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Beyond Training: A Policy Analysis of the Digital Competence of Early Childhood Teachers in Selected European Union Member States

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Abstract. With education rapidly transforming due to digital developments, members of the European Union (EU) have begun to implement extensive policy schemes to improve the digital capabilities of those teaching very young children. This article reports an examination of these policy initiatives, based on the policy documentation proposals of EU members, intended to augment the digital competencies of these early childhood educators. A qualitative design was utilized to analyse policy documents published between 2015 and 2025 from eight selected EU countries. Search keywords such as early childhood education, teacher digital competence, digital education strategies, and professional development were used to identify relevant documents through the official EU website and the official websites of education departments in the selected countries. Using the European Framework for the Digital Competence of Educators (DigCompEdu) as a foundation, the chosen policy documents were analysed with the guidance of a specifically created coding manual. According to the findings, the digital competencies of these educators have been strengthened principally via three key processes. These are professional growth and assistance from institutions; establishing platforms containing nation-level digital resources; and ensuring that digital technology is integrated innovatively into the education and care of young children. In this study, the implementation of these policies was revealed to encounter related difficulties and limitations. Utilizing experiences of these policies, advice is offered to nations aiming to enhance the digital capabilities of educators in preschool settings. Practical implications are suggested regarding the implementation of digital policies, mechanisms to assist educators, and ethical administration in the early childhood educational context.

Keywords: Early childhood education; Teacher digital competence; European Union policy; Digital education strategy

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1. Introduction

The education field is transforming due to major digital developments and in a rapidly globalizing and digitalizing context. With the increasing integration of digital technologies into education system, traditional pedagogical practices have been reshaped. A key factor in improving education in terms of access and quality is the implementation of digital approaches to learning. Teachers play a major role in reforming education, their digital competence have a direct influence on whether teaching practices effectively deploy digital technology (You & Yu, 2025). In the context of early childhood education (ECE), however, the digital competence of teacher raises distinctive challenges. ECE teachers work with children in settings where education and care are closely intertwined. Children's learning and development could be influenced by play, teacher-child interactions and peer relationships. Accordingly, ECE teachers' digital competence should necessarily consider adaptable developmental appropriateness, play-based pedagogy and digital ethics (Falloon, 2020).

The concept of digital competence has been variously defined in the literature over the past decade. A Recommendation of the European Parliament and of the Council of the European Union (2006) defines digital competency as the "confident and critical use of Information Society Technologies for work, communication, and leisure." Building upon this understanding, Ferrari (2013) further characterizes digital competence as the ability to use technology to effectively optimize our daily lives. The connotation of digital competence has since expanded to include various dimensions such as information recognition, communication and collaboration, content creation, security awareness, and technical problem-solving (Vuorikari et al., 2022).

Various national teacher digital competence frameworks emphasize that these competencies encompass both the technical level required by teachers and the necessary pedagogical knowledge (McGarr & McDonagh 2021). Specifically, these involve not only the technical skills linked to using digital tools in daily teaching but also comprehensive literacy, which is required to effectively integrate digital technology into teaching, assessment, and teacher-student interaction. In early childhood education (ECE), however, the digital competence of teachers entails more distinctive challenges. They must understand the principles of childrens' development, select digital resources and tools, support children's holistic development, and establish effective digital communication with both the parents and the wider educational environment (Falloon, 2020).

The effective development of such digital competence depends on well-structured teacher professional development systems, investment in digital infrastructure and digital resource platforms, and integration of digital technologies into the curriculum. However, existing research mainly focuses on the individual-level factors, such as teachers' knowledge and skills in using digital technologies, attitudes toward using digital technology, and digital self-efficacy (Falloon, 2020). Research analysing how early childhood teachers' digital competencies are conceptualized and supported by organizations at the policy textual level is very limited. This gap indicates that an important issue has been overlooked: the

development of digital competence for early childhood teachers depends heavily on institutional support. As noted above, professional development systems, digital infrastructure and resource platforms, and ethical governance of digital technologies need to be configured and defined through policy documents. Therefore, policy text analysis is needed to understand the development of digital competencies among early childhood teachers. Such analysis can reveal how policy texts connect professional development training, resource provision, curriculum integration, and ethical governance. In this sense, policy texts offer an important lens for examining the institutional conditions that shape the development of teachers' digital competence.

This study does not examine policy initiatives in the selected EU countries as isolated cases; rather, it explores how their policy document's structure different forms of support for ECE teachers' digital competence. To promote a more digitalized education system, reasonably comprehensive policy mechanisms and considerable practical experience are evident in the European Union (EU). More specifically, the European Commission issued the Achieving the European Education Area by 2025 Communication. This highlights how digital transformation in education creates various demands. To address these, the paper urges stronger digital competencies and pedagogical capacities among teachers.

Moreover, EU members are recommended to boost the classroom application of technology by educators with the establishment of effective systems of training for teachers (European Commission, 2020a). In addition, the Digital Education Action Plan (2021-2027), issued by the European Commission (2020b), clearly states the digital competency development of teachers as one of its core objectives. These strategies highlights how digital transformation in education creates various demands; to address these, the paper urges stronger digital competencies and pedagogical capacities among teachers. These are the main reasons why this study analyzes policy documents from the selected EU countries.

2. Literature Review

2.1 Digital Competence as a Professional Development Issue among Early Childhood Education Teachers

Previous research on the digital competence of early childhood teachers has mainly focused on two directions. One strand focuses on the individual level, examining the technology acceptance, levels of digital competence, and self-efficacy of teachers. The other evaluates the effectiveness of teacher training courses, digital workshops, and continuing professional development programs from the perspective of teacher professional development. In one example of individual-level research, Gudmundsdottir and Hatlevik (2017) conducted a national survey of 356 new teachers finding that their self-efficacy in teaching and learning was significantly positively correlated with their actual application of ICT.

Similarly, Blackwell et al. (2014) confirmed the mediating role of teachers' subjective beliefs in the process of technology adoption. This study showed that teachers' attitudes toward the value of technology education were the strongest

predictors of the frequency of technology use, followed by self-efficacy and external support. Based on these examinations of samples from a variety of countries and sets of participants, this research suggests that, overall, digital competencies among educators in early childhood and pre-service settings depend on a range of factors. These include technical capabilities, attitude, self-efficacy, and views on how valuable digital technologies are.

2.2 Competence Frameworks and Policy Support for Teachers' Digital Development

The DigCompEdu framework has been widely used in the field of conceptualizing and measure teachers' digital competence. This framework clearly defines the 22 competencies that educators need to possess, which are encompassed across six domains. Previous research on the DigCompEdu framework has focused on measuring teachers' digital capabilities. For example, Cabero-Almenara et al. (2023) used DigCompEdu in a cross-sectional study to survey the digital competence levels of teachers in Latin American universities.

DigCompEdu is also one of the most commonly used models for studying the competencies of ECEC educators. Silva-Quiroz et al. (2025) examined the DigCompEdu framework in early childhood education settings. They also proposed targeted adaptation to make the framework more responsive to early childhood education contexts. These studies are mainly empirical inquiries focused on the use of digital technologies. From a policy analysis perspective, research on the rationality of digital tool use, whether digital resources are sufficient, and whether there are sound support systems to help early childhood teachers enhance their digital skills is very limited.

2.3 Digital Competence in Early Childhood Education Practice

The digital competence of early childhood teachers is not simply about using digital tools but requires teachers to embed a series of digital pedagogical approaches into play-based learning activities to support young children's holistic development (Torres et al., 2021). In early childhood education settings, the assessment of children is not primarily centred on standardized academic performance; instead, it relies largely on the continuous documentation of children's learning and development (Koenarso, 2023). Therefore, the digital competence of early childhood teachers is reflected not only in the ability to use digital devices and resources, but also in the professional judgement required to determine whether digital tools align with developmental appropriateness practices and whether they can support children's social-emotional development and participatory learning.

Meanwhile, digitalization has also changed how children's learning is observed, recorded, and evaluated in ECE settings. Digital archives and digital learning records have replaced traditional handwritten records, raising higher demands on how teachers interpret child development information, manage data, and protect children's data privacy (Cowan & Flewitt, 2021). These changes highlight the need to address digital ethics in ECE, particularly children's data privacy and protection and screen exposure (Liu et al., 2025). These considerations suggest that, compared with teachers in other education sectors, early childhood teachers

require more context-sensitive policy strategies and support systems for developing their digital competence.

2.4 Research Gap and Theoretical and Policy Novelty

Despite some studies having extensively discussed teachers' digital competence, some shortcomings remain in the existing literature. First, most relevant studies focus on evaluations of teacher training programs, curriculum interventions, or the effects of technology use, while institutional support mechanisms for teachers' digital competency development have rarely been examined from the perspective of education policy.

Secondly, more attention has been directed to ordinary primary and secondary school teachers or pre-service teachers, with relatively limited attention paid to those teaching early childhood education. From the perspective of multi-country comparison in particular, there remains a lack of systematic sorting and analysis of digital competency development policies for preschool teachers. To a certain extent, this limits any in-depth understanding of different national policy paths, support priorities, and their common characteristics. It also makes it difficult to provide more targeted policy enlightenment for digital capacity building among ECE teachers.

Given the shortcomings outlined above, this study focuses on policies related to digital competence in early childhood teachers in EU member states, adopting the Digital Competence of Educators (DigCompEdu) as the analytical framework. The EU has established a systematic framework for digital education governance, and it continues to prioritize the enhancement of teachers' digital capabilities as a critical aspect of education transformation. Consequently, analyzing the relevant EU policies would enhance the comprehensiveness of the policy support paths followed to promote the digital competence of preschool educators. It would also provide theoretical insights and practical guidance for nations advancing the development of digital literacy systems for preschool teachers.

2.5 DigCompEdu as the Analytical Framework

This study is guided by the European Framework for the Digital Competence of Educators (DigCompEdu), which was developed by the European Commission's Joint Research Centre as a comprehensive reference framework for digital competence among educators. DigCompEdu divides this concept into six interrelated areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence (Redecker, 2017). Based on these six aspects, the digital capability of educators encompasses their engagement with the profession, making pedagogical decisions, practices of assessment, and supporting students in digitalized media environments (Tzafilkou et al., 2023; Kiryakova & Kozhuharova, 2024).

DigCompEdu moves past focusing narrowly on ICT abilities to highlight other teacher behaviors, including the employment of digital technology in their pedagogy, reflective practices, and student-oriented factors. Overall,

DigCompEdu reflects a wider comprehension of the effectiveness with which educators can operate in highly digitalized educational settings. The framework emphasizes that educators should be able to select and adapt digital resources, design digitally supported learning activities, implement digitally enabled instruction, use digital means to assess learning, and foster the ability of students to use digital technologies responsibly and creatively.

Thus, DigCompEdu offers a dedicated analytical framework with which to undertake comparisons of national policies. It also guides the coding and categorization of texts, which primarily explains why it was used in the current research. Moreover, the framework allows more systematic cross-domain examinations of the ways in which the digital competencies of teachers are supported by policy documentation, as well as revealing possible potential disparities in these policies. In general, DigCompEdu enables the digital competencies of teachers to be better understood by providing a conceptual basis for this. It also represents a robust foundation for analyzing the range, emphasis, and drawbacks of policy support in the education of preschoolers. Figure 1 illustrates the DigCompEdu framework, showing the six areas of competency, the coding procedure, and how the eventual themes were classified.

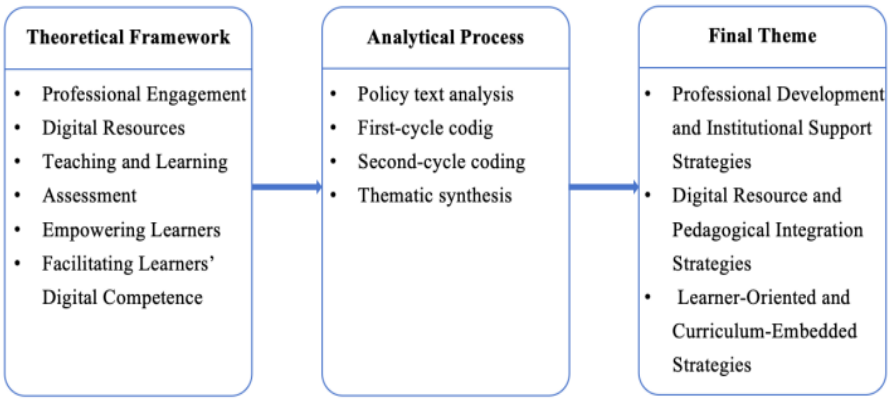

Figure 1: Analytical framework of the study, based on DigCompEdu

3. Research Questions

The following research questions were proposed:
RQ1: In the selected European Union member states, which policy approaches and implementation systems have been implemented to improve the digital competencies of early childhood educators?
RQ2: While implementing these policies, which major issues and obstacles have been met, and how can these problems inform the development of mechanisms for early childhood teaching?

4. Methodology

In the current work, policy texts were qualitatively analysed to explore which approaches and means of implementation have been deployed by selected eight countries in the EU to improve digital competencies among early childhood

teachers. Policy text analysis is a systematic approach for examining and interpreting printed and digital documents, allowing researchers to discern meanings, classify information, and recognize trends within policy texts (Bowen, 2009).

4.1 Data Collection

Given the large number of policy texts in the EU member states and the differences in document types, language availability, and policy coverage, a full sample was not used in this study. Instead, eight countries were selected: Germany, France, Sweden, Finland, Spain, Italy, Ireland, and Estonia. This purposive case selection balanced the feasibility of the study against the diversity of policy contexts and the availability of documentation. Documents were selected based on three criteria. First, the policy documents were published between 2015 and 2025, that is, after the publication of DigcompEdu.

Second, the documents were issued or endorsed by national education authorities or EU-level institutions, and they included strategies, action plans, competence frameworks, and official guidance. Finally, the documents were available in English or had official English translations. Priority was given to policy documents that explicitly addressed early childhood education (ECE). If a dedicated ECE document was unavailable at the national level, ECE had to be included in the broader digital education strategy. Table 1 provides an overview of the policy documents analysed in this study.

Country	Document code	Title	Issuing body	Document Type	Relevance to ECE
Spain	ED2026	España Digital 2026 / Digital Spain 2026 (2022)	Government of Spain; Ministry of Economic Affairs and Digital Transformation	National digital transformation strategy	Early childhood education is included as part of the document's system-wide digital education agenda.
France	MNEY-DE 2023-2027	Digital Strategy for Education 2023–2027 / Stratégie du numérique pour l'éducation 2023–2027 (2023)	Ministry of National Education and Youth	National digital education strategy	Early childhood education is included as part of the document's system-wide digital education strategy
Germany	MEYS-MBJS	Media education from the start: A guide for using digital media in preschools (2023)	Ministry of Education, Youth and Sports of the State of Brandenburg (MBJS)	ECE media education implementation guide	Direct relevance: provides guidance on the use of digital media in daycare and preschool settings.

Germany	MKFGFI-NRW	Digital media in early childhood education: A guide for educational professionals, providers, and parents in early childhood education and care institutions (2019)	Ministry for Children, Family, Refugees, and Integration of the State of North Rhine-Westphalia	ECE implementation guide and practice handbook	Direct relevance: specifically addresses digital media in early childhood education, pedagogical professionals, providers, parents, and daycare centres.
Sweden	SNAE-NDSS	Digital strategy for education 2023–2027 (2022)	Swedish National Agency for Education (Skolverket)	Proposed national digitalisation strategy for the school system	Early childhood education is included within the school system addressed by the document, which covers children's and pupils' digital competence and digitalisation in teaching and learning.
Finland	MEC-MLF	Media Literacy in Finland: National Media Education Policy (2019)	Ministry of Education and Culture	National media education policy	Direct relevance: the policy includes early childhood education and links media literacy, responsible digital participation, and educators' pedagogical role in supporting children's digital competence.
Ireland	DE-DSS	Digital Strategy for Schools to 2027 (2022)	Department of Education	National digital strategy for schools	Early childhood education is included within the school system addressed by the strategy, which supports learners' digital skills, schools' digital capacity, and teachers' use of digital technologies for teaching and learning.
Italy	PNSD	National Plan for Digital Education: Piano Nazionale Scuola Digitale (PNSD) (2015)	Ministry of Education, University and Research (MIUR)	National digital school plan	Early childhood education is included within the education system addressed by the plan, which covers digital infrastructure, learning environments, digital competences, staff training, and innovation support.
Estonia	MER-ES21	Education Strategy 2021–2035 (2021)	Ministry of Education and Research and Government of Estonia	National education strategy	Early childhood education is included within the education system addressed by the strategy, which covers digital transformation, learning pathways, digital skills, and innovation across all education levels.

4.2 Data Analysis

A deductive qualitative content analysis method was used. An initial coding manual was developed by the authors. Relevant text segments were extracted from the policy documents, including elements related to the digital competence, professional development support, digital resources, digital pedagogy. NVivo 15 software was used to assist with text extraction and categorization. The extracted segments were organized according to the six domains of the DigCompEdu framework, with the recurring subthemes further refined through iterative comparison.

The second cycle of coding reorganized and regrouped these subthemes, resulting in three overarching themes. Based on these themes, analysis was undertaken of the core strategies, implementation mechanisms, and support pathways adopted by the eight selected EU member states to enhance the digital competence of early childhood teachers. Additionally, the challenges and limitations associated with policy implementation were analyzed.

4. Results and Findings

4.1 Policy strategies identified from the policy documents

The policy texts of the EU countries were analyzed, which indicated that these states have created various interconnected policy approaches to enhance digital competencies among educators in early childhood settings. The main focus of these elements is support for professional development, the supplying of digital resources, integrating practices into the classroom, and orienting strategies around the empowerment of learners.

Table 2: The Policy Strategies Analysis of Documents of Selected Counties

Theme	Policy Strategies	Representative Countries	Related DigCompEdu Domains	Key analytical insights
Professional development and institutional support strategies	Continuing professional development and professional collaboration	France, Germany, Finland, Spain	Area 1, Area 2	Digital competence of educators is strengthened by policy prioritization that covers training in digital settings, learning from peers, and groups of fellow professionals.
	Pre-service and in-service teacher training	France, Finland, Italy, Germany	Area 1, Area 2	Teacher digital competence is supported through formal preparation and continuing training across pre-service and in-service stages.
	Professional learning communities	France, Germany, Sweden	Area 1	Professional learning communities support collaborative knowledge sharing, reflective practice, and peer-based digital competence development.

Digital resource and pedagogical integration strategies	Strategic steering at EU/national level	France, Spain, Sweden	Area 1, Area 2, Area 3	National strategies and policy frameworks provide overarching direction for digital competence development.
	Institutionalization in teacher education and curriculum	Ireland, Sweden, Italy, Estonia	Area 1, Area 3	Embedding digital competencies into reforms of curricula, educator training, and levels of professionalization.
	Local and institutional support mechanisms	Germany, Finland	Area 1, Area 2, Area 3	Practical implemention of policy mediated by ECEC leadership, localized network systems, and professional groups.
Learner-oriented and curriculum-embedded strategies	Pedagogical integration	France, Germany, Sweden	Area 3, Area 5	Practices in the classroom, learning reflectively, pedagogical inclusiveness are witnessing the embedding of digital tools.
	Learner empowerment orientation	Spain, Sweden, Germany, Ireland, Estonia	Area 5, Area 6	Through policy, teacher competencies among teachers are connected to the digital literacies, inclusion, and guided involvement of young learners.
	Inclusive digital learning	Italy, Germany, Spain	Area 5, Area 6	Digital strategies are used to support inclusion, accessibility, and more equitable participation in early childhood learning contexts.

4.1.1 Theme 1. Professional Development and Institutional Support Strategies

Three widely utilized policy measures were identified: Continuing professional development and professional collaboration, pre-service and in-service teacher training, Professional learning communities. Policy documents emphasize the enhancement of digital engagement and professional growth among early childhood teachers through the organization of digital competency training, peer learning, and collaboration with early education institutions. The French Digital Strategy for Education (2023–2027) proposed enhancing digital engagement in teaching among ECE educators through technical support, online training resources, and networked professional learning (France, MNEY-DE 2023–2027, 2023, p. 28). Germany's Digital Media in Early Childhood Education requires preschool institutions to formulate independent media use plans.

The scheme also encourages teacher teams to undertake joint reflection and decision-making related to educational goals and digital media integration (Germany, MEYS-MBJS, 2023, 6.1, p. 19). Finland has provided a long-term platform for professional exchange among early childhood teachers through the establishment of discussion forums on media education and the provision of

continuous guidance and information (FNAE，MEC-MLF, 2019，p. 14, p. 52). Spain's España Digital 2026 also identifies digital skills training as a national priority (Spain, Espana Digital 2026, P 15). Additionally, policy texts from France, Germany, and Finland mention incorporating teachers' digital competence development into pre-service and in-service teacher training. These three countries further support knowledge sharing among teachers, reflective practice, and peer support through professional learning communities. In summary, theme 1 indicates that the policy texts mainly focus on teacher professional engagement and digital resource selection, corresponding primarily to DigCompEdu Area 1 and Area 2. Across these countries, teachers' digital competence development is promoted through institutional-level collaboration mechanisms and ongoing support structures.

4.1.2 Theme 2. Digital Resource and Pedagogical Integration Strategies

Strategies under the theme of digital resources and teaching integration include strategic steering at EU or national levels, institutionalization in teacher education and curriculum, as well as local and institutional support mechanisms. Another important strategy is the development of national-level digital resource platforms to create supportive environments for teaching and learning. France has built a unified national digital education platform system that integrates open data, collaborative spaces, and digital educational services through a "platform state" model, thereby enabling teachers to access, create and share high-quality digital teaching resources (France, MNEY-DE 2023-2027, 2023, p. 25).

Sweden has emphasized the use of emerging digital technologies to establish secure network infrastructures and ensure that early childhood teachers can use digital tools reliably (Sweden, SNAE-NDSS, 2022, p. 12). In Italy, the Ministry of Education, Universities and Research (MIUR) promoted the *Curricoli Digitali* project through the National Digital School Program (PNSD) (Italy, PNSD，2024, P 15). Through this project, a website was created to provide digital teaching solutions and practical examples of STEM activities for ECE.

Additionally, the integration of digital tools into teaching and learning practices emerged as a common core promotion strategy. France emphasizes improved training of education teams in digital teaching and promotes the purposeful use of digital technologies by teachers before, during, and after teaching through peer support, learning communities, and teaching guidebooks (France, MNEY-DE, 2023-2027, 2023). Germany has provided time and funding for team-based training, technical discussions, and digital pedagogy consultations, and a website has been developed to support teachers and children in active media practices (Germany,MEYS-MBJS, 2023, p. 39). Spain has integrated the development of teacher digital skills into its national digital strategy (Spain, Espana Digital 2026, p. 22).

Theme 2 shows that the selected EU member states improve early childhood educators' digital competence through strategic policy steering, the institutionalization of teacher education and curriculum reform, and local

institutional support mechanisms. DigCompEdu Area 1 and Area 3 receive the strongest emphasis in the policy documents.

4.1.3 Theme 3. Learner-Oriented and Curriculum-Embedded Strategies

The findings illustrate that, regarding learner-oriented and curriculum embedded strategies, the relevant policies mainly fall into three categories: pedagogical integration, learner empowerment orientation, and inclusive digital learning. Spain's national strategy, Digital Spain 2026, states that digital transformation should be humanistic, inclusive, and people-centered, thereby establishing a clear ethical framework for the participation of teachers and learners in digital education (Spain, España Digital 2026, 2021, p. 22). Complementing this vision, Spain has provided legal and ethical references for ECE teachers to use in designing digital learning experiences through the Charter of Digital Rights (Spain, España Digital 2026, 2021, p. 18).

Sweden, by contrast, links digital competence to lifelong learning, equality, and gender equality (Sweden, SNAE-NDSS, 2022, pp. 7, 11). Germany has translated the critical, creative, and responsible use of media into concrete teacher support programs through partnerships with libraries, media education programs, and support initiatives at the federal and state levels (Germany, MEYS-MBJS，2023，8.1; Germany, MKJFGFI-NRW，2019, P. 22, P. 73). Compared with the broader humanistic frameworks of Spain and Sweden, Germany's policy represents a more practice-oriented effort to translate ethical principles into concrete teacher support programs and teaching resources.

In Ireland, the Digital Strategy for Schools to 2027 established a Standard Minimum Digital Skills Framework for Teachers and Learners, the goal being to ensure that all educators and students had a common foundation in digital literacy (Ireland, DE-DSS, 2022, p. 37-40). The strategy further calls for curriculum reform to integrate digital skills into everyday classroom practice and promote student-centered learning through digital archives (Ireland, DE-DSS, 2022, pp. 39-40). As a complement to the curriculum-focused measures taken by Ireland, digital competencies are regarded in Sweden as long-term educational requirements that link to the training of teachers and assessments in schools (Sweden, SNAE-NDSS, 2022, p. 7). Italy's policies are like those of Germany and Spain, reflecting an inclusive digital learning orientation that supports accessibility, inclusion, and fairer opportunities for children's participation through digital strategies (Italy, PNSD, 2024, p. 12).

Through this national policy, the logic has been expanded to integrate digital competencies into educational routes across the entire system. Illustrated via such approaches are the ways in which ECE teaching is supported by a national policy that aims to attain learner empowerment within teacher training and a curriculum framework. Theme 3, Learner-oriented and curriculum-embedded strategies, mainly corresponds to DigCompEdu's Area 3, Area 5, and Area 6. This theme focuses more on how teachers integrate digital technologies into teaching practice, support learner participation, and promote children's digital competency

development. Among them, DigCompEdu Area 5 and Area 6 received the most attention.

4.2 Policy challenges and limitations

Although the selected eight EU member states have developed several policy pathways to support early childhood educators' digital competence, the analysis of the policy texts also revealed challenges and limitations in existing policies. Table 3 presents the main challenges identified from the policy texts.

Table 3: Policy challenges and limitations in enhancing early childhood teachers' digital competence

Theme	Policy challenges	Representative Countries	Related DigCompEdu domains
Uneven emphasis across DigCompEdu domains	Assessment, learner empowerment and ethics receive less systematic attention than training and resources	Across selected countries	Area 4, Area 5, Area 6
Limited ECE-specific adaptation	Rather than being designed for specific requirements of early childhood contexts, many policies are still oriented toward general education.	Across selected countries, especially in general education-oriented policy documents	Across domains
Instrumental over pedagogical orientation	Tools and accessibility are frequently stressed in policies, instead of extensive changes to pedagogy.	Estonia	Area 2, Area 3
Underdeveloped ethics and child protection	Despite their existence, guidelines on ethics and systems for long-term assistance hampered by inconsistent operationalization.	Across selected countries	Area 6, Area 4 and Area 5

First, the text analysis based on the six DigCompEdu dimensions shows that the existing policies are more focused on professional development, resource support, and pedagogical integration, whereas relatively limited attention has been directed to dimensions of digital assessment. These results imply that the development of digital competence in ECE teachers still centers primarily on the "training-resource-application" model, with relatively weak system design for supporting observation, feedback, and continuous improvement through digital assessment (Hatzigianni et al., 2023).

Second, the specialized adaptation of the existing policies to the early childhood education context remains insufficient. Some documents primarily focus on the digitalization of general education, with preschool education being mostly incorporated into the broader education strategy. However, policy support that specifically addresses children's developmental characteristics, play-based learning, home–school collaboration, and age-appropriate use remains limited.

Digital competence in preschool education must grounded in developmental appropriateness, teacher professional judgment, and children's meaningful participation; otherwise, policies might easily stay at the principle level and provide limited support for translation into classroom practice (Undheim, 2022; Samuelsson, 2025). Third, the policy texts generally emphasize the supply of resources, platforms, and training, while teaching transformation, long-term support, and ethical governance have been relatively underdeveloped. This means that current policies are relatively strong in providing digital conditions but remain insufficient in clarifying how to transform digital technologies into teaching practices aligned with the characteristics of preschool education (Hatzigianni et al., 2023).

Without a support chain linking pre-service teacher education, continuing professional development, and classroom reflection, the effectiveness of policy initiatives aimed at developing early childhood teachers' digital competence may be weakened (Novella-García & Cloquell-Lozano, 2021). Finally, although issues such as children's privacy, digital safety, and teachers' professional discretion were addressed in the analysed policy documents, they have not yet been translated into sufficiently clear and institutionalised pathways of support.

5. Discussion

According to the results of this study, the focus of the eight European Union (EU) member states is the integration of the digital competencies of early childhood education (ECE) teachers into frameworks of ongoing professional development. Across the policy documents of these countries, there is a general recognition that enhancing these abilities among such educators depends not simply on one-off training; pre-service and in-class training must incorporate these improvement measures (Masoumi & Noroozi, 2023). That is, instilling in ECE teachers the necessary digital competencies must be regarded as one element of a multi-level approach to the management of education, not as a singular matter of training.

In such systems, pre-service training is consistently positioned as an important entry point for embedding digital competence into the professional preparation of ECE educators. Many research support for this policy direction, information technology courses in teacher education can significantly enhance the digital skills of pre-service teachers and strengthen their ability to design digital learning materials for early childhood settings (Romero-Tena et al., 2020; Dogan and Gogus, 2025). The development of this competence relies heavily on an accessible, actionable, and educationally relevant resource environment, rather than solely on the spontaneous exploration of individual teachers (Madsen et al., 2023).

Additionally, the findings reveal that national online resource platforms and the provision of digital resources have become common policy measures. This suggests that EU countries attach considerable importance to, firstly, the accessibility of digital governance strategies in early childhood education and care (ECEC), and secondly, enhancing the quality of ECEC through improved digital resources and educator training. Although ECE teachers generally display positive attitudes toward learning digital technologies, many do not enter the

profession with sufficient preparation to integrate these technologies effectively into their teaching practice (Casillas Martín et al., 2019). In fact, in-service ECE teachers are more inclined to strengthen their digital skills through short-term online training courses (Leoste et al., 2022). From this perspective, national online digital resource platforms can lower barriers to access, expand the scope of training, and provide diversified models of online digital skills development for preschool teachers. These policies indicate that the integration of digital technology into ECEC pedagogy processes is not simply a matter of using "smart devices", but of aligning technology use with pedagogical goals. This would support children's holistic development and foster their emerging digital thinking.

Similarly, Lähdesmäki et al. (2023) argued that digital pedagogy should be embedded in the core practices of play-based learning in kindergartens, thus providing a foundational framework for digital learning in ECEC. Furthermore, the findings of this study suggest that a part of policies have begun to move beyond a narrow focus on "technology provision" or on whether teachers can use digital tools. Instead, they increasingly emphasize that digital technology in ECEC should support children's holistic development, learning participation, and developmentally appropriate practice. More specifically, truly effective digital support must respond to the development characteristics of children's digital literacy and be embedded in both the curriculum and the everyday logic of teaching.

In the preschool years, the value of digital technology lies in its capacity to support children's cognitive development, language development, social interaction, and active exploration (Baikulova et al., 2024; Clemente-Suárez et al., 2024; Brinck et al., 2023). Digital practice in ECEC cannot simply be modeled on that of primary and secondary schools or on general digital education policies; instead, it must be grounded in developmental appropriateness, play-based learning, and the meaningful participation of children (Undheim, 2022; Otterborn et al., 2023). Similarly, Lähdesmäki et al. (2023) argued that digital pedagogy should be embedded in the core practices of play-based learning in kindergartens, thus providing a foundational framework for digital learning in ECEC.

The policy strategies for enhancing digital competence for early childhood teachers in the documents cover six major areas of the DigCompEdu framework. However, these policies mainly focus on technical training and digital resource development, while the support pathway for ethics, safety, assessment, and professional judgment are not clearly documented. This indicates that in the current field of early childhood education, teachers' digital competence assessment, digital ethics, and child privacy protection are key issues that need to be addressed. The shortcomings in these policies indicate that it remains difficult to establish a unified and widely recognized definition of digital competence for early childhood teachers.

This finding is consistent with the conclusions of Su and Yang (2024). Their systematic research on digital literacy in early childhood education points out that

there is still a lack of clear standards in the field for defining and assessing early childhood teachers' digital competence in digital teaching environments. Therefore, the goals of digital competence training for early childhood teachers are unclear. This may lead policy support to deviate from the core priorities of early childhood digital competence development (Undheim & Ploog, 2022). Masoumi and Bourbour (2024) explained the digital competence that early childhood teachers should possess from the perspective of cultivating children's digital literacy, such as enabling children to act safely, respectfully with others, and responsibly in a digital environment. Therefore, future policies need to shift from "expanding digital tools and training" to "establishing mechanisms for ethical governance, digital assessment, and teacher support".

6. Recommendations

Several recommendations are proposed, covering ECE-specific policy design, continuous professional development, digital resources, assessment mechanisms, and ethical governance. For EU member states, these recommendations point to the need to strengthen the coherence and implementation of existing digital education policies for early childhood education. For non-EU countries, these recommendations should be understood as adaptable policy implications rather than directly transferable policy models. Therefore, the broader significance of this study is not that countries should replicate the EU policy model, but that they should systematically strengthen ECE-specific policy design, sustained teacher support, and ethical and evaluation mechanisms in local contexts.

Digital policy design should avoid reducing the digital competence of early childhood teachers to the operational use of tools. Alternatively, digital competencies should be recognized within such designs as capabilities with multiple dimensions and that integrate pedagogical theory, understanding children's development, professional judgments, and adhering to one's ethical duty. Moreover, in their advancement of digitalization, each country needs to create sustainable infrastructures, supplies of stable resources, and ongoing paths for professional learning, instead of placing sole reliance on short-term courses or investing in hardware. In educating children before primary level, the basis for sufficient digital competence should be appropriate development, the professional judgments of educators, and the meaningful involvement of children. These actions are more vital than merely the increased use of digital technologies or tools (Masoumi & Bourbour, 2024).

Furthermore, additional focus should be placed on designs that integrate pre-service preparation of teachers prior to service, in-class courses, and assistance for kindergarten educators. The professional development procedures of teachers should incorporate digital pedagogies, in-class applications, reflective practices, and ongoing feedback. This is because when teachers can be prepared earlier and receive continual assistance, they tend to be confident about, accepting of, and able to combine digital technology with their in-class practices (Lim, 2023; Papavlasopoulou et al., 2024). In terms of policymaking, it is vital to create gamified preschool education-focused digital resources that are adapted to the age of the children, culturally sensitive, and less reliant on screens. Easily

understandable examples for use in teaching and formative mechanisms of assessing work should support these resources. More specifically, the policy documents should mention specific assessment mechanisms, evaluating preschool teachers' digital competence from multiple dimensions such as digital competence diagnosis, classroom observation of digital teaching methods, formative feedback, and professional development plans. These actions would guarantee that inquiry, interactivity, and inventiveness among children are facilitated by digital technology, instead of merely causing the downward movement of generalized educational materials to younger learning cohorts (Chu et al., 2024).

Lastly, the implementation of measures to enhance digital competencies among ECE teachers should emphasize digital ethical governance. Children's privacy, digital safety, age-appropriate use, family disparities, and the professional judgment of teachers should all be included in policy design and implementation evaluations. This would make digital education not only feasible in practice but also sustainable, accountable, and guided by the interests of children (Nagel, I., 2023).

7. Conclusion

Policy document analysis was conducted to explore how selected policy documents from eight EU member states conceptualise and support the development of ECE teachers' digital competence. The findings indicate that these policy documents frame the digital competence of early childhood teachers as moving from a single technology application toward a comprehensive competence covering professional development, resource support, teaching integration, and governance mechanisms.

Countries have promoted relevant policies primarily by building digital platforms, integrating digital education into early education curricula, and deploying multi-level management. However, deficiencies remain in assessment mechanisms, ECE adaptability, and digital ethics support. This study is also subject to certain limitations. First, the research method was limited, since the results of policy text analysis can only reflect policy intentions, so the actual implementation of policy by teachers in practice cannot be explored using these texts. The second limitation concerns the sample. Only eight EU member states were covered, which does not fully represent the range of differences across the EU.

Finally, using DigCompEdu as an analytical framework may have improved the research systematization but it might also have weakened the policy characteristics outside the framework. One potential outcome of this is an overly narrow understanding of the digital competencies that are essential for ECE beyond the scope of the framework, such as the critical thinking, creativity, and collaboration skills that are necessary for holistic child development. In the future, mixed-methods research such as interviews, questionnaires, or case studies could be applied to further examine how policies are implemented at kindergarten level. Comparative studies might also reveal the similarities and differences between

EU and non-EU countries in terms of digital capacity building for early childhood teachers. This would provide the basis for a more contextually adaptable policy design.

Conflict of Interest
The authors declare no conflict of interest.

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