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The Future of Schooling: Harnessing the Potential of Digital Education Technology

Final report

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Table of contents

Introduction	4
Part I: National investments and strategies for schools' digitalisation across the EU	5
1.1 Edtech Investments	5
1.2 Mapping national strategies on school digitalisation	9
Part II Understanding the enabling factors for the successful translation of National EdTech strategies into school-level practices and learning from successful processes	15
1. Summary of individual Case Study findings	16
1.1.Belgium: EdTech implementation in Flemish Schools	16
1.2 Italy: Empowering Schools in Italy: Overcoming Challenges in the Implementation of National EdTech Strategies	17
1.3 Greece: The impact of national resource repositories and learning management systems on Greek schools	18
1.4 Portugal: Edtech Implementation in Schools - Case Study in Portugal	19
2. Cross-case Analysis of Country Case Studies	20
2.1 Translating National Policies into School-Level Strategies and practices	20
2.1.1 School-level implementation of National EdTech strategies	20
2.1.2 Comparing the different approaches to EdTech integration into teaching and learning at a school-level	22
2.1.3 Identifying the main actors in the EdTech strategy implementation process at a school level	23
Understanding the role of ICT Coordinators in the digital transition	23
How does the Headteacher's vision shape a school's digital transition?	24
2.1.4 What are the key enabling factors and barriers in the integration of EdTech at a school-level?	25
2.1.5. Teachers' Continuous Professional Development: the importance of human capital in fostering a 'culture of continuous learning'	30
2.1.6 Teachers' perspective on EdTechs perceived effects on learning	32
2.1.7 Monitoring digital competences and overcoming the shortcomings of SELFIE	34
2.2 Understanding the Role of Technology Costs in a Schools' Digital Development Journey	35
2.2.1 Calling out the elephant in the room: the challenge of EdTech maintenance in schools	35
2.2.2 How do financial constraints shape a schools' digital strategy?	37
Conclusions and Policy Take-aways	40
Annex I (External) Report 1	42
Annex II (External) National Case Studies	42

Introduction

This report addresses two main questions: (1) How do public investments in educational technologies (EdTech) compare across European Union (EU) Member States? and (2) How are national strategies and teacher training policies effectively implemented in school practices?

Both questions are addressed in separate sections of the report (Part I and Part II), each employing a distinct methodological framework. These approaches allow the findings to complement and enrich one another. Most importantly, the two parts differ in focus: Part I examines national-level policies, aiming to reconstruct the main strategies and lines of investment, and to understand how these evolve over time. In contrast, Part II adopts a school-level perspective, seeking to understand how broad national strategies are translated into concrete actions and initiatives within schools, and to identify obstacles to their effective implementation.

The first part of the report (Part I) — based on a **multi-faceted approach** combining desk research, online surveys, consultations, and secondary analyses — shows how difficult it is to get a clear, comparable picture of public investments in edtech across EU countries. The main challenge lies in the fragmentation of responsibilities—between national governments, local authorities, and individual schools—which makes it hard to track spending. On top of that, funding often comes from diverse and uncoordinated sources. Very few countries systematically monitor or evaluate how edtech is being implemented. Where data exists, it usually comes from one-off audits rather than ongoing assessments making cross-country and longitudinal comparisons extremely limited. Moreover, while infrastructure is important, it does not automatically translate into effective use in the classroom. Teachers often prefer in-house training that fosters peer exchange and addresses the practical challenges of blended learning, yet such opportunities remain unevenly available.

The second part of the report (Part II) draws on **case studies** from four countries—Greece, Italy, Belgium, and Portugal—each with different levels of ICT development and distinct post-COVID experiences. By focusing on specific schools and educational settings, the aim was to understand how national strategies and investments in EdTech are put into practice on the ground. The case studies shed light on how schools are working to integrate digital technologies into everyday teaching and learning, revealing both promising developments and ongoing challenges in turning policy goals into meaningful classroom change.

Part I: National investments and strategies for schools' digitalisation across the EU

The first part of the research investigated national edtech policies by focusing on a) edtech investments (section 1.1); and b) edtech strategies (section 1.2)¹.

The research involved several types of research activities. First, a desk research was conducted, which included reviewing scientific and policy reports as well as official documents on public investments in EdTech. The research also relied on consultations with national and international experts and key stakeholders. These consultations included online surveys and bilateral meetings, aimed at assessing the availability of investment data as well as at investigating the governance of edtech policies in each national context. A second round involved in-depth interviews with national experts focusing on teacher training, ICT-mediated practices, and funding systems. Additional consultations were also conducted with experts from international institutions like the OECD. Furthermore, the research carried out a secondary data analysis based on large-scale international surveys such as Progress in International Reading Literacy Study (PIRLS), Programme for International Student Assessment (PISA), which allowed us to compare selected indicators across countries and over time. The analysis of these surveys focused on dimensions such as schools' ICT equipment (e.g., PC-student ratios), perceived shortages by school leaders, and students' home access to digital resources.² Additionally, the study analyses the national expert module of the International Computer and Information Literacy Study (ICILS 2023) in order to further explore countries' edtech investment policies and strategies.

1.1 Edtech Investments

To provide a comprehensive analysis of the investment trends in digital education technology in the EU countries, we examine investments across **three different aspects**:

1. **Models of funding:** the countries analysed offer different examples in terms of responsibility sharing between institutions (central state, local authorities, municipalities), higher or lower levels of single school institutions' autonomy in budget allocation to edtech, and the type of funds allocation mechanisms.

¹ This part of the research builds on and summarises the findings of a previous report, which is fully available in Annex I.

² The collected information was included in country notes, which were developed for nine selected countries combining the quantitative and qualitative information gathered through the various data collection strategies. Summary fiches were also created to offer a synthesised overview of the most significant and comparable findings from these comprehensive country notes.

2. **Financial resources allocated in public budgets:** a preliminary analysis has been conducted using data extracted from budget reports and information provided by various experts during interviews. It is important to note that the preliminary analysis of national budgets is limited to the available data, and is often incomplete and partly contradictory.
3. **Stocks of technology available in schools,** based on the data collected from international surveys (such as PIRLS, PISA), which allows us to capture the output of public investments, as well as its variation over time and across national contexts.

EdTech funding models across and within EU countries are marked by significant complexity and heterogeneity. Budget responsibilities for EdTech are distributed among various institutions, including the central state, regional and local authorities, and individual schools. While public budgets are a key funding stream, national education expenditure for digital content often **lacks a specific category**, making cross-country comparisons nearly impossible. The consultations with experts revealed a heterogeneous picture, with some countries relying on subnational governments for significant financing despite central funding dominating overall education budgets. **Different grant mechanisms exist**, such as earmarked grants (i.e. grants dedicated to specific purposes) and non-earmarked/block grants (i.e., grants allowing for flexible use), which directly impacts the traceability of EdTech investments. Countries with high school autonomy in budget allocation also present challenges in tracking how funds are used.

Based on the ICILS 2023 data, in EU Member States, public schools generally enjoy the highest **levels of autonomy** in organizing professional learning related to ICT, followed by autonomy in software selection, while they have less autonomy in purchasing ICT equipment and receiving technical support. Romania, Sweden, the Netherlands exhibit high or complete autonomy in all areas, indicating strong decentralization in ICT decision-making. In contrast, Spain, Greece, and Hungary report consistently low levels of autonomy across the board, with some limited control over professional learning and equipment purchases. Denmark, France, and Germany maintain moderate levels of autonomy across all indicators, while countries like the Czech Republic, Slovakia, Slovenia, Austria, Finland, and Latvia show varied levels depending on the area, typically higher in professional development and technical support. Among the four national case studies, Italy and Belgium report high levels of autonomy except Belgium's slightly lower autonomy in technical support. Portugal shows moderate autonomy overall with a relative strength in professional learning, whereas Greece displays the lowest levels of autonomy, except for a modest presence in professional development.

Tracking financial resources allocated to EdTech at the national level in public budgets is **extremely difficult**. Accounting and financial reporting systems are not designed to identify specific expenditures supporting digital learning, as it often comprises a mix of capital and current expenditure grouped with non-digital related costs. This difficulty was consistently underlined by consultations and OECD reports. At the EU level, however, a more detailed picture is obtainable.

Significant financial support has been provided through instruments like the Cohesion Policy Funds and the Recovery and Resilience Facility (RRF), particularly since the implementation of the latter. Member states have used these funds for infrastructure, equipment, teacher training, and content development. Notably, under the RRF (with a total budget of €723.8 billion), 21 member states chose to invest over €11 billion in measures supporting the digitalisation of schools. The RRF specifically requires member states to achieve pre-defined milestones, which makes tracking the amounts devoted to EdTech easier compared to previous instruments. The report lists substantial RRF allocations for countries like Greece (€365 million), Italy (over €4.2 billion from various measures like Connected Schools, Integrated digital teaching, New skills/languages, and School 4.0), Belgium (over €398 million across different regions), and Portugal (over €559 million including national funds). Other EU instruments like Erasmus+ and Connecting Europe Facility also support digitalisation. However, **national/local funding data is often not publicly available**, even when significant.

Despite the difficulties in comprehensive tracking, the Recovery and Resilience Facility (RRF) has made it significantly easier to track EdTech spending in recent years compared to prior funding mechanisms. For countries/regions where a clearer picture is available, the period after Covid-19 shows a continuation of a growing trend in investment, partly thanks to RRF funding, rather than a completely new surge.³

Regarding **EdTech availability in schools**, longitudinal analysis of large-scale survey data (PIRLS on 4th grade students and PISA on 15 years old students) shows an **increase in the PC-student ratio over the last ten years across the EU (Fig. 1 - 2), particularly in primary education**. The availability is now close to one computer per student in both primary and secondary education EU-wide. However, **significant cross-country variations persist**, with some countries systematically performing below the EU average. Some countries consistently performed below the EU average, including France, Italy, and Portugal in primary education, and Greece, Croatia, Italy, and Portugal in secondary education, often having values only slightly higher than 0.5 over the period. A marked post-Covid increase in the PC-student ratio was found in Italy and Portugal in primary education, and in Poland and Portugal in secondary education.⁴

In addition to analyzing the PC-student ratio, the school principals' perceptions regarding the adequacy of their school's ICT resources are also examined. Three indicators are used to capture whether principals believe instruction is negatively affected by a shortage of competent

³ European Commission: Directorate-General for Education, Youth, Sport and Culture, ECORYS, EIESP, H2 Learning, Day, L. et al., Digital education content in the EU – State of play and policy options – Technical report, Publications Office of the European Union, 2023, <https://data.europa.eu/doi/10.2766/826721>

OECD (2023), OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem, OECD Publishing, Paris, <https://doi.org/10.1787/c74f03de-en>.

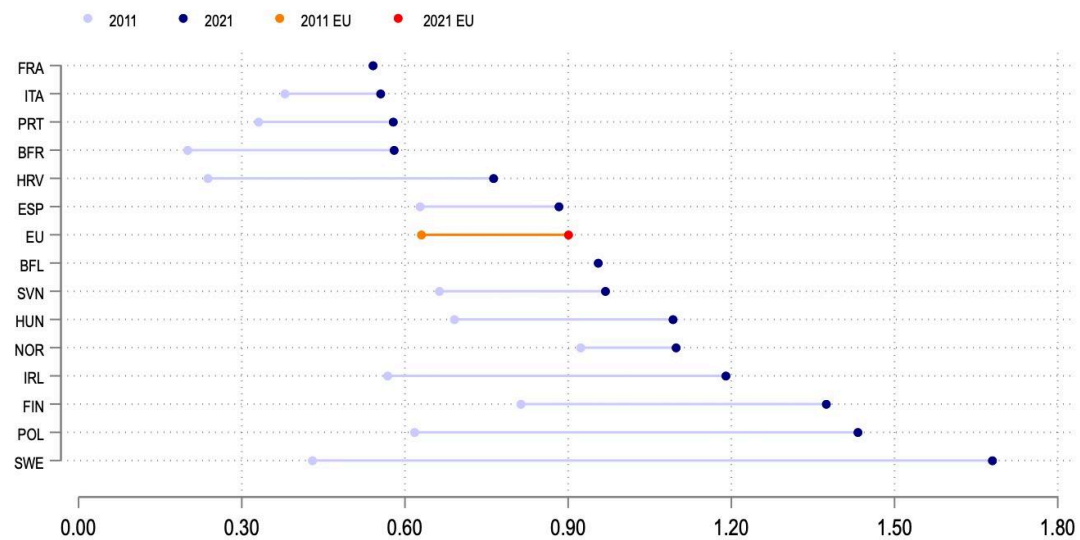
European court of auditors (2023) https://www.eca.europa.eu/ECAPublications/AR-2023-AIB/AR-2023-AIB_EN.pdf

⁴ Additional indicators are analysed and presented in Annex I

staff, technology and media resources, or software/applications for reading instruction. The data, derived from PIRLS for primary schools, shows a marginal **decline over time in perceived inadequacy** of these resources at the EU level, with fluctuations across countries. Notably, the shortage of technology-competent staff remained relatively stable, while shortages in technology and media resources and software applications for reading instruction declined. These trends suggest a **general improvement in schools' digital capacity**, although progress remains uneven across countries. By 2021, school leaders reported fewer challenges in providing instruction due to technological shortcomings, particularly in the post-Covid period.

In terms of students' access to digital resources at home, two key indicators are examined: the percentage of primary students with a digital device connected to the internet at home, and the percentage of secondary students with access to educational software at home. Over the past decade, there has been a notable increase in students' access to these resources, with primary students' access rising from 83% to 93%, and secondary students' access to educational software increasing from 54% to 69%. While the increase is observed across nearly all countries, the magnitude varies, with significant gains in countries like Italy, Poland, Portugal, and Hungary for primary students, and Finland, Hungary, Croatia, and Ireland for secondary students. Although there is no clear "Covid effect" for primary students, a slightly stronger post-Covid increase is visible among secondary students, particularly in the availability of educational software, likely due to the rise of remote digital learning.

Figure 1 PC/Student Ratios in Primary Schools 2011-2021



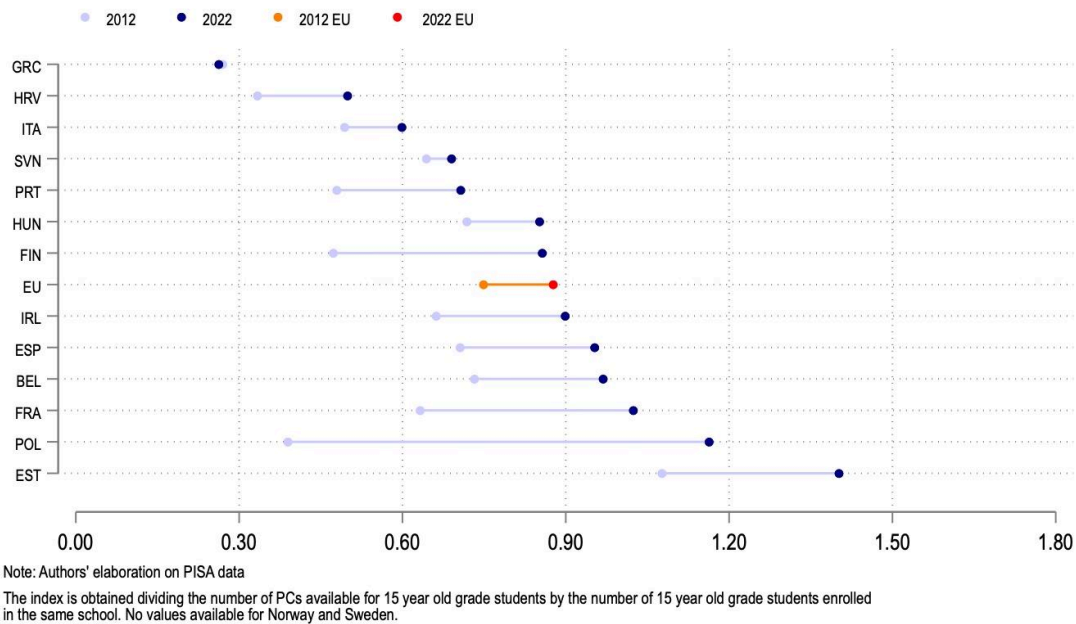
Note: Authors' elaboration on PIRLS data

The index is obtained dividing the number of PCs available for 4th grade students by the number of 4th grade students enrolled in the same school.

No values available for Greece and Estonia.

There is one missing value for Flemish Belgium (2011)

Figure 2 PC/Student Ratios in Secondary Schools 2012-2022



The latest ICILS 2023 data⁵ show that most survey respondents - school Headteachers and ICT coordinators - express a strong need for ICT-related resources, particularly emphasizing support for teachers and access to digital educational materials, internet connectivity, and hardware. Countries such as Austria, Denmark, Germany, France, Cyprus, the Czech Republic, Latvia, and Sweden report strong emphasis across most indicators. On the other hand, Croatia and Malta show little to no policy focus in these areas, and the Netherlands stands out by placing no emphasis on any of the ICT-related resources. This does not necessarily imply neglect; it may reflect a perception that such needs have already been met or are addressed through other means. Countries like Spain, Hungary, Romania, and Slovenia show moderate emphasis, often highlighting teacher support and digital resources but neglecting computer equipment and connectivity at students' homes. Italy, Greece, Belgium, and Portugal demonstrate a relatively strong and consistent policy approach across these indicators.

Based on the 2023 ICILS data, there appear to be a clear division among EU countries regarding 1:1 computing initiatives, with a slight majority having plans or policies to ensure every student has access to a digital device. However, this priority varies widely by country. Among the case studies, Italy, Belgium, and Portugal all have policies or plans to implement 1:1 computing, whereas Greece stands out as the only country without any such policy.

Box 1 - EDTECH INVESTMENT: MAIN TAKEAWAYS

⁵An International Perspective on Digital Literacy—Results from ICILS 2023
<https://www.iea.nl/publications/icils-2023-international-report>

- Tracking and comparing EdTech funding across EU countries remains a complex task. This is primarily due to the **absence of shared definitions and dedicated budget lines** for EdTech; **fragmented and inconsistent statistical data**; the coexistence of **multiple funding models spanning different levels of government**, each with varying degrees of transparency.
- While national and local investment data are often difficult to obtain or interpret, **EU-level programmes**—particularly the Cohesion Policy Funds and the Recovery and Resilience Facility (RRF)—**provide a more structured, albeit still partial, view**.
- The RRF has made monitoring somewhat easier and supported an increase in investment, but it largely **reinforced an existing upward trend** rather than triggering a sharp post-pandemic shift.
- This steady growth is evident in international survey data, which show **enhancements in ICT infrastructure** (e.g., improved PC-to-student ratios, greater use of interactive whiteboards); a **reduction in reported shortages of digital equipment**; and, a **significant rise in pupils' access to digital learning tools** at home.
- Nonetheless, **substantial disparities persist across countries**—highlighting the ongoing need for more harmonised data collection and clearer investment frameworks.

1.2 Mapping national strategies on school digitalisation

The acquisition of EdTech alone is insufficient to ensure its effective integration at the school level. To gain a deeper, comparative understanding of how new technologies are intended to be integrated in school practices is essential to examine more closely national edtech strategies and teacher training policies. The analysis reveals that the heterogeneity observed in efforts to monitor EdTech investments—discussed in the previous section—is equally evident when comparing national strategies and teacher training frameworks.

While the digitalisation of education has become a central policy priority across all EU Member States—particularly in the wake of the Covid-19 pandemic—not all countries have a **dedicated digital education strategy**. In many instances, such strategies are incorporated into broader national digital agendas, which often include targeted funding. Moreover, there is considerable variation in the content and design of these strategies.

As emphasised in consultations with education policy experts, the successful implementation of national strategies relies heavily on the active engagement of central governments in fostering the integration of **digital learning environments** across education systems. An effective digital learning environment integrates several key components: (1) digital tools that assist teachers with classroom management—such as monitoring academic progress, distributing learning

materials, and facilitating communication; (2) online portals for sharing digital learning resources and interactive content; and (3) platforms that support teachers' professional development.

To establish digital learning environments, all consulted countries have developed **online national platforms**, providing free educational resources for schools, students, and teachers. Many of these platforms, some of which existed pre-Covid, were strengthened and promoted during the pandemic. Examples include platforms in Finland, Poland, and Portugal. Belgium's KlasCement platform is often cited as a model of government-supported public-private collaboration, promoting teacher-led content creation and moderation.

In addition to the development of national platforms, the existence of **government-issued guidelines** that promote access and encourage the effective use of EdTech represents a further essential condition for the successful establishment of digital learning environments. While platforms provide the necessary infrastructure and content, national guidelines and online resources are crucial in supporting schools and teachers to make informed, pedagogically sound decisions regarding the integration of digital tools into teaching and learning practices.

Among the EU countries variation exists in terms of how each central government rolls-out EdTech integration guidelines. In Flanders (Belgium) for example, national ICT guidelines are framed in relatively broad terms, reflecting the significant autonomy granted to schools—an approach that can lead to diversity in the quality of implementation across institutions. Therefore, whilst some schools excel for example, others fail to struggle to meaningfully integrate ICT without set guidelines. According to the ICT-monitor cited by a policy actor in 2023, only one third of schools have a thorough ICT policy plan, and discrepancies exist between policy intentions at the school level and teacher awareness of those plans. The Flanders case study selected for this research contradicts the more critical perspectives, illustrating how one school developed a well-articulated ICT plan in collaboration with its teachers. This suggests that while initiatives such as the 'Digital Leap' aim to provide planning support, the actual state of ICT policy implementation in Flemish schools is highly variable and context-dependent.

The presence of digital platforms and national guidelines does not, in itself, guarantee the effective integration of EdTech into teaching and learning. Teachers must also develop the specific competences needed to use these tools meaningfully. In this context, capacity building—particularly through **initial teacher training (ITE)** as well as **continuous professional development (CPD)**—plays a central role and is a priority in most countries.

Country experts generally agree on the critical importance of a trained teacher workforce for the effective integration of EdTech into teaching and learning. However, as highlighted in the ICILS data, ICT-related skills are rarely mandatory in teacher education across EU countries. Most nations adopt a flexible approach, with requirements typically framed as participation in ICT training during ITE or CPD. Countries like Croatia, Cyprus, the Czech Republic, Finland, Slovenia, and Sweden report no formal requirements. Nevertheless, no formal requirements does not necessarily mean that ICT training is not included in ITE, or that teachers do not integrate ICT. In contrast, Denmark, the Netherlands, the Slovak Republic, Luxembourg, and

Hungary mandate ICT competencies during ITE, while Malta and Spain require teacher ICT training during CPD programs. Among the case study countries, Italy and Belgium do not impose any formal ICT requirements, while Greece and Portugal require teachers to engage in some level of professional learning related to ICT.

While data on the inclusion of ICT in ITE is limited, available evidence indicates significant variation: for instance, in 2018, Slovenia, Finland and Estonia reported relatively high figures, with over half of teachers indicating that the “use of ICT for teaching” was included in their formal education, despite ICT training not being mandatory in Slovenia and Finland. In contrast, Spain and Sweden recorded the lowest proportions, with just under 40% of teachers reporting such inclusion. CPD participation rates also vary substantially: Estonia and Spain exceed 65%, whereas Slovenia and Belgium report the lowest engagement, with fewer than 30% of teachers participating in relevant training activities.

The last figures highlight one of the main challenges in EdTech implementation: the low participation in voluntary CPD. Teachers often prefer in-house training tailored to the specific needs of their school, which they find more relevant and accessible. This preference is also reflected in Part II of this report, where teachers emphasise the value of school-based, context-specific training opportunities. Notable initiatives, such as Finland’s ‘Student Agent’ project, aim to harness existing expertise within schools, promoting peer learning and collaboration. In addition, teacher collaboration spaces are widely regarded as valuable platforms for sharing knowledge and good practice. Self-assessment tools such as TET-SAT and SELFIE are also used to support teachers in evaluating and developing their digital competences.

Also CPD efforts tend to be more effective in systems that adopt bottom-up, participatory approaches in shaping their national strategies, as seen in countries such as Ireland and France. These inclusive approaches help ensure that professional development responds to teachers’ practical needs, classroom realities, and evolving pedagogical objectives.

Another common challenge highlighted by experts is the **absence of robust policy evaluation frameworks** to assess the effectiveness of EdTech strategies. While expenditure is routinely monitored, comprehensive mechanisms to evaluate policy outcomes or to identify critical gaps remain largely absent. This lack of evidence limits the ability of schools and teachers to make informed, pedagogically sound decisions, and it complicates efforts to track the performance and long-term impact of national strategies. Moreover, growing concerns about the potential negative effects of EdTech on student learning and well-being—such as excessive screen time—have led some countries, such as Norway, to consider scaling back digital integration in schools.

The **Covid-19 pandemic** accelerated digitalisation and removed bureaucratic barriers, underscoring the need for modernisation across EU education systems. Countries responded quickly to equip students with devices and provide emergency funds, particularly for students with disadvantaged backgrounds. The crisis also solidified the role of the private sector in education, raising concerns around the monopolisation and “platformisation” of education. This

trend, accelerated by the pandemic, poses ethical questions about who shapes digital learning, controls data, and manages education as a public good. Experts emphasise the need for government vigilance, proactive regulation, and collaboration with tech companies to ensure that EdTech remains pedagogically focused and that quality standards are upheld. Belgium's KlasCement platform is presented as a successful example of government-led public-private collaboration, which played a pivotal role in supporting the transition to online learning during the pandemic. Despite increased familiarity with these platforms post-Covid, the long-term impact and the balance between digital and traditional methods remain open for discussion.

In response to the **COVID-19 crisis**, the countries examined across the case studies developed strategic plans, typically spanning a five-year period, with the purpose of addressing the digital transition across multiple sectors. Below is an overview of the main plans adopted in Belgium, Greece, Italy, and Portugal.

Belgium launched the Digisprong programme in 2021, aiming to drive a digital transformation of education and improve ICT infrastructure in schools. The programme is structured around four key components: (1) the provision of future-oriented and secure ICT infrastructure, (2) the development of a supporting and effective ICT school policy, (3) the promotion of ICT competences among teachers and teacher trainers, and (4) the establishment of a knowledge and advice centre in the country. Greece introduced the Digital Transformation Bible 2020–2025, which outlines necessary interventions aimed at fostering digital skills among the population, and promoting digital technology across all sectors of the economy and public administration. In the last five years, Italy has invested in the School Plan for Integrated Digital Teaching, specifically on distance learning activities, with particular emphasis on promoting digital equity. Investments have been made to supply digital devices and internet connectivity to students from socio-economically disadvantaged backgrounds, to provide educational platforms for schools, and to teacher training. Portugal launched the Action Plan for the Digital Transition over the past five years, based on three core dimensions. First, digital training for teachers with the purpose of enabling and motivating them to use digital technologies confidently. Second, develop and implement an Action Plan for the Digital Development of Schools (PADDE) in order to reflect and change educational practices. Finally, the plan includes the provision of high-quality digital resources and contents, ensuring their relevance and accessibility for all students and teachers. Despite differences and aims and implementation, the examined plans share a common recognition of the importance of digital transformation.

Box 2 - EDTECH NATIONAL STRATEGIES: MAIN TAKEAWAYS

- **National strategies are uneven across the EU:** Not all countries have stand-alone digital education strategies; many integrate EdTech into broader digitalisation plans. Strategy content, implementation approaches and funding mechanisms vary considerably.
- **Central governments play a crucial enabling role:** Even in decentralised systems, national-level guidance, resources, and platforms are essential to support schools and ensure coherence in EdTech implementation.
- **Effective strategies typically focus on two main areas:** (1) the integration of digital tools into teaching and learning, and (2) the use of ICT for education system management and monitoring.
- **Bottom-up and participatory planning enhances teacher engagement:** Countries like Ireland and France have shown that involving educators in strategy design strengthens ownership and effectiveness, particularly in teacher training.
- **Dedicated national platforms support access to quality resources:** Government-led platforms, such as Belgium's *KlasCement*, facilitate peer collaboration, teacher-led content creation, and smoother transitions to blended and remote learning.
- **Training is central, but uptake remains a challenge:** Continuous Professional Development (CPD) is key to successful EdTech use, but participation in voluntary programmes is low. Teachers favour in-house, peer-based training tailored to their school context.
- **Lack of robust evaluation frameworks persists:** While spending is often monitored, very few countries evaluate the actual impact of EdTech strategies on teaching and learning outcomes. This limits the ability to identify effective practices and inform future policies.
- **Equity and ethical concerns are increasingly relevant:** There is growing awareness of the risks of excessive screen time, digital dependency, and the influence of private platforms on public education. Some countries (e.g. Norway) are reconsidering the extent of digital integration in schools.
- **Covid-19 acted as a digital accelerator:** The pandemic removed administrative barriers and fast-tracked device provision and connectivity. However, sustaining momentum requires long-term strategic planning and greater regulatory oversight.
- **EU recovery funds offer key opportunities:** The Recovery and Resilience Facility (RRF) has helped bridge infrastructure gaps, especially in disadvantaged areas, but long-term sustainability depends on continued investment and coordination.

Part II Understanding the enabling factors for the successful translation of National EdTech strategies into school-level practices and learning from successful processes

This section presents the main findings from in-depth case studies conducted in Greece, Italy, Belgium, and Portugal, providing insights into how EdTech is being integrated at the school level within diverse policy and governance environments. These countries are particularly valuable for deeper analysis due to their diverse educational governance models, levels of ICT development, and investment trajectories they have made in EdTech.

The case studies span different **levels of centralisation** — Greece and Portugal operate under highly centralised systems, whereas Italy and Belgium fall closer to a medium level — affecting how national digital strategies translate into school-level practices.

They also differ in terms of their **level of digital development**, as shown by various indicators such as the DESI Index, the use of virtual learning environments in schools, and broader measures of digital investment. According to this classification, Greece and Italy are positioned at a lower level of digital readiness, while Portugal and Belgium fall within the medium range.

All four countries have received significant Recovery and Resilience Facility (RRF) funding, offering a valuable opportunity **for targeted investment** in digital education. The in-depth case studies conducted across four countries offer a chance to dive deep into understanding how schools manage large lines of Edtech funding and plan their school's digital transition in accordance with the higher-level national policies. Despite their differences, they share common **structural challenges**, including the task of bringing all teachers on board with new ways of teaching and learning, through the integration of Edtech, and, crucially, the **absence of robust policy evaluation frameworks** to evaluate EdTech's impact on student's **learning outcomes**. These shared constraints make them particularly relevant cases for examining what facilitates—or hinders—effective and sustainable EdTech integration in schools.

Data collection involved **site visits, in-depth and semi-structured interviews, observations, and document analysis**, with interviews conducted with key stakeholders such as school leaders, teachers, ICT coordinators, and where possible, relevant policy representatives.

Site visits were conducted to observe technology use in practice and gather contextual insights into how digital tools were integrated into daily teaching and learning activities. Additionally, **desk research** was carried out to review national policies and program documentation. Some studies also involved **online consultations** with project managers or experts for further perspectives.

The data analysis in three case studies followed a **thematic analysis** approach, identifying patterns and key themes from stakeholder experiences and practices. Moreover, the **Italian case study** applied a **realist-inspired evaluation framework**, focusing on **Context-Mechanism-Outcome (CMO) configurations** to understand the underlying mechanisms and conditions that led to successful EdTech integration.

1. Summary of individual Case Study findings

1.1. Belgium: EdTech implementation in Flemish Schools

This case study explores the **integration of digital technologies in a Flemish primary school**, aiming to understand how national policy measures, particularly the **Digisprong action plan**, are translated and implemented at various educational levels in Flanders. The research investigates the school's approach to technology integration, teachers' professional development, associated costs, and the perceived effectiveness of the policies, especially in the post-pandemic context. The study highlights the context of Flanders, where despite strong digital competency rankings, there are disparities in ICT achievements and a gap between infrastructure and pedagogical integration.

The methodology employed an **exploratory single-case embedded design**, focusing on a primary school and analysing multiple units: micro (teacher), meso (school), macro (institutional), and supra (national policy) levels. Data collection involved **semi-structured interviews** with teachers, the ICT coordinator, the Headteacher, and a stakeholder manager from Kenniscentrum Digisprong. A **site visit** was conducted to observe daily practices and technology availability, and **document analysis** of the school's ICT policy was also undertaken. Data analysis followed a **thematic approach** to explore the experiences and perceptions of stakeholders.

Key findings indicate that the school's **clear digitalisation strategy** and the presence of an **effective ICT coordinator** played crucial roles in supporting teachers' technology adoption. The school demonstrated a comprehensive integration of various hardware and software, including Chromebooks, iPads, digital whiteboards, Smartschool, and Google Workspace, often linked to specific curricular goals. The school also developed additional curricula for media literacy, programming, and computational thinking. Differentiation through technology, using tools like iPads and Snappet, was a key practice. The implementation process involved a structured approach with the principal, ICT coordinator, and teachers playing distinct roles within a Professional Learning Community (PLC) Media. The school emphasised **tailored professional development** through performance interviews, in-house experts, and ICT cafés. Barriers included limited teacher time, managing diverse student technological access at home, and keeping an overview of available technologies. Enabling factors were a clear vision, a structured approach, the ICT coordinator's support, and teacher motivation. Teachers perceived a positive

impact of digital technologies on student learning, particularly in automating tasks, increasing engagement, and diversifying learning modalities.

1.2 Italy: Empowering Schools in Italy: Overcoming Challenges in the Implementation of National EdTech Strategies

The Italian case study examines how two schools in Italy (primary school and lower-secondary school) increased their capacity to **effectively manage large amounts of public investments in EdTech and training for teachers**, developing a digitalisation strategy with a bottom-up approach through the support of a **capacity building programme** in the city of Turin. The research focuses on the **Istituto Comprensivo Gino Strada**, a school that participated in the 'Boosting Digital Capacity' programme funded by an international philanthropic foundation operating in the field of education 'Fondazione Per la Scuola'. The study contributes to understanding how national EdTech policies are translated and actioned into school-level practices and the influence of ICT costs on schools' digital development. A general overview of the national EdTech investment phases in Italy, are consistent with the findings from the case study research: there is a clear before and after Covid-19 scenario, culminating in the significant funding devolved to EdTech from the National Recovery and Resilience Plan (PNRR). The study highlights the challenges schools often face in managing these funds efficiently alongside the difficulties in choosing effective teacher training to ensure all teaching staff is able to 'keep-up' with the fast-paced and, necessary, digital transition, without leaving anyone behind.

The case study provides an in-depth examination of the digitalisation journey and practices adopted by the **Gino Strada Comprehensive Institute** in order to tease out the key enabling factors that make it a 'success story' in terms of EdTech integration in the context of public education in Italy. It is considered a **critical instance case study** through which the focus is on a single, highly significant case of success with the aim to gain a deeper understanding of how to transfer best practices from that particular context elsewhere. The participation of the school in the 'Boosting Digital Capacity' intervention is also considered to examine how and whether the programme contributed to its success. Data collection involved **desk research** of national policies and programme documentation, followed by **face-to-face semi-structured interviews** with the deputy Headteacher, Office Manager, ICT coordinators and Digital Animators (for primary and lower secondary schools), and teachers. Online and face-to-face consultations were also conducted with project managers from Fondazione per la Scuola, who followed the school's journey throughout the capacity building programme. Data analysis was based on a **realist evaluation premise**, which sought to identify Context-Mechanism-Outcome configurations (CMOCs) in the data to explain how the intervention led to successful EdTech integration.

Results highlight that the school's participation in 'Boosting Digital Capacity' was useful particularly for **increasing awareness** of teacher training needs and devising training strategies

from the bottom-up, as well as increasing **planning capacity** of national EdTech funds. Taking part in the programme also fostered **networking opportunities** with other schools which was viewed as instrumental for the replication of best practices happening elsewhere in their own school context. **Strong leadership** led by a forward-thinking Headteacher appointed in 2019 also played a part in accelerating the school's digitalisation process, but the presence of a solid group of motivated teachers willing to innovate amongst the teaching staff was crucial for embracing the digital transformation. **Practical teacher professional development**, including hands-on training led by teachers, was key to shaping EdTech integration through peer-learning. By capitalising on in-school 'innovator' teachers, 'Boosting Digital Capacity' effectively 'forced' teachers to put newly acquired knowledge to the test by demonstrating how EdTech tools had been implemented into day to day activities and lesson plans. The programme also equipped those trained through a 'train the trainer' approach with the skills to replicate training within their schools, which facilitated bottom-up EdTech integration through informal peer meetings and collaborative working groups, which were both effective mechanisms for knowledge sharing and organic EdTech uptake. A key reflection shared amongst research participants is that when transitioning to a pedagogically-informed use of EdTech simply increasing funding for EdTech is insufficient; effective fund utilisation requires capacity at bureaucratic, strategic, and pedagogical levels, as well as solid human capital. In terms of criticalities, **maintenance costs** and ensuring universal device access remains a dilemma for the future. Contrary to initial assumptions, the recent wave of PNRR funding provides little autonomy in equipment choices, but even so, 'Boosting Digital Capacity' supported strategic use of existing and new equipment through targeted training.

1.3 Greece: The impact of national resource repositories and learning management systems on Greek schools

This case study investigates the impact of **centrally provided digital infrastructure, digital learning platforms and training on teachers' ICT practices in Greek schools**, focusing on the context of recent digital transformation plans like "Digital Skills for Digital Greece" and "Greece 2.0". The study aimed to explore the enactment of digital education technology policy in primary and secondary experimental schools in Thessaloniki, considering how national policies are interpreted and translated at the school level. Greece's highly centralised education system and its long history of developing national digital platforms (e-Class, e-Me) and open educational resource and digital textbook repositories (Photodentro) provide a rich context for this investigation.

The methodology involved **purposive sampling** to select two experimental schools in Thessaloniki: a primary and an upper secondary school, chosen for their advanced digital practices. **Face-to-face semi-structured interviews** were conducted with school Headteacher, ICT teachers, subject teachers and two experts involved in the development of national digital platforms and training. Data analysis adopted a **thematic approach** to compare views and practices within and between the two schools, considering observations and desk research.

Key findings indicate that **while the state provided digital infrastructure** like interactive white boards have been well received and used regularly, **schools need additional material** on top of the state-provided robotics kits. Internet connectivity was a major obstacle despite recent efforts in the municipality to improve it. **Schools don't have dedicated ICT administrators** that provide technical and pedagogical support to the staff. Maintenance of the digital infrastructure and technical support remains the responsibility of computer science teachers. Teachers in both schools are overall innovative, and training about ICT use in teaching is covered by **“coordinator” teachers** in each core subject, who are responsible for organising **regular training for their colleagues**. The dominant digital teaching approach combines **flipped classroom method with student-centred activities** and collaborative learning to create digital media. Teachers often supplement state-provided platforms with free or paid commercial tools (Google Classroom, Padlet, Canva, Socrative) due to perceived limitations in usability, features, and storage of e-Class and e-Me. While teachers appreciate the privacy aspect of national platforms, they find them still **slow and outdated** for functions such as assessments and quizzes, **compared to commercial products**. Photodentro, the national resource repository, is used by science and math teachers more than others, because the available learning resources are more suitable for them. While sometimes technical issues happen (e.g., Flash-based content being obsolete), the state agencies continuously try to solve them and update the national platforms and have concrete plans for their sustainability (e.g., negotiating with the industry to integrate new third-party tools, integrating AI tools). **The B-level ICT certification programs are generally seen as useful for creating a foundational understanding of ICT in education**. More flexible, shorter training professional development relies heavily on teacher initiative in the school and the support of regional education counselors. **A lack of a strong co-teaching culture limits peer learning opportunities**. Despite progress since COVID-19, high-stakes standardised tests can still prioritise traditional teaching methods in secondary education. Schools actively seek additional funding from parents' associations, philanthropic organisations and through Erasmus+ projects to enhance their digital resources and infrastructure. This does not seem to hinder the experimental schools in the large city, but could be a barrier for schools in more rural areas, where there are fewer channels of funding available.

1.4 Portugal: Edtech Implementation in Schools - Case Study in Portugal

This case study examines the impact of Portugal's large-scale policy initiative, the **Action Plan for the Digital Transition**, a five-year top-down initiative built around four pillars: a set of laptops and mobile connectivity for every student and teacher; teacher professional development in digitally enhanced pedagogy; school strategy to support digitally-enabled innovation in teaching and learning; and digital learning resources. Unlike previous initiatives, in Portugal and other countries, that focused primarily on technology, this plan strategically links the use of technology with pedagogical purposes, emphasising ‘learning with technology’. The research focuses on how this Action Plan has been translated and implemented in the **Martim**

de Freitas school cluster in Coimbra. The study aims to understand how this national plan, with its "**pedagogy first**" and systemic approach, has influenced the school's use of digital technology, the reception and impact of its teacher training component, its interaction with the school cluster's own strategies, and the influence of the centrally organised funding model on school management.

The methodology involved a **qualitative approach**, including a full-day school visit with interviews with the school leader, teachers (experienced and new), students, the digital ambassador, the librarian, and internal and external teacher trainers. There were also presentations on the school's digital strategy, group discussions, classroom observations of project-based learning, and a visit to the new Digital Lab. The Martim de Freitas school cluster was selected as an **advanced case of good practice** for its pedagogical use of technology.

Key findings show that while the central provision of free laptops to students and teachers is an important initiative that should be free to the school, it still creates an **organisational burden** and **indirect costs** at school level in terms of **maintenance, repair management** and **support for students without laptops**. The school cluster addressed this by hiring a technician and training teachers to adapt their teaching practices to collaborate with fewer devices. In terms of teacher training, the study highlights the importance of **explicitly linking technology and tools to student skills and classroom scenarios**, as well as the crucial role of **intermediate actors** (such as ICT Ambassadors, Teacher Training Centres associated to schools, and ICT Competence Centres) and **communities of practice**, in bridging central training and school-level implementation. In addition, the fact that the Martim de Freitas cluster **formally allocates time for teacher collaboration** (one afternoon per week) has fostered a **culture of "testing practice"** with new technologies that facilitates the adoption of innovative teaching and learning in a sustainable way. The study also emphasises that **school leadership and their vision are critical** to successful technology integration, even with central guidance, written policies and action plans. Overall, the case study highlights the importance of a pedagogy-driven, evidence-informed, and contextualised approach to edtech implementation.

2. Cross-case Analysis of Country Case Studies

In the following section we seek to compare and contrast the similarities and differences amongst the different approaches taken by the individual schools in each of the four countries in which a comprehensive case study research was conducted. All case studies explore **how national policies and investments in digital education are implemented at the school level** (subsection 2.1) and the role and impact of **teacher professional development** in supporting technology integration (subsection 2.2).

2.1 Translating National Policies into School-Level Strategies and practices

2.1.1 School-level implementation of National EdTech strategies

The integration of national EdTech strategies at the school level in Flanders, Greece, Portugal, and Italy reveals a dynamic interplay between national frameworks, local leadership, and teacher agency. While each context operates within distinct governance structures—ranging from decentralised autonomy to centralised planning—the case studies demonstrate that **successful digital transformation depends less on the structure itself and more on how schools engage with and adapt** to their specific circumstances.

Across all four systems, the presence—or absence—of a formalised digital strategy played a nuanced role. In Flanders and Italy, schools developed a clear digital vision under the guidance of the **school leadership**, which was then translated into school-level action through strong internal support systems. In Flanders, the Headteacher's initiative led to the appointment of an ICT coordinator who not only implemented strategic tools such as the SELFIE framework, but also facilitated meaningful professional development through a Professional Learning Community. In Italy, a similar clarity of vision emerged under a newly appointed Headteacher. While guided by national roles such as the Digital Animator and ICT coordinator, the Italian school relied heavily on a collaborative group of teachers committed to experimenting with and disseminating innovative practices. In both contexts, a coherent school-level digital strategy was coupled with **distributed leadership and internal capacity-building**, allowing the national vision to be enacted in locally relevant ways.

Portugal, by contrast, operates under a more centrally guided model. Schools are required to develop digital action plans based on a national template aligned with the DigCompEdu framework, and receive structured support from trained Digital Ambassadors and affiliated teacher training centres. Despite this top-down framing, the role of the Headteacher remains pivotal. The case study highlights how the interpretation and enactment of national directives depend strongly on the school leader's ability to mobilise internal structures, such as the coordination of technical support and the organisation of teacher collaboration time. Thus, even within a tightly prescribed national framework, school-level agency plays a critical role in ensuring that implementation is not merely compliant but pedagogically meaningful.

Greece represents a contrasting example where national centralisation coexists with greater informality at the school level. First, although there is no written digital strategy required of schools, annual planning cycles are firmly in place: school boards discuss and revise decisions at the end of each school year, enabling a reflective and adaptive approach. The headteachers play an encouraging rather than guiding role in innovation and ICT use in teaching, and believe in the benefits of international professional networking for their teachers (e.g., through Erasmus+ and eTwinning). A second example is the recent national requirement for schools to organise 15 hours of training per school year. This stimulated teachers to exchange ICT experiences more with each other, with the freedom to determine the topics of training for which the teaching staff felt a need. This flexibility allows schools, particularly experimental ones, to

engage in partnerships with universities for professional development. The state ICT certification training seems to successfully develop teachers' ability to design student-centred lessons with ICT in mind although the digital tools it addresses might become obsolete due to the fast-changing EdTech landscape. Teachers in experimental schools perhaps have the mindset to try new digital tools even more, because the state requires them to pilot new curriculum material before they are rolled out nationally .. Finally, the centrally provided digital platforms form a common denominator for teachers, supported by the national certification training and the open resource repositories. Whenever these platforms do not meet the needs, teachers complement their practice with digital tools from the EdTech industry at their own initiative. While the lack of a unified digital policy may result in some variation in tools and platforms, these schools compensate through collegial deliberation and shared decision-making, often grounded in research-practice collaboration.

Despite differences in structure and degree of formalisation, all four cases highlight the centrality of leadership, teacher involvement, and contextual adaptation. Whether through the structured coherence of Portugal, the university-linked innovation in Greece, the teacher-led experimentation in Italy, or the professional learning infrastructure in Flanders, each case illustrates how digital strategy becomes effective when supported by a shared vision and anchored in the context of teaching practices within a school. Across the board, the presence of key support roles—ICT coordinators, Digital Animators, and Digital Ambassadors—was critical, yet their impact depended on being embedded within broader collegial and strategic processes.

2.1.2 Comparing the different approaches to EdTech integration into teaching and learning at a school-level

In Flanders, digital integration is extensive and systematically supported. Following the Digisprong initiative, Chromebooks are available for pupils from year 3, while iPads are used in lower years. Teachers report that these devices enable continuity between school and home learning, supported by platforms like Smartschool and Google Workspace. Digital boards and multimedia are regularly used to illustrate abstract concepts, while subject-specific tools like Snappet in mathematics provide adaptive support and formative tracking. In language education, a combination of digital and traditional resources is used, with tools like Fonemi aiding phonemic awareness. For homework and enrichment, platforms such as Bingel, Scratch, and Minecraft Education are employed. STEM-related digital tools such as Bee-Bot, Lego WeDo, and Micro:bit are used thematically, often for discovery-based learning, though access varies. Teachers highlight the use of tools like Kahoot, Canva, Padlet, and LessonUp for assessment and lesson preparation—tools that also appear in other cases, pointing to a shared repertoire across contexts.

Portugal presents a similarly structured but more centrally guided approach. The national Action Plan for the Digital Transition ensures that all students receive laptops and internet access, thereby removing key infrastructural barriers. At Martim de Freitas, this has enabled

project-based and interdisciplinary teaching practices. Students collaborate on digital projects, and the school participates in the national digital textbook pilot. The presence of a full-time technician helps address technical challenges, and adaptive teaching practices reflect a capacity for autonomous problem-solving within a broader reform. Much like in Flanders, tools that promote collaborative and active learning are prioritised, and teachers employ digital platforms to facilitate planning and communication. Assessment is also increasingly digital, aligned with student-centred pedagogies.

In Italy, the use of technology is closely linked to pedagogical aims such as personalisation, collaboration, and relevance to the subject being taught. Teachers integrate digital tools to support group work, realistic learning in subjects like mathematics and geography, and the creation of narratives and stories. Rather than treating digital tools as isolated inputs, their use is embedded within broader learning goals, often with strong support from ICT coordinators and innovative staff. Teachers highlighted the integration of ICT tools for more enhanced and realistic learning in geography (Minecraft and Google maps); playful mathematics exercises, and timeline softwares for history and storymaking. Similar to the Flemish and Portuguese cases, Italian teachers emphasise student engagement and autonomy, with technology serving as a facilitator for deeper understanding and contextualised learning. There are however concerns regarding screen-time, particularly when it comes to the primary school level. In the Italian case study the school has begun to make 'school and parent digital deals', whereby guidelines regarding screen time and the way in which technology is integrated in school and at home are agreed amongst the school and parents.

Greece offers a dual narrative. In primary education, ICT use is most visible in extracurricular clubs such as robotics, comics, and film editing. These activities use advanced tools like Lego microcontrollers and webcam recognition. During computer science lessons, limited ICT hours push teachers to work efficiently, favouring open-source software like Linux, LibreOffice, Inkscape, and GIMP. Instruction typically includes spreadsheet calculations, coding in Python or block environments like MakeCode, and educational games such as those from Photodentro. In secondary education, the focus shifts to computational thinking and creative production. Students use tools like Scratch, Python, 3D printers, and Sketchup to design and construct both digital and physical products. Pedagogically, Greece, like the other cases, shows a preference for student-centred approaches—flipped classrooms, group work, digital media creation, and hands-on tasks. There is also a shared concern across contexts for managing screen fatigue. In Greece, for instance, some activities are intentionally shifted offline (e.g., drawing mind maps by hand), a strategy echoed in other schools' efforts to balance screen time with physical interaction.

Commonalities emerge across the cases, particularly in the use of formative assessment tools such as Kahoot, which appears in both Greece and Flanders, and in the broader use of digital platforms (e.g., Google Workspace, Canva, Padlet) for planning, collaboration, and creative output. Project-based learning is a recurring feature, seen in Portugal's interdisciplinary collaborations, Italy's context-based assignments, and Greece's digital clubs and engineering projects. Differentiation and inclusion are also prioritised, with adaptive software in Flanders and targeted support for language learners in multiple contexts.

2.1.3 Identifying the main actors in the EdTech strategy implementation process at a school level

The case studies allowed us to gain a deeper understanding of who are the main actors involved in the process of integrating EdTech at a school level, and how the role and relationships amongst these actors is crucial for ensuring that EdTech is integrated effectively within school teaching and learning practices.

Understanding the role of ICT Coordinators in the digital transition

The main point to highlight for the Italy and Belgium case studies is the strategic role of ICT coordinators (even if under different labels), in devising practical strategies that respond to school needs and align with the Headteacher's vision for the school's digital transition. In fact, in both cases this role is crucial in translating the vision into practices that work within the school's individual context. Both case studies provide insight as to how a solid and competent figure bridging between the school head's vision and the practices adopted by teaching staff within a school is essential to ensure that appropriate steps are taken both in terms of maximising the use of EdTech equipment (and strategising on EdTech Acquisition) but also from the perspective of meeting teacher's training needs and building their digital capacity. A very similar role is played by the IT Ambassadors in Portugal, each of whom works with several schools while still teaching part-time at their own school; the difference is that they bring together and align the vision for teaching and learning of the Action Plan (centrally designed) with the vision of the school leader and teachers.

Across Flanders, Italy and Portugal studies, ICT coordinators play a key role in the approach taken to integrate EdTech at a school level. However, whilst this role seems more crucial in Belgium and Portugal, in Greece the responsibility is spread over multiple teachers, and in the Italian case study it seems more subtle but this is a mere issue of 'labels', as in Italy ICT coordinators with a more strategic role are labeled as 'Digital Animator'. The ICT Coordinator, is more often a teacher who also deals with the technical management of IT infrastructure within the school, whilst the Digital Animator is a teacher within the school appointed by the Headteacher who also takes on an active role in planning training initiatives, coordinating the integration of EdTech on a more educational and pedagogical level. It is thus important to look beyond the labels and more to what role each figure plays within its school context. For the cases of Belgium, and Portugal ICT coordinators play a similar role to the Italian 'Digital Animator' but under a different label. In Belgium the ICT Coordinator translates the Headteacher's digital vision into concrete classroom practices. While the Headteacher provides strategic oversight, the ICT coordinator is in charge of implementation, creating key documents, developing the school's website for dissemination, and organising in-house workshops to enhance teachers' digital competencies. The figure of the ICT coordinator is thus key in operationalising the Headteacher's digital vision, by liaising with teachers, understanding

training needs, strengthening day to day practices towards more pedagogically-informed integration in teaching practices. This is possible thanks to ICT coordinators' embeddedness within a school's dynamics and day to day, offering a bridge between the teaching's staff training needs and the digital vision of the school.

In both Italy and Greece the case studies also highlighted the importance of 'innovator teachers', i.e. those teachers who are not necessarily 'tech-savvy' but who are open to innovation and motivated to try out new and different approaches. Relying on this group appears to be instrumental in both cases to create buy-in amongst the wider teaching staff. In the case of Italy for example the group of innovator teachers was selected and trained through the capacity building programme through a 'train the trainer' approach, in order to ensure that these teachers were not only skilled but also equipped to share acquired knowledge with the rest of the teaching staff within the school. For this reason, from the interviews the success of the Italian case study approach seems to lie in the fact that a whole team was created, and whilst the ICT coordinator and the Digital Animator are indeed the more 'tech-savvy' teachers with a role in supporting colleagues through training initiatives and day to day issues, the implementation process is coordinated by actual teacher *working groups* and does not lie solely in the hands of the ICT coordinator and the Digital Animator.

How does the Headteacher's vision shape a school's digital transition?

The four case studies align on the importance of strong leadership when it comes to a school's digitalisation process. Particularly from the case studies of Belgium, Italy and Portugal, the role of the Headteacher in steering the digital transition is viewed as a precondition for a school to be able to seize available opportunities and embrace the digital transition within the school's teaching practices. Italy, Belgium and Portugal case studies highlight the importance of having a Headteacher with a clear digital vision who is able to prioritise scalable interventions to keep EdTech integration in line with the school's vision and National plans. Whilst these success stories are useful in teasing out such learning, and while strong leadership and vision are both desirable qualities in a school, the critical role assigned to a school Headteacher in terms of being a critical enabling factor in a school's success story raises some important concerns about the scalability and sustainability of such successful models. Particularly in schools where such leadership may be absent or underdeveloped, the over-reliance on school-level discretion may be empowering, but also runs the risk of increasing variability and inequalities in implementation and outcomes across the national system, whereby Headteachers are appointed randomly.

The role of the Headteacher extends beyond the introduction of new technologies: from the point of view of the Belgium, Italy and Portugal case studies it provides a strategic oversight on the integration of technology, for instance, facilitating a sustainable digital transformation, monitoring progress, and adjusting strategies as needed. Rather than being defined as a detached authority, the Headteacher is portrayed as a member of the school community, interacting with teachers and ICT coordinators through regular meetings and interactions serving as valuable mechanisms for defining digital plan implementation. Furthermore, the contribution of the school principal to the digital transition is closely linked to the school context.

2.1.4 What are the key enabling factors and barriers in the integration of EdTech at a school-level?

ICT coordinators with a pedagogical vision

Across the case studies we found that the role of the ICT coordinators was pivotal even if they are not always labelled in the same way, for example in Italy they refer to the ICT coordinator as the **Digital Animator**. Considering that teachers have little time to learn new tools by trial and error, it helped that an ICT coordinator organised regular in-school training on ICT use in the cases of Belgium and Italy. This worked especially well when the ICT coordinator also had a teaching background. In Portugal, the role of the ICT coordinator is largely fulfilled by **Digital Ambassadors** who work part-time as teachers in their own school while supporting the role of IT Ambassadors in a number of other schools; they are also able to identify the training needs of the school and connect them to the provision of the teacher training centres associated to the schools.

ICT coordinators played a smaller role in mainstreaming ICT use in Greece. Although they are teachers and thus have a pedagogical understanding of ICT use, their support was more informal, in the form of a “go-to” person for technical support and ideas for new tools. They also have teaching duties and have less time to dedicate to organising formal activities about ICT use. Training on ICT use was rather shared with coordinator teachers per each core subject, who may train others in ICT use or more subject-specific topics.

Professional development

Large-scale digital skills training activities have been implemented in Portugal (Action Plan for the Digital Transition in Education), Greece (B-level certification) and Italy (Piano nazionale per la scuola digitale, PNSD). Complementary to this, evidence collected from the case studies shows that **shorter and tailored training activities within schools** facilitate the **implementation of skills learned in centrally implemented training actions**, this is particularly highlighted in the Italian case study through the school-specific initiative ‘Riconessioni’. In Greece, there is a recent requirement for schools to organise 15 hours of teacher training per school year. This new requirement has **incentivised teachers to regularly organise training for their colleagues** and has promoted **knowledge exchange** among colleagues. They have the **freedom to choose the training topics** according to their daily **needs**. Something similar happened in Italy where the ‘DM 66’ which constitutes a regulatory instrument within the framework of the National Recovery and Resilience Plan (PNRR). The decree focuses on implementing digital teaching projects and **training school staff for the digital transition** by providing specific funding to schools, allowing them to carry out targeted programmes that **improve classroom technology use** and **train teachers in new digital skills**. In Portugal, intermediate level actors, i.e. bridging the vision and objectives from the central level to schools, such as the digital ambassadors and training centres, facilitated the implementation of large-scale training actions, but it was regular weekly meetings in school that mainly enabled experimentation with and adoption of digital practices. In Belgium, training opportunities are centrally offered to an extent by the **Digisprong** initiative, but professional

development is **tailored more at school level**. **School-level training activities** (from training organised by school leaders to the more informal ICT cafes) already take up most of the teachers' professional development time and school-network level or other external training are less prominent. The Belgian case further underlines the importance of flexible professional development and networking opportunities.

In all cases, professional development activities were **successful when they had a hands-on component and were conducted in school, tailored to teacher's needs**. In Italy, teachers were expected to report how they implemented digital practices in their teaching after their training. In Greece, the certification training required teachers to develop a lesson plan that integrates ICT, and the informal training organised at school also asked teachers to do practical exercises. Hence, providing **hands-on training opportunities** within school, tailored to the teacher's training needs and the ICT equipment availability is certainly viewed as a **facilitator towards the successful integration of EdTech**.

Formal and informal peer exchange

Training alone does not guarantee that teachers will implement what they learned from it in their classroom. A professional learning community in school can be a mediator in translating training into practice. In Portugal, teachers felt supported and encouraged to implement new ideas that involve ICT, because they had a set time every week to meet and exchange about their practices, even if held as an online meeting. In Italy, peer exchange worked well in informal settings, where teachers felt safe to express their training needs. In Greece, peer exchange took place during training sessions organised by more experienced teachers, where peer interaction was high thanks to a friendly atmosphere. In Flanders, this took the form of a professional learning community about ICT and innovation, which considered both student needs in school but also larger trends in the education system and evidence from research, for instance, when deciding whether to use virtual reality. When coupled with an evidence-informed decision-making mindset as in Belgium, informal peer exchanges and professional learning communities can support selecting digital tools that will bring the most meaningful benefits to the school.

School leadership with a vision of ICT use

Teachers' motivation to try new digitally enhanced teaching practices benefited from a supportive school leadership across all case studies by encouraging teachers in formal and informal ways: making time for self-reflection; improving infrastructure; encouraging international networking and innovation; involving in decision making and mobilizing peer support. In Flanders, the school principal had a clear vision that ICT will be used to make existing teaching more efficient and save teachers' time to be better used elsewhere, such as differentiation. Furthermore, the school leadership developed a digital strategy jointly with teachers and conducted a SWOT analysis on top of the SELFIE assessment, for a more tailored reflection on the school's needs and goals. In Italy, the new school principal triggered a digitalisation wave in the school, who made EdTech integration a priority and helped the school get ready for remote teaching before the COVID-19 outbreak. In Greece, school principals encouraged international

collaborations (Erasmus+, eTwinning), which created opportunities for innovative projects and renewing ICT equipment. Both emphasised the importance of digital skills for their teachers and innovative extracurricular clubs, because they need to be ready for implementing new curriculum material as experimental schools. In Portugal, schools established a digital teacher team which works with a distributed leadership mindset in implementing digital practices. These teams try encouraging other teachers to adopt new ICT-based education practices according to each school digital plan.

Resource repositories

Open educational resource (OER) repositories offer ready-to-use or adaptable resources to teachers, encouraging them to also upload and share their own lesson plans and resources. In Flanders (KlasCement) and Portugal (Periscope Island) a national platform aggregates digital learning resources. In Greece (Photodentro) teachers are also able to access content and lesson plans created by other teachers. The platform encouraged Greek teachers to upload their own material as well, especially digital resources for mathematics. In Italy, an online resource sharing platform was built within the school, where innovative teachers uploaded their own material. This encouraged more reluctant teachers to access ready material and get inspiration. Having a resource repository was seen by teachers in the Italian case study also as a way to tackle the issue of staff turnover, a way to pass over the knowledge and resources to new teachers entering the school.

Sudden shifts in national digital policy

Winds have been shifting for digitalisation in Europe, since the Swedish education system, as well as the Netherlands, raised concerns about screen time having a negative impact on learning and wellbeing. This led to a rapid change of policy in Portugal, where the primary education level was taken out of the digital textbooks pilot project. This led to frustration in some schools who had already adopted the new policy for testing. Rolling out a new policy too quickly can also be a cause for burden and delay the integration of digital practices. In Italy, the rapid rollout of the public investments to support school digitalisation was identified as a challenge that can cause some schools to struggle with integrating technology effectively. Moreover, raising concerns about screen time, particularly in primary schools, have brought schools to start introducing 'digital deals' between the school and parents as a way to counteract concerns. Greek schools have banned mobile phones in the classroom, and now teachers find alternative tools that require fewer devices, while in the past they relied on students' devices for some digital activities in the classroom when there were not enough computers for all students.

Pressure from curriculum and other competing responsibilities

Curriculum goals and high-stake exams in later grades can put pressure on teachers and take time away from teaching staff who could use it for experimentation, reflecting on their digital skills, or planning professional development and peer exchange. Both in Italy and Portugal,

teachers mentioned experiencing stress from a lack of time in implementing new practices and tools they learned in training. This was mitigated thanks to a fixed time in the week arranged by the school in Portugal and providing supervisor support to teachers in Italy. Time constraints can impact not only participation in PD but also in designing and organising them: in Italy, the heavy workload of the school staff in some cases led to purchasing generic training packages offered by external private providers. In Greece, especially in secondary education, high-stake standardised tests can put pressure on teachers, which might hinder daily use of more active and diverse digitally enhanced learning activities.

Partnerships

To a lesser degree, partnerships with external organisations seemed to support digitalisation, complementing large-scale national initiatives with more flexible support to schools. Both in Italy and Greece, schools collaborated with philanthropic organisations. Schools also seem to benefit from mobility and networking opportunities where they can learn from other schools. The school cluster structure helps Flemish and Portugal schools to organize infrastructure and professional development and cluster level. In Greece, the eTwinning initiative of the European Commission was an additional source of professional development and collaboration with teachers from other schools; the network of eTwinning is particularly active in Greece compared to the other three countries. In Flanders, collaborations with non-profit organisations and universities provided additional reflection on ICT practices in the school. In Portugal, the ecosystem created around the schools by the network of IT Ambassadors, the teacher training centres associated with schools, and the IT Competence Centres, cross-fertilise digitalisation of practice and facilitate the access to training provision that meets the needs of schools and individual teachers.

Limited access to technology

The case studies depict digital infrastructure limitations as a smaller barrier compared to the lack of knowing how to integrate it into daily teaching. The school infrastructure improvements since the COVID-19 outbreak has helped diminish the problem further, and a single interactive whiteboard in the classroom enables teachers to implement many digitally enhanced activities. In Portugal, the national infrastructure renewal even foresaw laptops with 4G for households that don't have Internet access. Even when the computer student ratio was not 1:1, this seemed to be an opportunity for collaborative, project-based learning rather than a deterrent, as observed in Greece and Portugal. Recent investments in Flanders largely solved computer and Internet access, but teachers from the case school were likely discouraged from using additional technologies (e.g., STEM technologies) more frequently, because they are available only in limited numbers. A long term barrier for all countries can be the workload and financial cost due to infrastructure maintenance needs, which will be addressed in Section 2.2. In Italy, schools also raised concern about the administrative workload that came with managing new budget

lines for digital infrastructure, but overall were satisfied with the amount of EdTech equipment that had been acquired by the school through the recent surge of PNRR funding.

Decision makers could act in the following directions:

1. **Establish Structured ICT Coordinator Roles with Pedagogical Training** - Require the appointment of ICT coordinators or "digital ambassadors" in schools, with minimal teaching hours to make time for tasks of organising training and leading formal and informal ICT-related discussions in the school. Support coordinators through regional training centres or school network boards.
2. **Implement diverse and smaller professional development activities at a large scale** - Develop a wide range of training activities that are scalable but of small duration that includes hands-on activities, professional networking and exchange elements and exploring pedagogical applications of emerging education technologies. These can be flexible and organised upon demand from schools.
3. **Develop national resource repositories and incentivise their use from initial teacher education to professional development** - Invest in a national open educational resources (OER) platform where teachers can access and contribute lesson plans and tools, aligned with national curriculum and digital strategies. Invest in the curation of good examples contributed by teachers and engage teachers in using the platform by including it in their initial teacher education and professional development programmes.
4. **Support school leaders in creating and assessing digital school strategies** - Provide funding and autonomy to school leaders to co-develop digital strategies with staff, including clear objectives, resource allocation plans, and time for digital practice integration.
5. **Support in-school professional learning communities** - Provide resources to schools so that they can reserve time for teachers to meet weekly to exchange digital practices and build cultures of shared practice and experimentation with new digital tools.
6. **Promote flexible, school-based professional development** - Enable schools to tailor professional development to their needs, with informal formats (e.g., ICT cafés, workshops) and avoid reliance on external PD providers or training focusing only on technology.
7. **Establish national ICT funding programmes that allow a degree of school autonomy** – Define minimal requirements for how funding will be used and leave some degree of freedom to schools in deciding their investment (e.g., specific programming kits, adaptive learning tools, professional development, etc.).
8. **Foster regional ecosystems and partnerships for professional development support** - Encourage schools or school clusters to collaborate with local universities, NGOs, tech hubs, and regional training centres to co-design PD programs and share innovation.

2.1.5. Teachers' Continuous Professional Development: the importance of human capital in fostering a '*culture of continuous learning*'

Across the four national contexts examined there is widespread recognition that investments in digital education cannot be effective without parallel and sustained investments in teachers' professional development. Yet the modalities and depth of this investment, and the extent to which they foster a genuine culture of continuous learning among teaching staff, vary considerably across the cases.

A central point of convergence across all case studies is the emphasis on **school-level agency** in shaping meaningful continuous professional development experiences. A common denominator to emerge from the case studies when asking about teacher training was the importance of capitalising on the group of '**innovator**' **teachers** present within the school to foster moments of **informal peer learning**, which are highly valued in terms of usefulness by teaching staff. Such approach is well-leveraged in the Flanders case study, with a highly structured and school-specific professional development model. Teachers engage in a blend of formal and informal learning opportunities tailored to their needs, which are regularly assessed through informal consultations. The establishment of ICT cafés, informal peer-led workshops, and the strategic use of internal experts exemplify a model where professional development is not simply delivered but co-constructed by the teaching staff themselves. Here, the role of the ICT coordinator, who acts both as a facilitator and mediator of digital pedagogy, is pivotal in embedding a culture of experimentation and learning.

Similarly, the Italian case appears to be a best practice, albeit in a national system still grappling with uneven access to in-school CPD opportunities. While national policy mandates training as part of its digital reform, its implementation is marked by disparities in quality and relevance to specific school contexts. Both the teachers and the Headteacher report limited opportunities for hands-on, context-relevant training, schools are often left alone in deciding which externally provided training to choose from. Moreover, the Headteacher highlighted how these generic one-off courses often fail to support sustained change in teaching practice. In this national scenario, the case study is an exception that demonstrates how as a result of receiving appropriate guidance through the participation in a **local capacity-building programme**, the school was able to harness regional and national networks and develop peer-led learning opportunities triggering innovative practices at a school-level. Thus, the Italian case study, in line with findings from the Flanders case, also highlights the critical importance of **building teacher capacity through bottom-up and informal school-based training initiatives**, capitalising upon teachers who embrace innovation with a positive attitude. Indeed, the Italian case study highlights how one of the major take-aways and learning points from the school's participation in the capacity-building programme was the ability to replicate such model of hands on, tailor-made training for the rest of the school teachers through a 'train-the trainer' approach, making this approach to continuous professional development tailored to the school's needs also sustainable over time.

The Greek case further illustrates the importance of coherence between national strategy and local implementation. While Greece has developed an extensive repository of digital resources and training materials—such as the National Resource Repository and centralised LMS—its centralised CPD programme has been criticised for being too long and having a limited quota per cycle. This means that many teachers do the national certification training only once, and they need a modular approach, with smaller-sized training sessions to stay up to date. Such smaller activities are handled by coordinator teachers at school and by regional counselors. These activities are encouraged by the top-down central requirement to have 15-hours of training per school year. Similarly to the Italian national context, teachers often complete online training modules without clear impact on their pedagogical practices, due in part to a lack of support for ongoing application and reflection. This disconnect reveals that while technological tools are essential, they are insufficient on their own without robust human capital within schools to accompany them. Both the Greek and Italian case study highlight how participating in online training on general ICT themes is not effective and does not translate to actual changes in practice at a school level. In order to change teacher's practices, school-based hands on training, tailored to teacher's needs is pivotal, and those who can play an active role in triggering such change are the school head and the team of digital innovators present within the school.

Portugal presents an intermediate model, where CPD is promoted through a combination of top-down strategic planning and school-driven initiatives. Teacher training programmes are systematically linked to national digital education goals and implemented through regional training centres. However, as in Greece, the translation of training into classroom innovation varies considerably by school. What distinguishes successful examples of the case studies is **the presence of strong leadership and a deliberate effort to integrate CPD into whole-school development planning** and mark time in the school calendar for teacher collaboration. In these contexts, CPD is not seen as an ancillary task but as a cornerstone of the school's mission.

Comparing these cases highlights that fostering a genuine **culture of continuous learning** depends not merely on providing training opportunities but on **embedding professional development into the organisational fabric of schools**. Evidence from the case study analysis shows that key enabling conditions to allow for this to happen include: protected time for collaborative learning, and the enhancement of teacher expertise. Moreover, the cases demonstrate that **peer learning** and **school-based mentoring**—particularly when guided by pedagogically credible ICT coordinators—can be more impactful than externally imposed training agendas, whereby attending training does not necessarily translate to a change in teaching practices.

Adopting a **contextualised perspective** contributes to more effective implementation of digital transitions in teacher professional development. When **professional learning is collaboratively designed at the school level**, the outcomes tend to be more successful: internal and locally embedded support within schools have emerged as valuable avenues for investment, specifically by fostering **teacher agency** and promoting **peer-led initiatives**, closely aligned with teachers' everyday life.

Decision makers could act on the following directions:

1. Ensure dedicated training hours to be completed in school are institutionalised and reflect teacher's training needs;
2. Establish structured and local training programmes, anchored within the national digital strategy guidelines, but adapted to a school's needs. Such programmes can be provided by both private or public organisations and should be guaranteed to all schools regardless of region or geographical area.
3. Encourage the formal appointment of 'digital working groups' coordinated by ICT coordinators, made-up of teachers who can promote peer-learning across the school through a bottom-up approach.

2.1.6 Teachers' perspective on EdTechs perceived effects on learning

Across the four case studies, teachers generally perceive EdTech as having **positive effects on student learning**, although the specific benefits highlighted and the challenges encountered vary based on each school's contexts and the technologies available to them.

Teachers identified significant benefits from digital platforms, in how they facilitate the **automation of learning tasks**, such as practising multiplication, increasing **student involvement** as they may not realise the volume of work they are completing. Teachers across the four country case studies also highlighted how **exercises** assigned with the use of EdTech software made students more **eager to complete the task** and also complete **higher volumes of work** without realising, compared to when assigned through traditional textbook exercises. Teachers reported that when technology was effectively integrated, students were more motivated and willing to complete additional work. This is possibly due to the element of **gamification** of tasks associated with exercises that involve EdTech equipment, according to the teachers we interviewed. Additionally, the cases highlight how the variety of learning modalities, including multimedia resources like videos and presentations, made **lessons more engaging and dynamic**. In Greece, state platforms such as e-Class and e-Me were primarily used for content presentation. While these platforms facilitated content delivery, teachers noted that additional tools were needed to support more active student engagement, such as enabling students to **create their own media** (e.g., using Canva). Teachers also noted the value of adaptive technologies in providing **personalised learning experiences**, helping to cater to **individual student needs**. Nevertheless, teachers firmly highlighted that a **blend of digital and analogue approaches is essential** to achieve learning outcomes. Teachers from across the four country case studies expressed concerns over the potential overuse of technology.

Teachers used digital tools to **differentiate the curriculum and support student collaboration on projects**, in line with competence-based learning approaches. These tools also contributed to broader citizenship education objectives, such as fostering media literacy and critical thinking.

The use of EdTech was also perceived as especially **beneficial** for students who experience **anxiety during formal tests** and oral examinations. Digital tools like Kahoot! and Forms were seen as **less intimidating forms of assessment**, enabling students to engage with the

material **without the pressure** of traditional tests. Teachers also employed digital tools for formative assessments, particularly through flipped classroom strategies. .

Evidence from the case studies suggests that EdTech integration also contributes to **broader citizenship education objectives**, such as fostering **media literacy and critical thinking**.

Common Positive Effects of EdTech on Learning

Across all four countries, several common themes emerged regarding the perceived positive effects of EdTech on student learning:

- **Increased Engagement and Motivation:** Digital tools were widely regarded as making learning more interesting and engaging, with teachers in both Flanders and Italy particularly emphasising how these tools made lessons “more fun” and increased student involvement.
- **Support for Differentiation and Variety:** EdTech was valued for its ability to provide diverse learning modalities and to adapt instruction to meet individual student needs. In Flanders, teachers highlighted how adaptive learning environments could respond to students’ varying proficiency levels, while in Portugal, digital tools were key to differentiating the curriculum more effectively and supporting inclusive education. Similarly in Italy, teachers highlighted how in some cases the use of digital tools for certain group activities allowed some students with special educational needs to shine, impacting positively also on their self-esteem and in-class relationships with their peers. Moreover, tools like Kahoot! were regarded as particularly useful for students suffering from anxiety of formal assessments, as the software allows to capture and record tasks without the student realising and feeling under pressure as opposed to traditional assessment methods.
- **Potential for Active Learning and Content Creation:** Teachers in both Greece and Portugal acknowledged that many digital tools encouraged students to move from passive recipients to active participants or content creators. Greek teachers noted how digital platforms facilitated the flipped classroom model and extracurricular Science/ICT and entrepreneurship clubs, while in Portugal, EdTech supported collaborative projects and competence-based learning.

In line with what was highlighted in the previous report (ref to task 1 and 2) although teachers are able to discuss the perceived effects of EdTech integration on students’ learning, a core issue highlighted by teachers across the case studies remains the challenge incorporating appropriate tools to evaluate the impact of EdTech on learning outcomes. As discussed by a teacher in the Italian case study, this remains ‘*a huge question mark*’.

Overall, across the four case studies teachers perceive EdTech as a valuable tool for increasing student engagement, supporting differentiation, fostering active learning, and providing greater

inclusivity. However, the specific perceived benefits, the tools most prominently used, and the challenges faced vary depending on local contexts, the availability of state versus commercial tools, and national education policies. Ultimately, the effectiveness of EdTech in enhancing learning outcomes is closely tied to teacher capacity, the quality of training provided, and the school's approach to integrating technology pedagogically.

2.1.7 Monitoring digital competences

The **SELFIE tool** (Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies), developed by the European Commission, was designed to help schools assess how they use digital technologies for teaching and learning. **Adopted across the four country case studies** in varying degrees, it offers a structured, school-wide reflection process that involves school leaders, teachers, and students. However, in practice, the case studies collected as part of this research reveals that countries and individual schools have adapted, supplemented, or moved beyond SELFIE in various ways to address contextual needs and overcome its limitations.

Flanders/Belgium case study, provides a compelling example of a layered monitoring approach. At the macro level, the Flemish Ministry of Education uses the ICT-monitor, a large-scale survey among students, teachers, and school leaders, to guide digital policy decisions. Insights from Monitoring digital competences with SELFIE the ICT-monitor directly informed strategic priorities in the Digisprong initiative, such as infrastructure investments, enhanced ICT coordination roles, and teacher training support. At the meso and micro levels, individual schools often move beyond SELFIE. One school adapted its results into a **more contextualised competency scan** for teachers, enabling targeted professional development actions. Student competencies are tracked through a combination of badges, rubrics, and practical assessments, highlighting a **pragmatic approach that blends qualitative and digital indicators**.

In Greece, SELFIE is embedded as a **cyclical school-wide reflection instrument** within the country case study. All primary teachers complete the assessment twice per year, and findings feed into annual planning and evaluation processes at school level. While this offers **continuity and a structured basis for dialogue**, it is largely internal and not directly linked to broader national policies or differentiated assessment tools.

In the school visited in Portugal SELFIE is integrated within a **broader systemic strategy**, grounded in the DigCompEdu framework. At the national level, monitoring starts with a **diagnostic phase** using the Check-in tool, a DigCompEdu-based assessment that places teachers within specific digital proficiency levels. These **results feed into a tailored professional development trajectory**. Each school then builds its PADDE (Digital Development Action Plan), which is partly informed by SELFIE results but **extends into strategic planning** across pedagogical, technological, and organisational dimensions. National-level projects such as MAIA and the ITENS platform further support ongoing assessment, offering concrete tools for teachers to improve classroom-based evaluation practices, thereby extending monitoring to student learning outcomes.

In the Italian case-study, the use of SELFIE is still in its **early stages**. While the tool was first distributed to teachers in May 2024, and to students in December, its **results remain under-analysed**. Initial feedback suggests scepticism among educators regarding its utility. This signals both the potential and the limitations of SELFIE when not embedded in broader, structured frameworks for implementation and follow-up or in a more contextualised manner as was done by a school in the Flanders case study for example.

Across the four contexts, SELFIE serves different roles: from a **basic reflection tool** (Italy), to an **embedded yearly practice** (Greece), to a **starting point for school-led planning** (Portugal), and as a **basis for refinement through school-driven tools** (Flanders). The most impactful use of SELFIE appears when it is either complemented by systemic initiatives (Portugal) or adapted for local relevance (Flanders), ensuring that data collection translates into concrete action. This comparison underscores the need for **adaptable, context-aware monitoring tools** that bridge self-reflection with actionable outcomes at all levels of the education system.

2.2 Understanding the Role of Technology Costs in a Schools' Digital Development Journey

2.2.1 Calling out the elephant in the room: the challenge of EdTech maintenance in schools

Across Europe, national governments and regional authorities have invested significantly in digital infrastructure and device provision for schools. However, the long-term sustainability of these efforts is threatened by a critical issue: the ongoing cost and organisation of maintenance. The case studies of schools in Belgium (Flanders), Italy, Greece, and Portugal reveal that even when the initial roll-out of digital equipment has been broadly successful, the absence of systemic maintenance strategies—both technical and financial—creates significant risks for the durability, equity, and pedagogical effectiveness of digital education reforms.

The first hand school-level insights provided by the case studies highlight shared patterns, country/region-specific approaches, and policy directions for decision makers to urgently address maintenance as an integral part of digital transformation planning.

Commonalities across systems usually concern **hidden costs** (schools face significant maintenance costs that are not covered by initial funding or operational budgets, despite widespread state provision of devices); **lack of maintenance funding lines** (none of the countries currently provide earmarked funding for maintenance or device renewal at the school level); **pressure on school autonomy** (responsibility for maintenance is devolved without adequate resources what leads to improvisation, inequity, and burnout among staff already managing pedagogical and administrative duties); **technician shortages** (in most cases, schools lack in-house ICT technicians, and when available - e.g., in Portugal or Italy-technicians are often shared across schools or paid for from the school's own limited budget);

equity risks (financial disparities among schools, especially between urban and rural or affluent and disadvantaged communities, lead to unequal maintenance capacity and device reliability).

The four case studies illustrate how the usual problems mentioned above are differently received and addressed by the schools visited depending on the type of education system (centralised/decentralised) they pertain to.

Flanders stands out as the only example among the four case-studies of proactive school-level lifecycle planning, with schools maintaining reserve stocks and developing device renewal schedules. School autonomy in Flanders being high, this pro-active forward looking approach is strategic but corresponds to a model placing a heavy financial burden on schools without central support. The search for resources to support this strategic planning places pressure on the organisational autonomy of schools, particularly those with fewer possibilities for flexible allocation of teaching hours or those with a higher proportion of socio-economically disadvantaged pupils which restricts options for prioritising initiatives such as ICT. A situation that in turn poses a challenge to equality.

In Italy, Greece and Portugal, which have in common centralised funding (Greece) or mixed funding (Italy and Portugal, where the local level provides funding in addition to the central level), there is no forward planning for the maintenance of existing equipment. This failure to plan ahead and fund maintenance can only be addressed differently in each of the three countries. Italy reflects a system highly dependent on temporary investment cycles (e.g., PNRR, Italy's recovery and resilience plan), without institutionalised mechanisms for sustaining digital infrastructure. If priorities and timetables are aligned with needs, schools may be able to benefit from such a temporary facility to invest in maintaining and upgrading technological equipment, but the outlook remains uncertain, which doesn't encourage long-term planning for changing educational practice to integrate more technology. Greece illustrates extreme budgetary constraints at central (and therefore school) level), where general school operating funds must be stretched to cover ICT needs. Reliance on family associations, foundations or grants becomes the only possible strategy, which in turn poses a challenge to equity. Portugal, which has a strong government commitment to digital inclusion but limited budgets, uses low-spec devices that are prone to damage. With students and teachers using laptops all over the school and outside, the opportunities for damage were numerous, and even if the equipment was still under warranty, some types of damage were not covered, placing a heavy burden on the school to organise the repair process and taking time to ensure that all students were properly equipped. Some schools, such as Martim de Freitas, mitigate this by hiring technical staff to repair what can be repaired at that level and by adapting pedagogical practices - but this is the exception, not the rule, which again underlines the importance of school leadership. In digital ecosystems, decision makers should act on the following directions depending if centralised or decentralised systems are concerned:

For centralised systems (e.g., Greece, Portugal, Italy)

- 1. Integrate Maintenance into National Funding and Procurement Plans**

→ Establish dedicated, multi-year maintenance funding lines embedded in national

budgets and digital strategy frameworks. Include warranties, replacement cycles, and service agreements in procurement contracts.

2. **Establish National or Regional Technical Support Services**
 - Create centrally funded pools of ICT technicians or mobile support units to serve school clusters, especially in rural or underserved areas.
3. **Mandate Maintenance Planning in School Digital Strategies**
 - Require every school to submit a sustainability section in its digital development plan (e.g. PADDE), covering repair logistics, device lifecycle, and contingency solutions.
4. **Build Leadership Capacity in Financial and Technical Planning**
 - Train school leaders and administrative staff on lifecycle budgeting, digital asset management, and how to align pedagogy with available ICT resources.

For decentralised systems (e.g. Flanders)

5. **Set Local Budget Guidelines for Lifecycle Management**
 - Recommend (or mandate, where appropriate) that schools or local authorities allocate a minimum percentage of EdTech funding to maintenance and device renewal planning.
6. **Encourage Multi-School Collaboration and Shared Services**
 - Support the formation of consortia or local partnerships that pool technician support, spare devices, and repair services to reduce costs and improve efficiency.
7. **Promote Flexible Procurement Models with Built-in Support**
 - Encourage schools to adopt leasing, managed service contracts, or long-term procurement that includes maintenance and tech support, to reduce administrative load and improve sustainability.
8. **Monitor and Support Equity in Maintenance Capacity**
 - Introduce light-touch monitoring of ICT maintenance gaps across schools or networks, and target support to those with persistent difficulties (e.g. funding shortfalls, technical staff shortages).

2.2.2 How do financial constraints shape a schools' digital strategy?

Compared to other cases, the schools in **Greece** had limited funds for purchasing and maintaining their digital infrastructure. New digital equipment is purchased at central level and distributed to schools. Consequently, schools have a diverse set of channels to obtain goods: philanthropic organisations, parents associations and EU-funded projects. Perhaps one positive side is that schools in Greece have more freedom in how they use the funds they obtain or what kind of goods they can ask for, compared to **Italy** where schools had strict and clear instructions on how to use the funds received from the PNRR (Italy's post-Covid recovery and resilience plan). However, the schools in the Greek case study probably reflected the best case scenario, while schools in more **rural** parts of **Greece** might have fewer channels of support.

Flanders and **Greece** represented two ends of a spectrum of how much freedom schools have in purchasing their own digital tools and services. The case studies indicate that the two approaches shape the schools in different ways, with different points of strength in each.

In the case of **Flanders**, a competitive EdTech market can stimulate improvement of services for schools. However, we can argue that the success of EdTech products do not only rely on better pedagogical value, but also on design (i.e. user friendliness) and marketing strategies (e.g., how products are promoted in schools or competitive pricing). On one hand, adaptive learning technologies like Snappet and Bingel are effective in improving student learning thanks to exercises that adapt to the student's proficiency level. On the other hand, teachers⁶ and the digital education agency⁷ raised concern about these tools in the Netherlands. These concerns were that they rely too heavily on a performative, behaviourist model of individual learning and increased screen time both for teachers and students, potentially taking time away from other, hands-on activities. Researchers also argue that EdTech products are not neutral tools that teachers can adopt to simply enhance their teaching. They rather actively shape pedagogical practices in schools (Kerssens & van Dijck, 2022)⁸. This shift was visible in the Netherlands, where schools were encouraged by the Ministry of Education to set goals towards showing measurable outcomes (Kerssens & van Dijck, 2021)⁹. Although EdTech providers employ educators as consultants, it is rather the design and logic of EdTech, primarily developed by engineers, that influences how learning is structured (e.g., Pangrazio & Sefton-Green, 2023)¹⁰. The prominent pedagogical model in EdTech such as adaptive learning technologies is self-regulated learning and behaviourism (e.g., students' correct responses are reinforced with positive feedback and repetitive practice). This can lead to time taken away from student-centred activities based on collaboration and problem-solving.

Nevertheless, teachers in Flanders appear to be aware of these risks: while they make greater use of adaptive tools for mathematics, they continue to rely on physical textbooks for reading and writing. They also critically reflected on the impact of these tools on pupils' handwriting in languages.

In **Greece**, the e-me is based on a collaborative learning model, with the aim to promote active learning and higher-order cognitive skills in students. The platform was developed through cycles of consultations with education stakeholders, and with non-commercial incentives. The agency managing the development has also a vision for its sustainability and is able to adapt to the evolving digital education landscape, considering the integration of AI tools and setting up innovation centres.

⁶ <https://nivoz.nl/nl/ik-haat-snappet-juf>

⁷ <https://www.kennisnet.nl/onderzoek/de-invloed-van-adaptieve-leersystemen-op-de-professionele-ruimte-van-de-leerkracht/>

⁸ Kerssens, N., & van dijck, J. (2022). Governed by edtech? Valuing pedagogical autonomy in a platform society. *Harvard Educational Review*, 92(2), 284-303

⁹ Kerssens, N., & Dijck, J. V. (2021). The platformisation of primary education in The Netherlands. *Learning, Media and Technology*, 46(3), 250-263.

¹⁰ Pangrazio, L., & Sefton-Green, J. (2023). Digital literacies as a 'soft power' of educational governance. In *World Yearbook of Education 2024* (pp. 196-211). Routledge.

Despite state-provided platforms and tools, some teachers can still prefer to use alternatives. Although the platform development in **Greece** went through many cycles of consultations with teachers and experts, it is difficult to account for personal preferences of all users. Alternatively, if schools have the freedom and means to choose industry suppliers, then they can adopt tools that seem to fit their context the best. One challenge in this case could be a more fragmented landscape of EdTech tools being used even within a single school. For instance, multiple learning management systems were mentioned by the **Flemish** schools, which are all essentially offering similar functions (although this did not come up as an issue during the interviews).

An alternative to private or self-developed national tools could be to adopt open-source tools. This would still keep schools' data out of commercial use and make the customised solution part of a larger international community of developers and users, as it is the case for open-source platforms like Moodle or edX. An in-between approach could be to offer basic functionalities nationally (a personal learning environment with cloud storage and communication with peers and teachers) and establish a digital marketplace where national and international EdTech products can be purchased and integrated into the existing national platform. The digital marketplace structure in Norway could serve as an example.¹¹ A single-sign on system is available in all the four case study countries, which is one requirement to integrate EdTech into the national platform.

Decision makers could act on the following directions:

1. In European funding programmes, incentivise national, regional or municipal funding lines that will provide a buffer for unexpected infrastructure renewal, maintenance and disposal costs.
2. Establish one digital portal that unifies national services and services offered by the industry
 - Develop and maintain a national platform that offers basic services to schools, such as an LMS, school administrative data management and a digital marketplace for purchasing digital resources.
 - Negotiate with digital service suppliers to list their products on your platform.
3. Develop national EdTech certification criteria
 - Consult educators, experts and local EdTech developers to develop a set of criteria that defines minimum requirements in terms of pedagogical design elements, how EdTech products can be backed up by research evidence and how student personal data will be kept private.¹²
 - Provide guidance to the EdTech enterprises to meet these criteria.

¹¹ <https://www.feide.no/en>

¹² An example by the Digital Futures Commission in the UK:
<https://digitalfuturescommission.org.uk/blog/how-do-our-edtech-certification-criteria-emerge-from-our-work-at-the-digital-futures-commission/>

Conclusions and Policy Take-aways

The comparative analysis of EdTech implementation at a school-level in Belgium (Flanders), Greece, Italy, and Portugal reveals the deeply contextual and evolving nature of digital transformation in education. While each country articulates a national strategy to advance digitalisation, their trajectories reflect divergent levels of digital maturity shaped by national governance structures, investment patterns, and institutional capacities. This report does not seek to prescribe best practices or promote direct policy transfer; instead, it provides a grounded understanding of how education systems mobilise resources, interpret central frameworks, and embed digital innovation in locally responsive ways. It offers a practical view into who are the main actors involved in translating national policies into school-level practices (discussed in section 2.1.3) and how the relationship between these actors- alignment of vision, goals and actions amongst these stakeholders- is pivotal for change to occur. Across all four cases, **success in EdTech implementation hinges less on the mere presence of infrastructure or policy mandates, and more on the capacity of school actors to adapt and translate these into meaningful practice.** The cases underscore that digital transformation is ultimately a pedagogical and organisational challenge, not just a technical one.

Applying the **Framework for Digital Maturity of Schools (FDMS)**,¹³ countries can be understood as existing along a developmental continuum rather than in fixed hierarchies. This framework identifies five stages of maturity—ranging from *Basic* to *e-Mature*—across the domains of planning and leadership, pedagogical use of ICT, development of digital competences, ICT culture, and infrastructure. Based on findings from this research, **the schools** from the four country case studies can be classified as follows:

The Schools visited in **Flanders and Portugal** demonstrate characteristics of *Level 3 (e-Enabled)* to *Level 4 (e-Confident)*. In the Flanders case study, locally driven professional development structures (e.g. ICT cafés), embedded leadership roles, and strategic planning have facilitated school-wide ownership of digital strategies. Similarly, Portugal's PADDE initiative and its intermediary structures (e.g. digital ambassadors, competence centres) provide a coherent infrastructure for capacity-building and innovation. In both contexts, schools exhibit a balance between national guidance and school-level agency.

The schools in **Italy and Greece**, by contrast, fall between *Level 2 (Initial)* and *Level 3 (e-Enabled)*. While both national systems have made rapid post-COVID advances in infrastructure and policy, research conducted at a school-level revealed challenges in aligning digital tools with curricular aims, sustaining teacher training, and ensuring equitable access to EdTech equipment. In both contexts, informal cultures of innovation and locally-led experimentations compensate for gaps in systemic coordination. The Italian case study represents a virtuous yet small pocket of innovation within a larger national system in which

¹³ Begicevic Redjep, N., Balaban, I., & Zucec, B. (2021). Assessing digital maturity of schools: framework and instrument. *Technology, Pedagogy and Education*, 30(5), 643-658.

schools are often left alone to manage and decide on types of teacher training on new EdTech equipment. In this sense, both case studies raise questions of scalability of these ‘success’ models, which despite being successful examples, are nonetheless dependent on local philanthropic organisations willing to invest in building capacity and innovation in local schools.

Despite contextual differences, several **common enabling conditions and mechanisms of change emerge**:

1. **Visionary and distributed leadership is essential.** Whether through headteacher-led strategy (Italy), collaborative school governance (Portugal), or informal teacher leadership (Flanders and Greece), strong leadership enables schools to navigate reforms, mobilise resources strategically, and align digital tools with pedagogical aims.
2. **Embedded professional learning drives change.** Teacher development is most effective when integrated into the school’s organisational routines, supported through peer exchange, coaching, and action-oriented training. Across cases, success is linked to collective learning cultures and the availability of in-house support structures (e.g. ICT coordinators, digital ambassadors).
3. **Strategic planning and adaptability matter.** Schools that engage in ongoing reflection and use digital maturity tools (e.g. PADDE rubrics in Portugal, locally adapted evaluation in Flanders) demonstrate stronger alignment between policy goals and classroom realities.
4. **Funding and maintenance remain persistent challenges.** Initial infrastructure investments must be complemented by long-term strategies for technical upkeep, equitable access, and renewal. In several cases, schools rely on parents’ associations or European funding, which introduces variability and fragility in provision.
5. **Equity and localisation must be addressed.** Schools in less affluent areas or with fewer human resources often struggle to sustain digital reforms, highlighting the need for targeted support mechanisms and intermediary bodies that can mediate national ambition and local implementation.

While none of the schools visited and examined as part of this case study research have yet reached *Level 5 (e-Mature)*— i.e. the full integration of ICT across all aspects of school life, robust digital cultures, and system-wide coherence—each school offers valuable insights into the institutional conditions and relational capacities that underpin the process of integrating digital educational technology in day to day teaching and learning practices.

In conclusion, the cases collectively affirm that **technology alone does not drive educational innovation**. Sustainable digital transformation depends on finding ways to create enabling environments where strategic vision, organisational capacity, professional development, and

context-sensitive planning and training intersect. Future national strategies must therefore invest as much in human infrastructure and school-level empowerment as in technological provision, if digital education is to be both transformative and enduring.

Annex I (External) Report 1

<https://docs.google.com/document/d/1hCEjM0fQxOsz-KGWdKSaY3Y7lqmnBVoHH1mfk3Z-lp0/edit?tab=t.0#heading=h.9ybqaaov1mtv>

Annex II (External) National Case Studies

https://docs.google.com/document/d/1kYem8JD7pWwsJPTEnMMTlbf_zWrzOSbx/edit?pli=1