Implementation of digital education in primary school from an interdisciplinary perspective

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Abstract: *The integration of digital education in primary school represents both a challenge and a strategic opportunity for developing the essential competences of 21st-century learners. In the context of recent curricular reforms, the inclusion of digital education in primary schooling involves not only introducing new content but also reconfiguring teaching, learning, and assessment models. This article analyses the theoretical and curricular foundations of digital education as a transversal domain, highlighting opportunities for its integration into existing subjects, elective courses, and interdisciplinary activities. The approaches to implementing digital education from an interdisciplinary perspective are anchored in European and national educational policies, recent curricular models, and pedagogical experiences from Romania, Estonia, and Finland. The paper proposes a model of integrated curricular design aimed at developing digital competence as an essential dimension of the student's graduate profile. It also outlines the theoretical premises of digital education, the teacher's role in the digital transformation process, and examples of interdisciplinary learning activities that employ digital tools and resources. The proposed methodological framework for integrating digital education in primary school is flexible and based on collaboration, creativity, and reflective learning.*

Keywords: Digital education, Curricular implementation, Interdisciplinarity, Primary education, Digital competence.

1. Introduction

The digital transformation of education has become a central priority of European educational policies, a process significantly accelerated by the experience of online learning during the COVID-19 pandemic. In Romania, this transformation has been formally articulated through the National Education Law No. 198/2023 (Parliament of Romania, 2023) and the SMART.Edu Strategy (2021–2027), which emphasize the development of digital competence as a transversal dimension of the school curriculum. Within this framework, primary education plays a crucial role in the early formation of digital competences, not only through the use of technology but also by fostering critical thinking, creativity, and responsible digital behaviour.

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Digital education is no longer viewed merely as a supportive component of the instructional process, but as a distinct educational field with significant formative value. Consequently, the development of digital competences in primary school students represents a strategic priority, as these competences form the foundation for lifelong learning and active participation in the knowledge society. According to European reference frameworks, digital competence is defined as a combination of knowledge, skills, and attitudes that enable individuals to use digital technologies critically, creatively, and safely for learning, work, and civic engagement (European Commission, 2022). Therefore, digital education at the primary level must extend beyond basic operational skills and intentionally promote higher-order thinking, creativity, and digital responsibility.

Numerous international studies and policy reports (OECD, 2023; UNESCO, 2021) emphasise the early introduction of digital education through interdisciplinary approaches that connect traditional school subjects with digital technologies. Countries such as Finland and Estonia offer relevant examples of good practice, where digital education is embedded in the core curriculum and supported by systematic teacher training. In Romania, strategic policy documents, including the SMART.Edu Strategy (2021) and the National Education Law No. 198/2023, advocate for the integration of digital education across all levels of schooling. However, at the primary education level, implementation remains limited, highlighting the need for flexible curricular models and pedagogical experimentation to demonstrate the effectiveness of innovative approaches. In this context, the present study aims to contribute to the integration of digital education in primary schooling, including through optional subjects, as a means of developing transversal competences. To ensure alignment with European standards on digital competence, such initiatives require systematic expansion and integration into the core curriculum of primary education.

2. Pedagogical foundations of digital education in primary school

Digital education, in its contemporary understanding, extends beyond the instrumental use of technology as a teaching aid and focuses on the systematic development of digital competence. This competence is defined within European reference frameworks as a combination of knowledge, skills, and attitudes necessary for the critical, creative, and safe use of digital technologies. In primary education, digital education should be introduced progressively, in alignment with children's cognitive, emotional, and social development, through playful, exploratory, and collaborative learning experiences.

From a curricular perspective, digital education represents a complex process that involves the integration of digital technologies into teaching, learning, and assessment, while simultaneously functioning as a transversal dimension of competence development for life in the knowledge society (UNESCO, 2021). In this context, the digitalisation of education is no longer an optional technological enhancement, but a pedagogical and curricular requirement that reshapes the roles

of teachers and students, encouraging active participation, collaboration, and personalised learning pathways (OECD, 2023).

Pedagogically, digital education is grounded in constructivist and socio-constructivist learning theories, which emphasise knowledge construction through exploration, problem-solving, projects, and social interaction (Piaget, 1970; Vygotsky, 1978; Bruner, 1996). Within the postmodern educational paradigm, digital education is further associated with the theory of connectivism, proposed by Siemens (2005), which conceptualises learning as a dynamic network of connections among individuals, digital resources, and technological environments.

The pedagogical foundations of digital education are also supported by international competence frameworks that define benchmarks for digital literacy and the responsible use of information and communication technologies. Among the most relevant frameworks are the European Framework for the Digital Competence of Citizens – DigComp 2.2 (European Commission, 2022), which identifies five key competence areas (information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving), the European Framework for the Digital Competence of Educators – DigCompEdu (Redecker, 2017), which provides guidance for the pedagogical integration of digital technologies, and the SMART.Edu Strategy (Ministry of Education, 2021), which aims to support the digital transformation of the Romanian education system through the development of digital competences in both students and teachers.

From a formative perspective, digital education goes beyond the acquisition of technical skills and targets the development of critical thinking, creativity, learning autonomy, and ethical digital behaviour (Selwyn, 2016; Drăghicescu, 2020). Due to its transversal nature, digital education functions as an integrative curricular dimension, encouraging interdisciplinary approaches and facilitating meaningful connections between traditional school subjects and the digital realities of contemporary society.

Consequently, the pedagogical foundations of digital education are based on several core principles: active and collaborative learning, competence-based education, the integration of technology into authentic learning contexts, and the promotion of responsible and ethical digital awareness. In primary education, these principles are operationalised through student-centred, playful, and exploratory activities, in which technology serves as a mediator of learning rather than an end in itself (Coroi, 2024).

3. The interdisciplinary approach – Premises and benefits

Interdisciplinarity provides an optimal framework for implementing digital education in primary school. Through thematic projects and integrated learning activities, pupils can apply digital competences in authentic learning contexts, connecting knowledge and skills from multiple disciplines. Examples of good practice can be identified in the educational systems of Estonia and Finland, where digital education is treated as a transversal key competence, developed through

interdisciplinary activities and student-centred learning projects (Coroi, 2025).

In the context of globalisation and rapid technological change, digital education can no longer be understood merely as a set of technical skills. Instead, it represents an essential dimension of pupils' holistic development, fostering critical thinking, creativity, collaboration, and responsible participation in digital environments. These objectives align naturally with interdisciplinary approaches, in which technology supports meaningful connections between subjects and learning processes. Consequently, European countries have adopted diverse strategies for integrating digital technologies into education, shaped by their specific social, cultural, and economic contexts.

Estonia stands out as a European benchmark in the digitalisation of education (Eurydice, 2019; Eurydice, 2023). Since the early 2000s, national educational policies have focused on the systematic integration of digital technologies at all levels of education, emphasising curricular flexibility and the transdisciplinary application of digital competences. In primary education, the subject Technology has been redesigned to include digital communication, online safety, and the use of emerging technologies. These elements are not treated as isolated content but function as tools that support learning across disciplines. As a result, pupils develop digital competences alongside critical thinking skills and the ability to apply knowledge in diverse and authentic contexts, fostering interconnected and innovative learning (Redecker, 2017).

Similarly, Finland adopts an integrated and transdisciplinary approach to digital education. The National Core Curriculum defines seven transversal competences, among which digital competence plays a central role. Rather than being organised as a separate subject, digital technologies are embedded across all learning areas and are used for research, collaboration, project-based learning, and presentations. Finnish pedagogy, grounded in phenomenon-based learning, encourages pupils to explore complex themes from an interdisciplinary perspective, connecting knowledge from sciences, arts, languages, and digital technologies. This approach promotes contextualised, meaningful, and student-centred learning (Finnish National Agency for Education, 2014–2020).

In contrast, Romania is currently at a more fragmented stage of digital education implementation. Although digital competence is included among the key competences in the national curriculum, its practical application remains uneven across schools. The integration of digital technologies depends largely on local initiatives, available infrastructure, and teachers' levels of digital preparedness. The SMART.Edu Strategy outlines a clear national direction until 2027; however, achieving results comparable to those of Estonia and Finland requires the development of coherent curricular practices that promote the interdisciplinary application of digital competences, sustained investment in educational infrastructure, and continuous professional development for teachers.

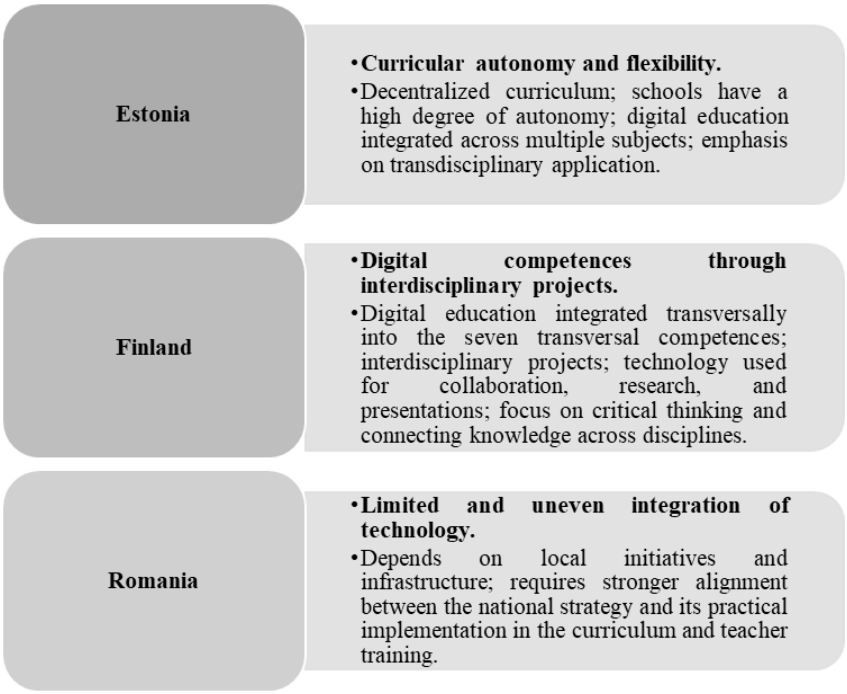

Figure 1. Curricular models for integrating digital education in primary school

Figure 1 illustrates the main curricular models for integrating digital education in primary school in Estonia, Finland, and Romania. The comparison highlights that the successful integration of digital education depends not only on the existence of strategic policy documents, but also on the extent to which technology is used as a bridge between disciplines, fostering collaboration, creativity, and critical thinking. The Estonian and Finnish models offer concrete examples of effective practices, demonstrating how digital literacy and interdisciplinarity can be embedded from the primary level. These models may serve as valuable reference points for Romania in the development of sustainable, coherent, and integrated approaches to digital education that prepare pupils for the challenges of an increasingly complex digital society.

4. Curricular approaches to implementing digital education

Implementing digital education at the primary school level requires a systemic approach, encompassing several complementary strategies:

1. Integrating digital competences into existing subjects;
2. Developing thematic elective courses;
3. Using open educational resources;
4. Ensuring continuous teacher training.

The Romanian model can build on the experiences of the SMART.Edu Strategy and European frameworks such as DigCompEdu, adapting them to the

specific needs of primary education and the local resources available (Ministry of Education, 2021; Redecker, 2017).

A flexible and effective method for integrating digital education in primary schools is through the School-Based Curriculum (SBC), by designing optional courses aimed at developing age-appropriate digital competences. This approach allows for the contextualization of digital education according to each school's resources, profile, and needs, while also fostering interdisciplinary connections with core subjects, such as Romanian Language, Mathematics and Environmental Exploration, Arts, ICT, and Civic Education.

Designing such an optional subject involves several key steps:

- Defining specific competences based on the Digital Competence framework from the Student Graduate Profile and the European DigComp framework;
- Selecting content that promotes critical thinking, online safety, responsible technology use, and digital creativity;
- Structuring learning activities around interdisciplinary themes (e.g., "Digital in My Life," "I Am a Responsible Digital User," "The Digital World – Friend or Foe?");
- Using digital resources, including educational platforms, interactive applications, Google tools, LearningApps, Canva for Education, Kahoot, and Wordwall;
- Conducting comprehensive assessment through digital portfolios, multimedia products, practical activities, and self-assessment.

A concrete example of this approach is the optional subject "Digital Education", developed as part of an experimental pedagogical study (2022–2023) and implemented with 2nd- and 3rd-grade students over one school year (34 hours). The program aimed to develop functional digital competences, ranging from basic knowledge and skills to responsible attitudes and online collaboration. The results indicated that the systematic inclusion of digital activities within an interdisciplinary elective led to significant increases in student engagement, the development of critical thinking, and the formation of foundational digital culture, aligned with the European student competence profile (Coroi, 2024; Coroi, 2025).

Technology provides an ideal context for integrating subjects and supporting project-based learning, offering benefits such as systemic thinking, motivation, learning transfer, and collaboration. The experience of implementing a digital education elective demonstrated that designing interdisciplinary activities enhances student engagement and supports the development of the key competences outlined in the Graduate Profile.

5. Examples of interdisciplinary activities and digital resources

Interdisciplinary activities provide meaningful opportunities to combine digital education with core curricular areas such as language arts, science, civic education, and the arts. Relevant examples include the creation of digital

presentations, concept maps, formative assessment activities using platforms such as Kahoot or Wordwall, and the development of small-scale multimedia projects that reflect pupils' digital competences. In this context, the digital portfolio represents a comprehensive tool for reflection, documentation of learning progress, and self-assessment.

The integration of digital education in primary school requires the use of technological resources within interdisciplinary learning contexts that stimulate creativity, critical thinking, and collaboration among pupils. The examples presented below illustrate how activities designed within a Digital Education elective can support integrated learning and the development of transversal competences:

a) „Digital Stories" – interdisciplinarity between Romanian Language and Digital Education. Pupils create short illustrated narratives using digital tools such as Canva for Education, BookCreator, or StoryJumper. This activity supports the development of written and oral communication skills, while also fostering the creative and purposeful use of digital tools. The final product—a digital book—is included in the pupil's portfolio, illustrating the integration of linguistic and digital competences.

b) „The Digital Class Journal" – interdisciplinarity between Civic Education, Communication, and Digital Education. Working in teams, pupils create a monthly digital class journal using collaborative platforms such as Google Docs or Padlet. The activity aims to develop civic responsibility, cooperation, and teamwork, while also promoting safe and effective digital communication. Through documenting and reflecting on school-related events, pupils practise reasoned expression, critical thinking, and the ethical use of digital technologies.

c) „The Environment in Interactive Images" – connections between Science, Arts, and Digital Education. Using platforms that support interactive digital content, such as *LearningApps*, *Genially*, or *Livresq*, pupils create interactive presentations on natural elements and environmental topics. These activities encourage observation, classification, and the description of natural phenomena, linking scientific understanding with digital and visual skills and supporting discovery-based learning.

d) „Learning through Digital Games" – interdisciplinarity between Mathematics, Science, Communication, and Digital Education**.** Digital platforms such as Kahoot, Wordwall, or WordArt are used to consolidate mathematical and scientific knowledge, as well as communication skills, through playful and interactive challenges. Pupils create or solve digital games that involve logical reasoning, calculation, and clear expression, applying analytical and collaborative skills. This approach enhances motivation and engagement, transforming the digital environment into an attractive space for exploration and knowledge application. Figure 2 presents a visual synthesis of natural resources in the form of a word cloud, serving as a starting point for interactive digital learning activities.

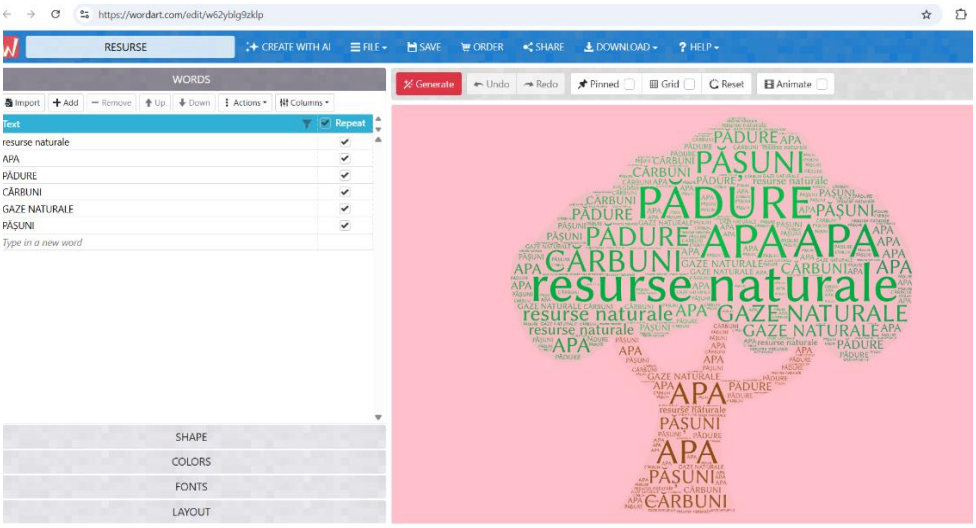

Figure 2. Word cloud of natural resources – WordArt

e) *„Responsible Digital Citizen" – interdisciplinarity between Civic Education, Social Education, and Digital Education.* This activity focuses on the development of ethical digital behaviour, including safe online practices, personal data protection, the identification of fake news, and respect for copyright. Pupils collaboratively create digital posters or presentations, which are subsequently discussed in class to reinforce reflective and responsible attitudes toward digital environments.

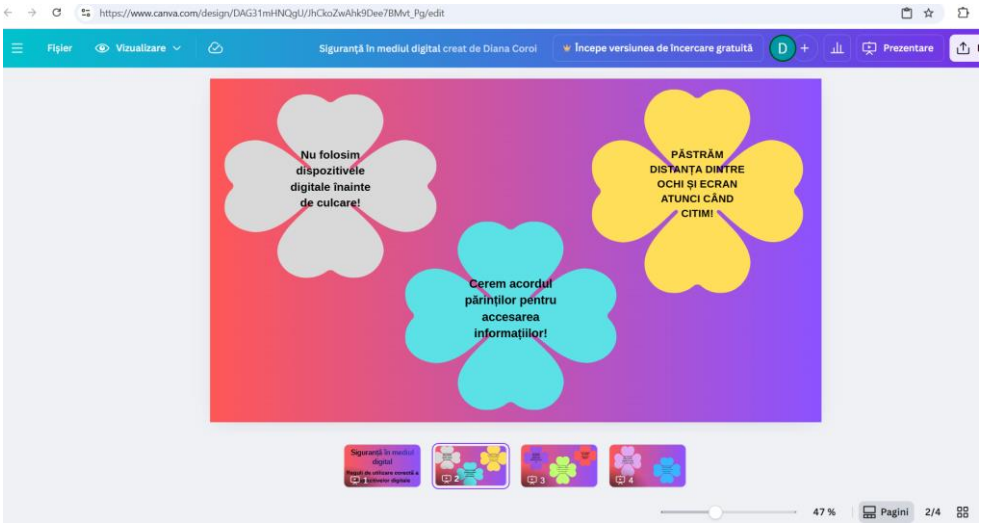

Figure 3. Digital safety rules for primary school pupils – Canva presentation

The example illustrated in Figure 3 represents an interactive presentation created using Canva, outlining technology usage rules adapted for primary school pupils, with a particular focus on digital safety. Overall, these activities demonstrate that the elective subject Digital Education can function as an integrative framework for developing the key competences of the primary curriculum through interdisciplinary projects that combine knowledge, expression, and creativity with the meaningful use of technology. Moreover, through its practical and applied nature, this elective supports the development of pupils' autonomy and fosters a reflective and responsible attitude toward the digital environment (Coroi, 2024).

6. The role of the teacher and digital pedagogical competences

The teacher plays a central role in integrating digital education, acting as a mediator between technological resources and pupils' actual learning needs. Digital pedagogical competences include the ability to select, adapt, and create digital resources, design learner-centered activities, and assess learning through technology. Continuous professional development remains essential for the effective implementation of digital education.

In the digital age, the teacher's role extends beyond the traditional transmission of knowledge, transforming into that of a facilitator of learning and a designer of the digital learning environment. Teachers guide pupils in the active construction of knowledge, stimulate collaboration and creativity, and integrate digital resources tailored to each pupil's needs and learning pace (Drăghicescu, 2020; Selwyn, 2016). This approach emphasizes a learning environment where technology serves as a means, not an end, and pedagogical principles remain central.

Teachers' competences in digital contexts are systematized in the European Framework for the Digital Competence of Educators (DigCompEdu), which identifies six areas: professional digital competences, digital collaboration, and integration of digital resources in teaching, fostering learners' digital competences, digital assessment, and engagement in continuous professional development (Redecker, 2017). These dimensions highlight that the effectiveness of digital education depends primarily on pedagogical expertise rather than mere technical skills. Romania adapts this framework for teacher training and assessment of digital competences.

Continuous training and an open mindset toward technology are essential. Teachers must adopt lifelong learning attitudes, experiment with new methodologies, and quickly adapt to technological innovations, while encouraging students to become critical and creative users of digital resources (Ertmer & Ottenbreit-Leftwich, 2010; Selwyn, 2016).

Research on the implementation of the Digital Education elective demonstrated that successful digital learning depends not only on technology availability but also on teachers' pedagogical competences. Practical experience

showed the need for training focused on pedagogical use of technology rather than technical proficiency alone. Consequently, teacher education should emphasize digital teaching strategies, integration of interactive resources, and promotion of a digital culture that fosters pupils' autonomy and collaboration.

Therefore, the teacher's role in digital education is complex and dynamic: facilitator, designer, and mentor, capable of connecting technology with educational goals and fostering pupils' digital competences in an integrated and sustainable manner.

7. Conclusions and perspectives

Integrating digital education in primary schools requires a coherent, interdisciplinary approach, grounded in collaboration, creativity, and reflection. European examples illustrate that success depends on the quality of teacher training, digital infrastructure, and the coherence of educational policies.

Digital education should be embedded in the curriculum as an essential dimension of learning rather than as an isolated component. Interdisciplinary approaches and elective courses provide effective tools for curricular innovation, stimulating pupils' creativity and the development of digital competences.

Such approaches also offer teachers a framework for pedagogical experimentation and for adapting learning activities to the diverse needs of pupils. The Digital Education elective implemented in this study demonstrated the value of this approach by fostering pupils' creativity and promoting digital competences in a practical, contextualized way (Coroi, 2024; Coroi, 2025).

The findings further highlight the importance of coherent educational policies supporting digital integration at the national level and of continuous teacher training, enabling educators to harness technology pedagogically. Lifelong professional learning, combined with an open digital mindset, is a key factor in transforming technology into an effective learning tool.

Looking forward, integrating digital education in primary schooling represents a strategic investment in developing a generation capable of learning, collaborating, and creating in an increasingly connected world. This approach not only addresses the demands of the digital society but also strengthens the foundation for an innovative, equitable, and sustainable education system.

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