-2, 53% for 3-6, 63% for 0-6). As for the risk/opportunity discourse, risks alone were considered only in 4% of papers, while opportunities alone were present in 36% of publications and both in 57%, with the remaining 3% mentioning none of them. The discourse on risks only was solely present for the 0-2 age range (14%), on opportunities mainly was present for the 3-6 age range (57%), while both were present in 57% of the 0-2 range, 36% of the 3-6, and 100% of 0-6. This finding is surprising, especially for the minority of papers that solely focused on risks, being the narrative on the dangers of digital media for children mainstream (Zaman et al., 2020). These data, in turn, show a more dialogic attitude toward the relationship between digital media, digital skills, and early childhood.

Finally, as per wellbeing, this was referenced in 32% of papers, primarily when considering the whole 0-6 age range (75%) and, to a lesser extent, considering the 0-2 (38%) and 3-6 (7%) range.

QUALITATIVE FINDINGS

Young children's digital competence in formal educational contexts

Formal educational contexts represent a relevant environment where children experience digital media use. Through our thematic analysis, we identified three main thematic areas addressing our research questions: 1) The educational potential of digital technology, 2) Ecological contexts, and 3) Intentionality

The educational potential of digital technology. Research within this thematic area sheds light on the educational potential of digital technology. Several articles investigate the ways digital tools are used by young children in early childhood services (see, among others, Baltzaki & Chlapana, 2023; Burnett, 2020; Dolgova et al., 2018; Hatzigianni et al., 2018), addressing how digital competence is conceived in the studies included in the review (RQ1).

For instance, the review by Undheim (2022) illustrates that, among other things, prior research has emphasized how digital technology can expand educational possibilities for children in early childhood services, stressing the relevance of giving a broad definition of digital technology and acknowledging the manifold activities children experience (RQ1).

According to the reviewed studies, addressing the issue of digital technology in early childhood means considering the need for technology to be child-friendly (Arnott et al., 2019; Crescenzi Lanna & Grané Oro, 2019; Demetriu & Nikiforidou, 2019; Undheim, 2022) and to be used as a complementary resource with a view to integration (Baltzaki & Chlapana, 2023; Demetriu & Nikiforidou, 2019; Undheim, 2022).

Recurring themes are the understanding of tools and the acquisition of digital literacy skills (see, among others, Burnett et al., 2020; Demetriu & Nikiforidou, 2019; Hatzigianni et al., 2018; Stamatios, 2024) by both the educational staff and children. In Mertala (2019), the issues of security and privacy are addressed.

Furthermore, some studies discuss the role of app designers and developers and highlight their possible lack of knowledge about the cognitive models and abilities of young children (Crescenzi Lanna & Grané Oro, 2019; Nacher et al., 2019). In this regard, the authors stress the need for developers to design age-appropriate content tailored to specific developmental milestones. The articles show that collaboration emerges only from interfaces valued by children; otherwise, their lack of interest arises (Arnott et al., 2019; Nacher et al., 2019; Papadakis, 2022).

In the literature review presented by Arabiat et al. (2023), the possible risks or benefits related to the use of digital devices were analyzed. The reported data point to extremely divergent results in research on the use of digital technologies in early childhood. This suggests that there is still no

consistent finding on the effects of children's use of digital technologies and that many results can be traced significantly to the timing of use.

Intentionality. Intentionality emerges as a core dimension of digital competence in early childhood education (RQ2), especially in formal contexts (RQ3). In particular, many studies focus on whether and with what intentionality digital technologies are integrated into early childhood education. Some tools used significantly in educational services are, for example, Tablets, IPads, Robots, IToy, Game Apps, Coding Apps, Digital Games, Interactive whiteboards, Laptops and Printers. Some activities reported in the reviewed studies are territory exploration, shared storytelling, and visual art (Baltzaki & Chlapana, 2023; Sakr, 2018).

Within formal contexts, the educational dimension is inherent in the intentionality with which digital and non-digital tools and content are chosen and used given specific goals or in the enjoyment of the experience. This leads to investigating the adult's perceptions of digital technologies and their educational integration, as well as the adult's willingness and responsibility to take on the perspective of childhood, in its intrinsic participation and exploration in the experience, which becomes playful and free.

Numerous studies explicitly refer to the integration of digital technologies with non-digital experiences (Arnott et al., 2019; Baltzaki & Chlapana, 2023; Burnett et al., 2020; Demetriu & Nikiforidou, 2019; Hatzigianni et al., 2018). Within the integration approach, children learn through play from a perspective of freedom and exploratory learning (Demetriu & Nikiforidou, 2019; Stamatios, 2024; Undheim, 2022).

Significant is the difference reported about views between adults and children. Research shows that various activities are considered educational by adults and playful by children (Arnott et al., 2019). In addition, unconscious learning is transmitted in the playful dimension (Arnott et al., 2019; Mertala, 2019) through enthusiasm, participation, motivation, autonomy, creativity and self-esteem (Burnett et al., 2020; Demetriu & Nikiforidou, 2019; Haas et al., 2022; Herodotou, 2018). Children's freedom of choice is central to this educational dimension (Demetriu & Nikiforidou, 2019; Undheim, 2022). Without these requirements, the activities lose interest on their part. A clear pedagogical theory emerges in which children are at the center, not adults – with their beliefs – or digital technologies (Demetriu & Nikiforidou, 2019; Mertala, 2019; Stamatios, 2024; Undheim, 2022).

The widespread indication is that adults should acquire suitable accompaniment and mediation (Arabiat et al., 2023; Baktzaki & Chlapana, 2023; Haas et al., 2022; Herodotou, 2018). At the same time, adults should be aware that digital technologies should not be used as a substitute but as a support, moving toward integration (Baltzaki & Chlapana, 2023).

Transversal are themes related to skill development and learning, key dimensions of digital competence in formal education environments (RQ2 and RQ3): literacy, computation, geometry, computational thinking, memory, problem-solving, decision-making, and imagination (Arnott et al., 2019; Demetriu & Nikiforidou, 2019; Mertala, 2019; Papadakis, 2022; Stamatios, 2024).

It is reported in some research that an integrated approach – between methods based on digital and non-digital technologies – is the most functional for skill development and meaningful educational action (Baltzaki & Chlapana, 2023; Burnett et al., 2020; Haas et al., 2022). In this approach, the role of educators and teachers is crucial, especially in risk reduction and accompaniment to awareness. The role of educators and teachers is correlated with their beliefs, which inversely affect the use and integration (Demetriu & Nikiforidou, 2019; Papadakis, 2022; Stamatios, 2024; Undheim, 2022).

Educators and teachers demand more training and digital literacy (Burnett et al., 2020; Dolgova et al., 2018; Sakr, 2018; Undheim, 2022). In settings where training has been conducted, greater integration is reported in the beliefs of educators and teachers (Mertala, 2019). Integration of beliefs allows for greater incisiveness in accompaniment and mediation. In addition, the training enables the creation of "a single information space" (Dolgova et al., 2018). A working community involves a continuous exchange of information and fruitful sharing of experiences.

Ecological contexts. The focus of the analysis here is on the ecological contexts in which children move fluidly through tools, fruitions and activities (Arnott et al., 2019; Burnett et al., 2020; Demetriu & Nikiforidou, 2019; Papadakis, 2022), identifying the key dimensions of digital competence in early childhood formal settings (RQ3). In Undheim (2022) and Arnott et al. (2019), the disconnection between ecological contexts is presented, especially in the qualitatively different experiences children have at home and in educational settings. The disconnection is mainly due to differences in adults' perceptions of digital technologies, which are considered in their instructive aspects by educational service staff and in their playful ones by parents. In particular, Arnott et al. (2019) emphasize that the disconnection between the two contexts allows children to acquire the ability to move between different domains, developing an enhancement of their skills.

According to these studies, children do not distinguish between digital and non-digital play. They distribute digital technology among the various activities and tools they use and independently find a balance in the local ecology (Arnott et al., 2019; Undheim, 2022).

In Demetriu & Nikiforidou (2019), it emerges how the effective use of technology is due to the presence, support, place and social context of educators and teachers. Their beliefs play a significant role in how digital technology is used and integrated in pedagogical practices(Demetriu & Nikiforidou, 2019; see also Dolgova et al., 2018; Undheim, 2022). It is specified how, in early childhood educational settings, digital technologies can be employed from a holistic development perspective (Hatzigianni et al., 2018) with increased benefits: socialization, cooperation, spatial exploration, social-emotional skills, self-expression, communication, creativity, self-regulation, and integration with physical activities (Arabiat et al., 2023; Burnett et al., 2020; Demetriu & Nikiforidou, 2019; Haas et al., 2022; Hatzigianni et al., 2018).

Balance and holistic development promote children's awareness acquisition and transition from passive users and consumers to active users and producers (Stamatios, 2024; Undheim, 2022).

Entrenched with the ecological context, the studies reviewed bring to light the role of socio demographic variables (Crescenzi Lanna & Grané Oro, 2019; Demetriu & Nikiforidou, 2019; Dolgova et al., 2018; Herodotou, 2018Haas et al., 2022; Papadakis, 2022).

For instance, issues related to gender differences are discussed in the articles reviewed. In Stamatios (2024) and Nacher et al. (2019), gender differences do not affect the use of digital tools. Montuori et al. (2022) report gender differences in coding tasks, noting that a boy-favoring effect can appear as early as ages 5–7. As cognitive abilities do not explain this phenomenon, the authors suggest that the key influence is the classroom's ecological context, where cultural norms and implicit beliefs about coding and competitive activities tacitly shape children's attitudes.

Two other issues are significant. First, issues related to the integration of digital technologies within early childhood services (e.g., teachers' and parents' beliefs, costs, and the fragility of devices, features that relegate digital technology exclusively to structured activities, not allowing the convergence of experiences; see Arnott et al., 2019; Demetriu & Nikiforidou, 2019). Second, the "adultmorphic fallacy" (Arnott et al., 2019), for which one is inclined to read early childhood and its relationship with digital technologies from an adult perspective.

Young children's digital competence in informal educational contexts

Children's screen access and consumption in the domestic environment constitute a core focus of the studies reviewed. Addressing our RQs, three major and not mutually exclusive themes emerged: 1) the use(s) of digital devices, 2) parental mediation, and 3) the effects of exposure. Even though these themes are strictly intertwined and treated as such in the reviewed articles, for the qualitative analysis, we unpacked each theme to spotlight the complex, multifaceted nature of digital competence.

The use(s) of digital devices. Not surprisingly, children's use of digital devices at home crosscuts all studies. The term "use" encompasses a wide range of different issues, showing how digital competence is conceived (RQ1) and the key dimensions (RQ2). First, it refers to the types of digital devices available at home. In this regard, the studies included in the review attest the presence of a variety of devices in young children's everyday lives, including smartphones, smart TV, TV, tablets, laptops, computers, game consoles, DVD players, Kindles, digital radios, and virtual assistants like Alexa (see among others Bentley et al., 2016; Cruz et al., 2020; Kalabina & Progackaya, 2021; Karabanov et al., 2023; Read et al., 2018; Rek & Kovačič, 2018; Wald et al., 2023). Interestingly, such variety does not seem strongly influenced by family socio-economic conditions (Cruz et al., 2020).

A second area of investigation concerns the types of content and activities children engage in when using digital devices at home. Most studies report that children interact with age-appropriate content and activities like watching cartoons or video animation, playing games, taking photos, using various educational apps, making video calls, or creating and listening to sounds (e.g., Haas et al., 2022; Karabanov et al., 2023; Kumpulainen et al., 2020; Kurcikova et al., 2018; Nikken & Schols, 2015; Read et al., 2018). Only one study reports children's exposure to inappropriate, adult-aimed content (Kalabina & Progackaya, 2021). This result is not surprising if we consider that these studies rely on self-report techniques (i.e., surveys or interviews with parents) and, therefore, the well-known social desirability bias may be operating, especially since "good parenting" is arguably at stake.

Time exposure is another central aspect of children's use of digital devices at home. In this regard, the studies that collected specific, quantified information about screen time (Dardanou et al., 2020; Kalabina & Progackaya, 2021; Karabanov et al., 2023; Nikken & Schols, 2015; Rek & Kovačič,

2018) depict a mixed scenario. Some report excessive screen time compared to international guidelines (Kalabina & Progackaya, 2021; Karabanov et al., 2023; Rek & Kovačič, 2018), while others describe a more nuanced exposure (Rek & Kovačič, 2018), depending on different factors such as the child's age (Karabanov et al., 2023; Nikken & Schols, 2015), skills (Nikken & Schols, 2015), as well as parents' age, education (Karabanov et al., 2023; Nikken & Schols, 2015), income, and media use (Nikken & Schols, 2015; Rek & Kovačič, 2018).

Relatively less explored, though pedagogically relevant, are parents' motivations for "allowing" (or not) their children to use digital media. Among these, it is worth mentioning the belief that they serve as educational tools to facilitate learning, improve school performance, or develop creative skills; as "pacifiers" to calm down the child; as entertainers when parents are engaged in household activities; to share enjoyable family time; or being in contact with distant relatives (Bentley et al., 2016; Dardanou et al., 2020; Kalabina & Progackaya, 2021; Nikken & Schols, 2015; Rek & Kovačič, 2018). Alongside these advantages, results also emphasize the manifold risks perceived by parents, including concerns about inappropriate content exposure, the development of addiction and social exclusion, possible changes in behavior, negative impact on health (e.g., sight, sleep, and sedentary-related problems), development, and social skills, as well as dangers related to connecting with "wrong" people (Bentley et al., 2016; Covolo et al., 2021; Cruz et al., 2020; Dardanou et al., 2020; Nikken & Schols, 2015; Operto et al., 2020; Rek & Kovačič, 2018). Only one study shows that parents underestimate the risks connected to the online environment (Kalabina & Progackaya, 2021).

Furthermore, it is worth mentioning that only a few studies explicitly discuss and emphasize a) children's agency and critical-creative skills in using digital devices (Arnott et al., 2019; Kurcikova et al., 2018; Kumpulainen et al., 2020) and b) the deep intertwinement of digital and non-digital activities in children's everyday lives (Arnott et al., 2019; Cruz et al., 2020; Kumpulainen et al., 2020; Kurcikova et al., 2018). Both aspects are particularly relevant from a pedagogical perspective and should receive more attention in future research.

Effects of exposure. Considering the key dimensions of digital competence in early childhood education (RQ2), effects of exposure emerge as a recurrent and relevant theme. Four studies (three of which are literature reviews, see Arabiat et al., 2023; Bustamante et al., 2023; Swider-Cios et al., 2023) examine the possible effects of media exposure on children's skills and development. The narrative review by Swider-Cios and colleagues (2023) focuses on the influence of digital media on the cognitive and socioemotional development of children aged 0 to 5 years. It highlights that research findings published since 2010 agree that prolonged "passive" exposure to content not explicitly intended for children and without parental supervision hampers children's executive functions and the development of attention, language, and learning skills. Additionally, it is supposedly detrimental to the parent-child relationship. However, together with the risks, the authors also stress that children's consumption of interactive content suited for their specific age and under parental supervision may benefit learning, attention skills, and working memory. Similar mixed evidence on risks and benefits on children's cognitive and language skills is pointed out in the systematic review by Arabiat et al. (2023). The authors also focus on the effects of digital devices on motor development, stressing, among other things, that most studies suggest a negative association between the two. A specific focus on time exposure is provided in the meta-analysis by Bustamante et al. (2023), where no statistically significant

association between screen time exposure and executive functioning is found. However, as suggested by the authors, more variables such as children's age, programming type, contextual factors, and content features should be considered in future studies. Finally, the impact of digital devices on language development is investigated by Operto and colleagues (2020) in the Italian context. In their cross-sectional study on children aged 0 to 3, the authors found, among many other things, that higher screen time is associated with lower language skills. The authors interpret that the content type and parental mediation are not significantly associated with language development due to a lack of focus in the study design on a) the use of educational applications and b) a distinction between passive and active co-viewing.

Parental mediation. Addressing RQ3, parental mediation emerges as a key dimension of digital competence in early childhood informal educational contexts. In line with previous studies, results reveal that parents adopt various strategies, ranging from more "restrictive" actions to co-use and more supportive, active practices. Restrictive practices include establishing rules concerning time and/or content, banning the child's unsupervised usage, setting parental control and/or filters, or hiding the devices (Bentley et al., 2016; Cruz et al., 2020; Kalabina & Progackaya, 2021; Karabanov et al., 2023; Kurcikova et al., 2018; Nikken & Schols, 2015; Read et al., 2018; Rek & Kovačič, 2018). Co-use involves different ways of parents engaging with digital devices together with their children (Bentley et al., 2016; Haas et al., 2022; Karabanov et al., 2023; Kumpulainen et al., 2020; Nikken & Schols, 2015; Operto et al., 2020; Wald et al., 2023), and more supportive and active practices comprise talking about the digital media, explaining to the child how to use the devices appropriately and safely, supporting and encouraging autonomous activities, or complimenting when they make "good" use (Bentley et al., 2016; Cruz et al., 2020; Karabanov et al., 2023; Kurcikova et al., 2018; Nikken & Schols, 2015). Restrictive actions and co-use appear to be relatively more frequent than active mediation.

Several interrelated factors contribute to shaping parents' mediation strategies, including socio-demographic variables, parents' educational level, parents' values and attitudes toward digital devices, parenting style, motivations for use, the child's age, gender, media skills, and type of activity, the presence of older siblings, and cultural discourses on device use in early childhood (Karabanov et al., 2023; Nikken & Schols, 2015; Wald et al., 2023). Although results depict a complex and mixed scenario, parents who are more educated and aware of the risks associated with young children's exposure to digital devices and those whose children are older and more skilled seem more likely to adopt restrictive strategies (e.g., Dardanou et al., 2020; Rek & Kovačič, 2018). Furthermore, results suggest the presence of a sort of parental "struggle" with their mediating role as they seek to minimize possible risks related to inappropriate usage on the one hand and maximize educational opportunities on the other (e.g., Kurcikova et al., 2018).

DISCUSSIONS AND CONCLUSIONS

In this article, we analyzed findings from empirical studies published between 2015 and 2024 on digital competence in early childhood, particularly concerning formal and informal educational settings. Addressing RQ1 (i.e., how is digital competence conceived in the studies included in the review?) and RQ2 (i.e., what are the key dimensions of digital competence in early childhood education emerging from the studies included in the review?), the quantitative analysis has highlighted

how digital competence in early childhood is a multifaceted, complex phenomenon encompassing different skills, settings, figures of care, activities, and discourses. As for the qualitative analysis, we have identified the key themes underpinning the relationship between digital media and early childhood in the reviewed studies. Addressing RQ3 (i.e., what are the key dimensions of digital competence in early childhood formal and informal educational contexts emerging from the reviewed studies?), the thematic analysis has highlighted different core dimensions for formal and informal contexts. As for the former, three broad thematic areas emerged as relevant: 1) Between digital technology and educational potential: a childhood-friendly technology, 2) Ecological contexts and active citizenship. For a holistic childhood education: fluidity, convergence, balance and accompaniment, and 3) Playfulness and childhood freedom: an integrated educational design. Concerning the latter, three significant themes crosscutting the studies included in the review have been identified: 1) the use(s) of digital devices, 2) parental mediation, and 3) the effects of exposure.

The literature review highlights how, in the face of a theme emerging in public debate and scientific research (from various disciplinary perspectives: paediatric, psychological, sociological, and pedagogical, mainly), childhood digital education is a field of study that needs to be better explored, to promote meaningful educational responses. Research testifies to an increasing presence of digital tools in childhood, right from the first years of life, in many cases even before the age of two, the age before which paediatric recommendations prohibit their use.

The analysis brings to light the recurrence of research and reflections that highlight the centrality of monitoring screen time (as the most widespread paediatric guidelines on the subject emphasise), but also the importance of the choice of contents, both according to the age of the recipients and according to how screens can be used. The most significant evidence concerning the effects of digital tools during childhood, transversal among the studies examined, is also linked to the criticalities that can emerge through "passive" exposure to screens and the absence of adult accompaniment. The usefulness of adequate parental mediation is thus emphasised, as well as the possibility of using the screen to enjoy content made by others (as in the case of cartoons or other videos on the various platforms) and to exploit the interactive, cognitive and explorative possibilities of screens.

Beyond the distinctions between formal and informal contexts, the reviewed studies converge on the idea that supporting children's digital competence requires shared responsibility across families, educators, and institutions. The implications extend beyond the operational dimension of using digital tools: they point toward educational mediation, critical reflection, and ethical participation. For educators in early childhood education and care, this means integrating digital experiences within play-based and inquiry-oriented pedagogies that value exploration, co-creation, and dialogue (Li et al., 2024; Nardone, 2025). For parents, it calls for cultivating reflective co-use practices that transform everyday media encounters into opportunities for talk, storytelling, and joint meaning-making (Flewitt et al., 2024). Policymakers, in turn, are invited to move beyond quantitative "screen time" parameters and to embrace ecological frameworks that consider content, context, and social mediation as interdependent (Herdzina & Lauricella, 2020; Lauricella et al., 2017). From this integrated perspective, fostering digital competence in early childhood becomes not merely a matter of control or exposure,

but of developing relational, creative, and civic capacities through guided engagement with digital media.

These conclusions are as relevant for formal as for informal and non-formal contexts: a Media Literacy approach can, therefore, be valuable and from an ecological and systemic perspective, adults should be trained to use digital tools consciously; adults should also be informed and trained – without blaming, demonising and mythologising – to propose conscious, interactive, critical and creative uses to children. The objective could be to promote "competent" interactions with digital tools, understanding their possibilities and limitations. From this perspective, it can be hypothesised that the inclusion of digital technologies in formal contexts dealing with childhood should neither be categorically banned nor introduced as a "fashion". If promoted from the perspective of Media Literacy, reflecting on the digital can become helpful in the construction of healthy habits and the promotion of "digital well-being".

In parallel with the training of adults in digital literacy, the studies conducted testify to the usefulness of initiating reflections that are aimed at building digital competence from childhood onwards to avoid the taking root of inactive habits, to foster "digital well-being" even during childhood, and to promote forms of self-regulation that can be implemented when the child is alone in using the tool. "Competent" use of the digital cannot be taken for granted, and, on the contrary, the Media Literacy educational intervention could become an opportunity to foster uses that are not substitutive but complementary to analogue experiences and that can promote reasoning and nurture childhood thinking.

Based on the literature reviewed in this paper, we advance an understanding of digital competence in early childhood as an ecological and developmental phenomenon that unfolds across the intertwined settings of home and educational institutions. In domestic environments, competence emerges through everyday interactions, parental mediation, and children's exploratory engagement with digital tools (Green et al., 2024). In early childhood education and care, it develops through pedagogical intentionality, teacher beliefs, and opportunities for creative participation (Su & Yang, 2024). In this sense, promoting digital competence in early childhood requires more than teaching children how to use technology; it calls for shared responsibility. On one hand, from significant adults to enable children, through guided experience, to inhabit digital environments reflectively, creatively, and responsibly as an expression of their rights; on the other, from those who design and govern digital environments to ensure that these spaces respect and uphold children's digital rights (Livingstone et al., 2025).

LIMITATIONS AND FUTURE DIRECTIONS

While this review contributes to mapping and interpreting current knowledge on digital competence in early childhood, several limitations must be acknowledged. First, the dataset was intentionally delimited to European peer-reviewed studies indexed in Scopus, which ensures conceptual and methodological consistency but may exclude innovative research and non-indexed regional literature. Second, the analysis relied on evidence reported in many self-report studies. While these approaches can provide valuable insights, they are also subject to social desirability and recall bias, especially in parents' and educators' accounts of children's media use. As a result, they should

be understood as proxies rather than direct measures of children's digital skills, a limitation that is also partly inherent to studying the early years, when formal assessment of such competences remains challenging. Third, the quantitative synthesis was necessarily based on categorical variables coded ex post from the reviewed studies, which constrains the range of statistical analyses that can be meaningfully performed. Yet, our findings can inform both future literature reviews and empirical research on children's digital competence.

For future reviews, scholars could expand the search strategy to include additional databases and apply or adjust the proposed keyword string to different linguistic and geographical contexts, comparing how digital competence in early childhood is conceptualized across diverse cultural settings. Such work would help refine the theoretical and conceptual boundaries of the field and broaden the relevance of findings beyond the present corpus.

For future empirical research, studies could use open or newly collected datasets to explore in greater depth the relationships between children's age and other dimensions of digital competence, adopting a more fine-grained approach to early childhood differences. To deepen understanding of how digital competence develops in the early years, empirical work could integrate naturalistic and ethnographic designs, in-home observations, and longitudinal approaches capable of tracing learning trajectories over time. Quantitative approaches such as large-scale surveys can complement these in-depth qualitative insights, offering broader contextual evidence and national and/or international points of comparison. Finally, emerging research should pay attention to the role of artificial intelligence in early childhood environments, considering how it may contribute to shape early forms of digital competence, including children's abilities to interact with, understand, and critically engage with digital and intelligent technologies. This may occur intentionally or indirectly, for example through smart toys that adapt to children's responses, voice assistants integrated into family routines, or creative storytelling tools based on generative AI. These technologies raise new pedagogical and ethical questions in terms of opportunities and risks, calling for careful reflection on their implications for children's learning, agency, and wellbeing.

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References

AAP Committee on Public Education. (1999). Media education. *Pediatrics, 104*, 341–343.

AAP (2015). *Growing up digital: Media research symposium*. Washington, DC.

Arabiat, D., Al Jabery, M., Robinson, S., Whitehead, L., & Mörelius, E. (2023). Interactive technology use and child development: A systematic review. *Child: Care, Health and Development, 49*(4), 679-715. https://doi.org/10.1111/cch.13082

Arnott, L., Palaiologou, I., & Gray, C. (2019). Internet of toys across home and early childhood education: Understanding the ecology of the child's social world. *Technology, Pedagogy and Education, 28*(4), 401-412. https://doi.org/10.1080/1475939X.2019.1656667

Baltzaki, M., & Chlapana, E. (2023). Fostering receptive vocabulary development of kindergarten children with the use of Information and Communication Technologies (ICT). *Education and Information Technologies, 28*(11), 14019-14049. https://doi.org/10.1007/s10639-023-11707-7

Barr-Walker, J. (2017). Evidence-based information needs of public health workers: A systematized review. *Journal of the Medical Library Association: JMLA*, *105*(1), 69-79. https://doi.org/10.5195/jmla.2017.109

Bentley, G. F., Turner, K. M., & Jago, R. (2016). Mothers' views of their preschool child's screen-viewing behaviour: a qualitative study. *BMC Public Health, 16*, 718. https://doi.org/10.1186/s12889-016-3440-z

Buckingham, D. (2019), *The media education manifesto*. Polity Press.

Burnett, C., Merchant, G., & Neumann, M. M. (2020). The appearance of literacy in new communicative practices: Interrogating the politics of noticing. *Cambridge Journal of Education, 50*(2), 167-183. https://doi.org/10.1080/0305764X.2019.1654978

Bustamante, J. C., Fernández-Castilla, B., & Alcaraz-Iborra, M. (2025). Relation between executive functions and screen time exposure in under 6 year-olds: A meta-analysis. *Computers in Human Behavior*, *145*, 107739. https://doi.org/10.1016/j.chb.2023.107739

Christakis D. A. & Hale, L. (2025, eds.), *Handbook of Children and Screens*. Springer.

Cino, D., Brandsen, S., Bressa, N., Eriksson, E., Mascheroni, G., & Zaman, B. (2023). Children's digital skills acquisition in non-formal educational contexts: Pedagogical practices, learning, and inclusion opportunities in coding and robotics workshops. *Italian Journal of Educational Research*, *16*(30), 54-72.

Cino, D. (2021). The "5 Ws and 1 H" of Sharenting: findings from a systematized review. *Italian Sociological Review*, *11*(3), 853. https://doi.org/10.13136/isr.v11i3.495

Cino, D., Mascheroni, G., & Wartella, E. (2020). "The kids hate it, but we love it!": Parents' reviews of Circle. *Media and Communication*, *8*(4), 208-217. https://doi.org/10.17645/mac.v8i4.3247

Cornish, F., Gillespie, A., & Zittoun, T. (2013). Collaborative analysis of qualitative data. In Flick U. (Ed.), *The SAGE Handbook of Qualitative Data Analysis* (pp. 79–93). Sage.

Creswell, J.W. (2014). *Research design: qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage.

Cruz, C., Franco, C., Anunciação, F., & Cunha, M. J. (2020). Screens' domestication in childhood: Uses and parental mediation in city and rural contexts. *Comunicação e Sociedade, 37*, 71-92 https://doi.org/10.17231/comsoc.37(2020).2411

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

De Rossi, M., & Ferranti, C. (2025). Digital integration in early childhood education and care: Innovating educators' competencies. *Media Education*, *16*(1), 49-56. https://doi.org/10.36253/me-17161

Demetriou, K., & Nikiforidou, Z. (2019). The relational space of educational technology: Early childhood students' views. *Global Studies of Childhood, 9*(4), 290-305. https://doi.org/10.1177/2043610619881458

Dolgova, V., Batenova, Y., Emelyanova, I., Ivanova, I., Pikuleva, L., & Filippova, O. (2019). Factors of the readiness for information exchange in pre-school education establishments. *Education Sciences, 9*(3), 1-10. https://doi.org/10.3390/educsci9030166

Green, L., Haddon, L., Livingstone, S., O'Neill, B., Stevenson, K. J., & Holloway, D. (2024). *Digital media use in early childhood: Birth to six*. Bloomsbury Academic.

Drotner, K. (1999). Dangerous media? Panic discourses and dilemmas of modernity. *Paedagogica Historica*, *35*(3), 593-619. https://doi.org/10.1080/0030923990350303

Ferrari, A. (2013). *DIGCOMP: A framework for developing and understanding digital competence in Europe*. Joint Research Centre of the European Commission.

Flewitt, R., El Gemayel, S., Arnott, L., Gillen, J., Goodall, J., Winter, K., Dalziell, A., Liu, M., Savadova, S. and Timmins, S. (2024). *Toddlers, Tech and Talk: Very young children's language and literacy learning at home in a post-digital age. Summary Report*. Manchester Metropolitan University.

Godaert, E., Aesaert, K., Voogt, J., & van Braak, J. (2022). Assessment of students' digital competences in primary school: A systematic review. *Education and Information Technologies*, 27, 9953-10011. https://doi.org/10.1007/s10639-022-11020-9

Haas, B., Lavicza, Z., Houghton, T., & Kreis, Y. (2022). Evaluating technology-enhanced, STEAM-based remote teaching with parental support in luxembourgish early childhood education. *Frontiers in Education, 7*, 1-12. https://doi.org/10.3389/feduc.2022.872479

Haddon, L., Cino, D., Doyle, M.A., Livingstone, S., Mascheroni, G. & Stoilova, M. (2020) *Children and young people's digital skills: A systematic literature review* ySKILLS.

Haddon, L., Cino, D., & Doyle, M. A. (2023). The challenges of conducting systematic evidence reviews: A case study of factors shaping children's digital skills. *Bulletin of Sociological Methodology/Bulletin de Méthodologie Sociologique*, *158*(1), 71-90. https://doi.org/10.1177/07591063221141730

Hatzigianni, M., Gregoriadis, A., Karagiorgou, I., & Chatzigeorgiadou, S. (2018). Using tablets in free play: The implementation of the digital play framework in Greece. *British Journal of Educational Technology, 49*(5), 928-942. https://doi.org/10.1111/bjet.12620

Helsper, E.J., Schneider, L.S., van Deursen, A.J.A.M., & van Laar, E. (2020). *The youth Digital Skills Indicator: Report on the conceptualisation and development of the ySKILLS digital skills measure*. KU Leuven, Leuven: ySKILLS.

Herdzina, J. & Lauricella, A. R. (2020). *Media Literacy in Early Childhood Report*. Technology in Early Childhood (TEC) Center, Erikson Institute.

Herodotou, C. (2018). Mobile games and science learning: A comparative study of 4 and 5 years old playing the game Angry Birds. *British Journal of Educational Technology, 49*(1), 6-16. https://doi.org/10.1111/bjet.12546

Hobbs, R. (2010). *Digital and media literacy: A plan of action*. The Aspen Institute Communications and Society Program; Knight Foundation.

Hobbs, R., & Jensen, A. (2013). The Past, Present, and Future of Media Literacy Education. *Journal of Media Literacy Education, 1*(1). https://doi.org/10.23860/jmle-1-1-1

Kalabina, I. A., & Progackaya, T. K. (2021). Defining digital competence for older preschool children. *Psychology in Russia, 14*(4), 169-185. https://doi.org/10.11621/pir.2021.0411

Kucirkova, N., Littleton, K., & Kyparissiadis, A. (2018). The influence of children's gender and age on children's use of digital media at home. *British Journal of Educational Technology, 49*(3), 545-559. https://doi.org/10.1111/bjet.12543

Kumpulainen, K., Sairanen, H., & Nordström, A. (2020). Young children's digital literacy practices in the sociocultural contexts of their homes. *Journal of Early Childhood Literacy, 20*(3), 472-499. https://doi.org/10.1177/1468798420925116

Lanna, L. C., & Oro, M. G. (2019). Touch gesture performed by children under 3 years old when drawing and coloring on a tablet. *International Journal of Human-Computer Studies, 124*, 1-12. https://doi.org/10.1016/j.ijhcs.2018.11.008

Lauricella A., Blackwell C.K., & Wartella E. (2017). The "new" technology environment: the role of content and context on learning and development from mobile media. In Barr, R., & Linebarger, D.N. (Eds.), *Media exposure during infancy and early childhood* (pp. 1-23). Springer.

Li, H., He, H., Luo, W., & Li, H. (2024). Early childhood digital pedagogy: A scoping review of its practices, profiles, and predictors. *Early Childhood Education Journal*. https://doi.org/10.1007/s10643-024-01804-8

Lindeman, S., Svensson, M., & Enochsson, A. B. (2021). Digitalisation in early childhood education: A domestication theoretical perspective on teachers' experiences. *Education and Information Technologies, 26*(4), 4879–4903. https://doi.org/10.1007/s10639-021-10501-7

Livingstone, S., Ólafsson, K., & Pothong, K. (2025). Digital play on children's terms: A child rights approach to designing digital experiences. *New Media & Society*, *27*(3), 1465-1485. https://doi.org/10.1177/14614448231196579

Livingstone, S., & Pothong, K. (2022). Beyond screen time: Rethinking children's play in a digital world. *Journal of Health Visiting*, *10*(1), 32-38. https://doi.org/10.12968/johv.2022.10.1.32

Livingstone, S., Mascheroni, G., & Stoilova, M. (2023). The outcomes of gaining digital skills for young people's lives and wellbeing: A systematic evidence review. *New Media & Society*, *25*(5), 1176-1202.

Livingstone, S., Ólafsson, K., Helsper, E. J., Lupiáñez-Villanueva, F., Veltri, G. A., & Folkvord, F. (2017). Maximizing opportunities and minimizing risks for children online: The role of digital skills in emerging strategies of parental mediation. *Journal of Communication*, *67*(1), 82-105. https://doi.org/10.1177/1461444816686318

Mandracchia, F., Llauradó, E., Tarro, L., Del Bas, J. M., Valls, R. M., Pedret, A., & Boqué, N. (2019). Potential use of mobile phone applications for self-monitoring and increasing daily fruit and vegetable consumption: A systematized review. *Nutrients*, *11*(3), 686. https://doi.org/10.3390/nu11030686

Mann, S., Calvin, A., Lenhart, A., and Robb, M.B. (2025). *The Common Sense census: Media use by kids zero to eight, 2025*. Common Sense Media.

Masoumi, D., & Bourbour, M. (2024). Framing adequate digital competence in early childhood education. *Education and Information Technologies*, *29*(15), 20613-20631. https://doi.org/10.1007/s10639-024-12646-7

Meoded Karabanov, G., Aram, D., López-Escribano, C., Shtereva, K., Asaf, M., Ziv, M., ... & Sonnenschein, S. (2023). The COVID-19 Pandemic: Changes in Parent–Child Activities at Home from Spring 2020 to Spring 2021 from a Cross-Cultural View. *Education Sciences, 13*(10), 1013. https://doi.org/10.3390/educsci13101013

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. *Computers in Human Behavior, 101*, 334-349. ttps://doi.org/10.1016/j.chb.2019.08.003

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS med*, *6*(7), 339. https://doi.org/10.1136/bmj.b2535

Montuori, C., Ronconi, L., Vardanega, T., & Arfé, B. (2022). Exploring gender differences in coding at the beginning of primary school. *Frontiers in Psychology, 13*, 887280. https://doi.org/10.3389/fpsyg.2022.887280

Nacher, V., Jurdi, S., Jaen, J., & Garcia-Sanjuan, F. (2019). Exploring visual prompts for communicating directional awareness to kindergarten children. *International Journal of Human-Computer Studies, 126*, 14-25. https://doi.org/10.1016/j.ijhcs.2019.01.003

Neuendorf, K. A. (2019). Content analysis and thematic analysis. In Brough, P. (Ed.), *Advanced research methods for applied psychology* (pp. 211-223). Routledge.

Nardone, R. (2025). Digital media in 0-6: Educational design between services and families. *Media Education*, *16*(1), 25-33. https://doi.org/10.36253/me-17097

Nikken, P., & Schols, M. (2015). How and why parents guide the media use of young children. *Journal of Child and Family Studies*, *24*, 3423-3435. https://doi.org/10.1007/s10826-015-0144-4

Operto, F. F., Pastorino, G. M. G., Marciano, J., de Simone, V., Volini, A. P., Olivieri, M., ... & Coppola, G. (2020). Digital devices use and language skills in children between 8 and 36 month. *Brain Sciences, 10*(9), 656. https://doi.org/10.3390/brainsci10090656

Papadakis, S. (2021). The impact of coding apps to support young children in computational thinking and computational fluency. A literature review. *Frontiers in Education*, 6, 657895. https://doi.org/10.3389/feduc.2021.657895

Ranieri, M. (2020), *Tecnologie per educatori socio-pedagogici*. Carocci.

Read, J. C., Horton, M., Clarke, S., Jones, R., Fitton, D., & Sim, G. (2018). Designing for the'at home'experience of parents and children with tablet games. *Proceedings of the 17th ACM Conference on Interaction Design and Children*, 441-448. https://doi.org/10.1145/3202185.3202769

Rek, M., & Kovačič, A. (2018). Media and preschool children: the role of parents as role models and educators. *Media Studies, 9*(18), 27-42.

Rideout, V. (2017). *The common sense census: Media use by kids age zero to eight.* Common Sense Media.

Sakr, M. (2018). Multimodal participation frameworks during young children's collaborative drawing on paper and on the iPad. *Thinking Skills and Creativity, 29*, 1-11. https://doi.org/10.1016/j.tsc.2018.05.004

Sawka, K. J., McCormack, G. R., Nettel-Aguirre, A., Hawe, P., & Doyle-Baker, P. K. (2013). Friendship networks and physical activity and sedentary behavior among youth: A systematized review. *International Journal of Behavioral Nutrition and Physical Activity*, *10*(1), 1-9. https://doi.org/10.1186/1479-5868-10-130

Smahel, D., Machackova, H., Mascheroni, G., Dedkova, L., Staksrud, E., Ólafsson, K., Hasebrink, U. (2020). *EU kids online 2020: Survey results from 19 countries.* London School of Economics.

Stamatios, P. (2024). Can preschoolers learn computational thinking and coding skills with ScratchJr? A systematic literature review. International *Journal of Educational Reform, 33*(1), 28-61. https://doi.org/10.1177/10567879221076077

Su, J., & Yang, W. (2024). Digital competence in early childhood education: A systematic review. *Education & Information Technologies,* 29, 4885–4933. https://doi.org/10.1007/s10639-023-11972-6

Swider-Cios, E., Vermeij, A., & Sitskoorn, M. M. (2023). Young children and screen-based media: The impact on cognitive and socioemotional development and the importance of parental mediation. *Cognitive Development, 66*, 101319. https://doi.org/10.1016/j.cogdev.2023.101319

Szabó, D., Győri, K., Lajos, P., & Pusztai, G. (2024). Systematic literature review on parental involvement in digital education. *Journal of Media Literacy Education, 16*(2), 98-107. https://doi.org/10.23860/JMLE-2024-16-2-8

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

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes*. Office of the European Union.

Wald, R., Piotrowski, J. T., Araujo, T., & van Oosten, J. M. (2023). Virtual assistants in the family home. Understanding parents' motivations to use virtual assistants with their Child (dren). *Computers in Human Behavior, 139*, 107526. https://doi.org/10.1016/j.chb.2022.107526

Wartella, E. (2019). Smartphones and tablets and kids: Oh my, oh my. In C. Donohue (Ed.), *Exploring key issues in early childhood and technology: Evolving perspectives and innovative approaches* (pp. 27–31). Routledge.

Wartella, E., & Jennings, N. (2000). Children and computers: New technology, old concerns. *The Future of Children, 10*(2), 31–43. https://doi.org/10.2307/1602688

Zaman, B., Holloway, D., Green, L., Jaunzems, K., & Vanwynsberghe, H. (2020). Opposing narratives about children's digital media use: A critical discourse analysis of online public advice given to parents in Australia and Belgium. *Media International Australia*, *176*(1), 120-137. https://doi.org/10.1177/1329878X20916950

Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education, 168*, 104212. https://doi.org/10.1016/j.compedu.2021.104212