European Commission

# Structural indicators for monitoring education and training systems in Europe 2023

# Digital competence at school

Eurydice report

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# Digital competence at school

Eurydice report

European Education and Culture Executive Agency

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# INTRODUCTION

This report presents the results of the 2023 data collection on the structural indicators for monitoring education and training systems in the area of digital competence.

The report contains six indicators on key policies in the following areas:

1. curriculum,

2. teachers,

3. assessment,

4. the digital education ecosystem.

The paper contains information for the 2022/2023 school year. Participating countries include the EU Member States, along with Albania, Bosnia and Herzegovina, Iceland, Liechtenstein, Montenegro, North Macedonia, Norway, Serbia and Türkiye ([1]).

([1]) This report is based on information from 38 European education systems. Switzerland does not participate in the project on structural indicators for monitoring education and training systems in Europe.

## DIGITAL COMPETENCE AT SCHOOL

The structural indicators on digital competence provide an overview of key policies that support their development at school in Europe. The selection of indicators is based on the strategic priorities outlined in the European Commission's *Digital Education Action Plan* 2021–2027 (European Commission, 2020a), which is a renewed EU policy initiative to support the sustainable and effective adaptation of education and training systems to the digital age ([2]). In particular, the Digital Education Action Plan sets two strategic priorities: promoting the development of a European digital education ecosystem and enhancing the digital competence (knowledge, skills and attitudes) of all learners for the digital transformation and a world mediated by digital technologies ([3]). Achieving these priorities requires the implementation of a number of initiatives such as promoting:

- basic digital skills and competences from an early age;
- computing education;
- digitally competent and confident teachers and education and training staff;
- effective digital capacity planning and development, including up-to-date organisational capabilities.

As a direct follow-up to Action 11 of the Digital Education Action Plan, in February 2021 the Council of the European Union introduced a new target on digital skills. It called for the share of low-achieving eighth-graders in computer and information literacy to be less than 15 % by 2030 ([4]). In addition, a structured dialogue on digital education and skills with all Member States was launched in 2022 ([5]). Through their Recovery and Resilience Plans, Member States have allocated almost EUR 23 billion to the development of digital education and skills ([6]).

On 18 April 2023, the Commission proposed Council Recommendations on key enabling factors for successful digital education in education and training and on improving the provision of digital skills in education and training ([7]).

In line with these EU-level policy priorities and on the request of the Directorate-General for Education and Culture, the Eurydice network undertook the 2023 data collection on structural indicators for digital competence. The diagram below depicts the selection of indicators.

([2]) COM/2020/624 final.

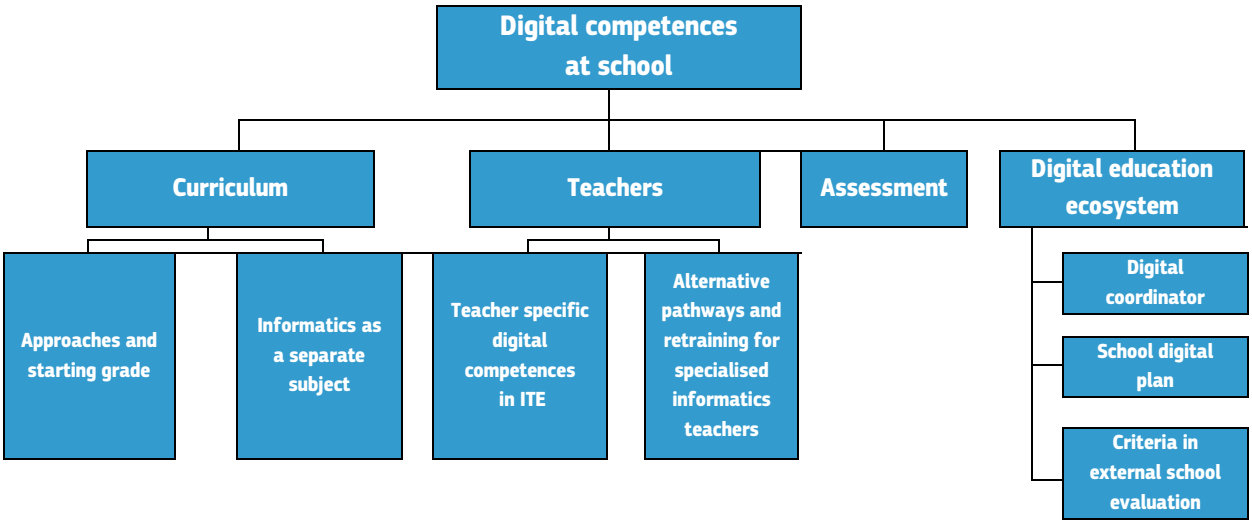
([3]) SWD (2020) 209 final. COM (2020) 624 final.

([4]) OJ C 66, 26.2.2021.

([5]) https://education.ec.europa.eu/focus-topics/digital-education/action-plan/action-1#StructuredDialogue.

([6]) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023SC0205&qid=1659174525177.
The figures in this paragraph are calculated using Annex VII of the Recovery and Resilience Facility regulation.

([7]) https://education.ec.europa.eu/focus-topics/digital-education/action-plan/action-1#Proposal.




These indicators are mainly based on the analysis in the Eurydice report *Digital Education at School* (European Commission / EACEA / Eurydice, 2019a), the Eurydice brief *Digital Education at School in Europe* (European Commission / EACEA / Eurydice, 2019b), the Eurydice report *Informatics Education at School in Europe* (European Commission / EACEA / Eurydice, 2022a) and the 2022 report on Eurydice structural indicators (European Commission / EACEA / Eurydice, 2022b). The selected indicators usually cover school education from ISCED 1 to ISCED 34.

## 1. Compulsory starting grade for teaching digital competence and curriculum approaches

To foster the development of digital competence in students, national school curricula need to explicitly include it from an early age. In this analysis, the term 'national curriculum' is used in a wide sense, referring to any official steering document issued by top-level authorities which contains study programmes, learning content, learning objectives, attainment targets, assessment guidelines or syllabuses.

The curriculum approaches to digital competence may include teaching and learning through a cross-curricular topic, a separate subject (compulsory for all pupils or optional) or several other subjects (integrated approach). Each approach has its own benefits and shortcomings. In practice, national curricula often combine several of these approaches, which are defined as follows.

- **Cross-curricular.** Digital competence is understood to be transversal and is therefore taught across all subjects in the curriculum. All teachers share the responsibility for developing digital competence.
- **Separate subject.** Digital competence is taught as a discrete subject area similar to other traditional subject-based competences. This can be compulsory for all or optional.
- **Integrated into other subjects.** Digital competence is incorporated into the curriculum of other subjects or learning areas.

### 1.1. Compulsory starting grade for teaching digital competence

The first indicator shows the earliest grade from which digital competence must be taught at school and whether this is a separate subject, integrated into other subjects or cross-curricular.

In most European education systems, the compulsory teaching of digital competence for all pupils starts in primary education (ISCED level 1). The table of Figure 1 shows that in 20 education systems,

this is done as early as grade 1 of primary education, and in five systems this happens several grades later in primary education (grade three in Bulgaria, Hungary and Slovakia and grade 4 in Czechia). In other five countries, top-level education authorities set the compulsory starting grade at ISCED level 24. While Croatia, Austria and Romania start compulsory teaching of digital competence in fifth grade, in Cyprus, Malta and Albania the compulsory starting grade is grade seven.

Finally, in the remaining eight education systems, top-level education authorities have not set a compulsory starting grade for teaching digital competence to all students. In the three Communities of Belgium, Germany, the Netherlands and Iceland, the decision on the starting grade is taken at the school and local or regional level, while in Ireland and Slovenia, the starting grade is only recommended.

## 1.2. Curriculum approaches to teaching digital competence

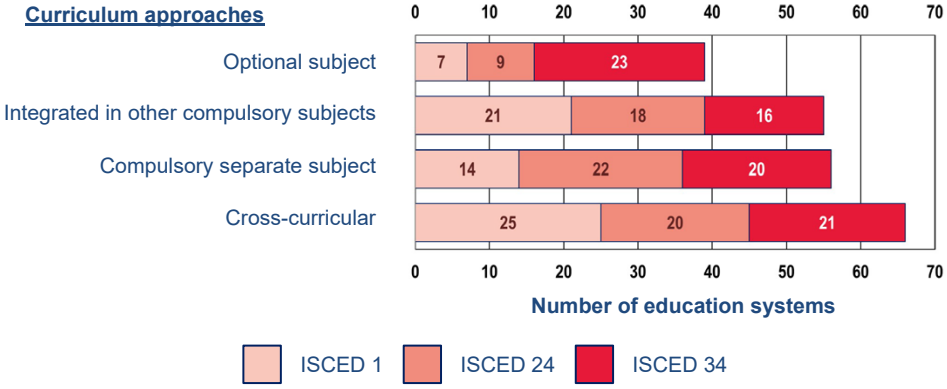
Across Europe digital competence is being taught using several curricular approaches, often in parallel. As Figure 1 shows, the cross-curricular approach is the most common one. Digital competence is taught across all subjects in almost two thirds of education systems in primary education and in more than half of the countries in secondary education. Compulsory separate subjects are the second most common approach. Inversely to the cross-curricular approach, this one is more common in secondary than in primary education. Around half of the countries also integrate digital competence into other subjects. This approach is however more common in primary and lower-secondary education.

Therefore, there are some patterns depending on the education level. Overall, in primary education, the most common approach is to teach digital competence as a cross-curricular subject. In secondary education, digital competence is commonly taught as a separate subject, which is often compulsory for all pupils in lower secondary school and increasingly optional in upper secondary education. This trend was already observed in the Eurydice report *Digital Education at School* (European Commission / EACEA / Eurydice, 2019a).

A variety of situations exist in terms of the combination of curriculum approaches at the national level (see Annex 1). It is common for at least two of the approaches discussed above to coexist. A third of European education systems combine all three approaches at one or several education levels (Czechia, Denmark, Estonia, Ireland, Spain, France, Lithuania, Slovenia, Sweden, Albania, Liechtenstein, North Macedonia and Serbia).

On the other hand, some systems offer only one curriculum approach during both primary and secondary education. For instance, in Bulgaria, Croatia, Bosnia and Herzegovina and Türkiye, digital competence is taught only as a (compulsory) separate subject.

**Figure 1: Curriculum approaches to teaching digital competence and compulsory starting grade in primary and general secondary education (ISCED 1, 24 and 34), 2022/2023**




**Compulsory starting grade for teaching digital competence**

| (*) | BE fr | BE de | BE nl | BG | CZ | DK | DE | EE | IE | EL | ES | FR | HR | IT | CY | LV | LT | LU | HU | MT | NL | AT | PL | PT | RO | SI | SK | FI | SE | AL | BA | IS | LI | ME | MK | NO | RS | TR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grade | – | – | – | 3 | 4 | 1 | – | 1 | – | 1 | 1 | 1 | 5 | 1 | 7 | 1 | 1 | 1 | 3 | 7 | – | 5 | 1 | 1 | 5 | – | 3 | 1 | 1 | 7 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 |

(*) Compulsory starting grade

*Source:* Eurydice.

## Explanatory notes

The figure shows the number of education systems reporting one or several curriculum approaches at each education level. The categories are not exclusive, and most countries combine several curriculum approaches. For an overview by country, see Annex 1.

The table below Figure 1 shows the earliest grade from which digital competence must be taught through a compulsory separate subject, or through another compulsory subject that includes digital competence.

## Country-specific note

**Czechia**: a top-level document sets that schools have to start teaching digital competence from grade 4 at the latest.

In recent years, many countries have been carrying out informatics education reforms. In some countries, the reforms have been fully implemented; in others, the process of implementation is ongoing (European Commission / EACEA / Eurydice, 2022a). The following country examples illustrate the ongoing curricular reforms that impacted changes that have happened during 2022/2023 reference year or that will happen in the near future.

In Czechia, the new informatics curriculum will be fully implemented from 1 September 2023 at the primary level and by the 2024/2025 school year at the lower secondary level. Informatics will be taught as a separate compulsory subject from the grades 4–9. At upper secondary level, 'informatics' will replace 'informatics and ICT' as a subject by September 2025.

In Spain, recent curriculum reforms ([8]) have led several autonomous communities to include optional subjects related to digital competence in primary education (e.g. technology and robotics in the Autonomous Community of Madrid). For lower secondary education, the national curriculum establishes that the autonomous communities must offer an optional subject for the development of digital competence in grades 7, 8 and/or 9. In upper secondary education, they may do this as well.

The new compulsory curriculum for primary and lower secondary education ([9]), which was approved by the Slovakian minister of education in May 2023, defines digital literacy as part of literacy skills to be taught across all subjects in the curriculum. As of September 2023, 30 primary school will start to

([8]) Royal Decree 157/2022, of 1 March, which establishes the organization and minimum contents of Primary Education. https://www.boe.es/buscar/act.php?id=BOE-A-2022-3296; Royal Decree 217/2022, of 29 March, which establishes the organization and minimum contents of Compulsory Secondary Education. https://www.boe.es/buscar/act.php?id=BOE-A-2022-4975.

([9]) https://www.minedu.sk/data/att/26391.pdf.

implement the new curriculum, while the full implementation of the reform is planned for the 2026/2027 school year.

In North Macedonia, the new concept for primary education started being implemented in the 2022/2023 school year, in terms of changing the teaching plans/programme. The competences concerning digital literacy are developed in different subjects starting from grade 1.

## 1.3. Provision of informatics education through a separate subject

The recent proposal for a Council recommendation on improving the provision of digital skills in education and training acknowledges the need to provide quality informatics education at school ([10]). The current state of informatics education in Europe was analysed in depth by Eurydice in the report published in September 2022 (European Commission / EACEA / Eurydice, 2022). This section focuses on the provision of informatics as a separate subject.

In most of the countries, the compulsory separate subject relating to digital competence (see Figure 1) is informatics ([11]). Figure 2 shows during which grades from primary to upper secondary education informatics is taught as a separate (compulsory for all or optional) subject.

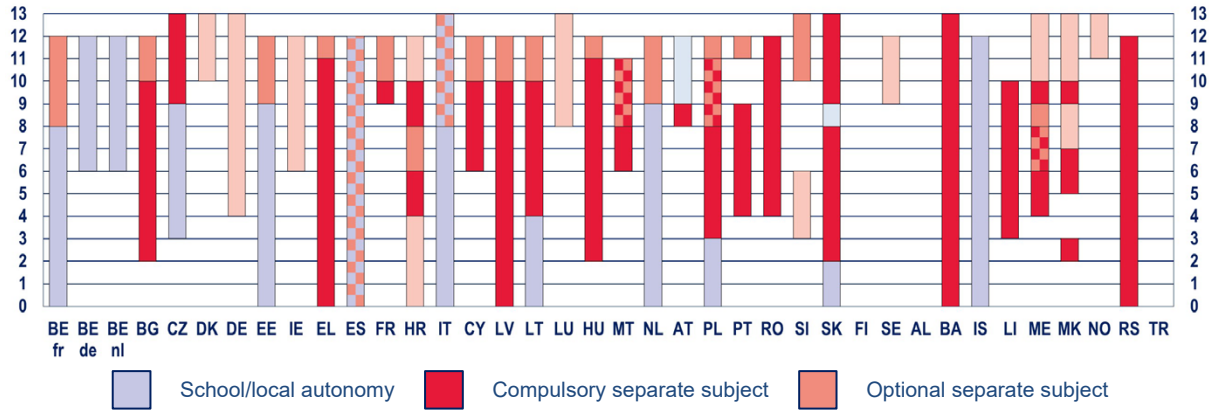
As already revealed in the Eurydice report *Informatics Education at School in Europe* (European Commission / EACEA / Eurydice, 2022a), in primary education, the provision of informatics as a separate subject is not yet widespread. Several education systems start offering informatics at the end of primary education or in lower secondary education. While in primary and lower secondary education the subjects are mostly compulsory for all students, in upper secondary education these are usually optional or compulsory only for some students. Figure 2 shows that a few countries provide informatics as compulsory separate subject for all students as from grade 1 and throughout most (Greece and Latvia) or the entire duration of school education (Bosnia and Herzegovina and Serbia). Another group of countries start a few grades later, but also offer the subject during a considerable number of years to all students, namely Bulgaria, Lithuania, Hungary, Poland, Romania, Slovakia and Liechtenstein. Still, in many other countries, the provision of informatics through a separate subject only benefits some students, as it is optional, or offered only in some schools or regions in case of local/school autonomy.

In Finland, the mathematics subject and the transversal competence ICT include learning outcomes on informatics. Local and school authorities can include additional content in subjects of their respective curricula. In Albania informatics is taught as part of the ICT subject, and in Türkiye it is taught as part of the IT and software subject.

([10]) Proposal for a Council Recommendation on improving the provision of digital skills in education and training. SWD (2023) 205. COM (2023) 206 final. 2023/0100 (NLE).

([11]) Only in Czechia (for primary and lower secondary education), Luxembourg and Austria (for lower secondary education), Albania (secondary education) and Türkiye (primary to upper secondary education), the focus of the separate subject is on the use of technology and general digital competence, rather than on informatics.

**Figure 2: Informatics as a separate subject by grade in primary and general secondary education (ISCED 1, 24 and 34), 2022/2023**




*Source:* Eurydice.

**Explanatory note**

Only subjects where informatics is taught as a distinct discipline are considered here.

Compared to the reference year of the Eurydice report on informatics education (2020/2021), there are no major changes. Still, in some education systems there have been recent changes linked to curricular reforms currently under implementation.

In Spain, new curricula have been published in 2022 in view of the new 2020 Education Law and have begun implementation in the 2022/2023 school year, increasing the provision of informatics as a separate subject in many autonomous communities ([12]). In Lithuania, teaching informatics in primary education is now compulsory, but not necessarily as separate subject. The school chooses the approach on how to implement the general curriculum ([13]). In Hungary the subject Digital culture is being gradually introduced into the new informatics curriculum. It was included in the 2022/2023 school year for grades 3, 5, 6, 7, 9, 10 and 11, and will be added to the rest of the grades in 2023/2024. The previous system will still apply in 6-year and 8-year high schools (ISCED 2–3) and will be phased out gradually ([14]).

## 2. Teachers' preparedness to teach digital competence and availability of specialist informatics teachers

The Digital Education Action Plan mentions 'digitally competent and confident teachers and education and training staff' among the key elements of a high-performing digital education ecosystem. It is essential for them to be prepared and able to act as role models for the future generation. They also need a set of specific competences that will allow them to realise the potential of digital technologies to transform their teaching and learning. (Redecker, 2017, p. 15). These specific digital competencies are the focus for this indicator and are referred to as teacher-specific digital competencies.

Including those competences as from initial teacher education (ITE) is essential to prepare all prospective teachers in a sustainable way. In addition, regarding the development of digital competence through informatics education, and in view of the potential challenge of facing shortages

([12]) Organic Law 3/2020, which amends the Organic Law on Education 2/2006 (LOMLOE) (https://www.boe.es/buscar/act.php?id=BOE-A-2020-17264#df-5); Royal Decree 157/2022 on primary education (https://www.boe.es/buscar/pdf/2022/BOE-A-2022-3296-consolidado.pdf), p. 26; Royal Decree 217/2022 on compulsory secondary education (https://www.boe.es/boe/dias/2022/03/30/pdfs/BOE-A-2022-4975.pdf), p. 189; Royal Decree 243/2022 on *Bachillerato* (https://www.boe.es/eli/es/rd/2022/04/05/243/dof/spa/pdf), p. 346.

([13]) Order of the Minister of Education, Science and Sport of the Republic of Lithuania: https://www.e-tar.lt/portal/lt/legalAct/06c1f24040b711edbc04912defe897d1.

([14]) National Curriculum 2012: https://ofi.oh.gov.hu/sites/default/files/attachments/mk_nat_20121.pdf; National Curriculum 2020: https://njt.hu/jogszabaly/2012-110-20-22.5#CI.

of specialist teachers, it is also necessary to see what education authorities can do to ensure a sufficient pool of potential informatics teachers.

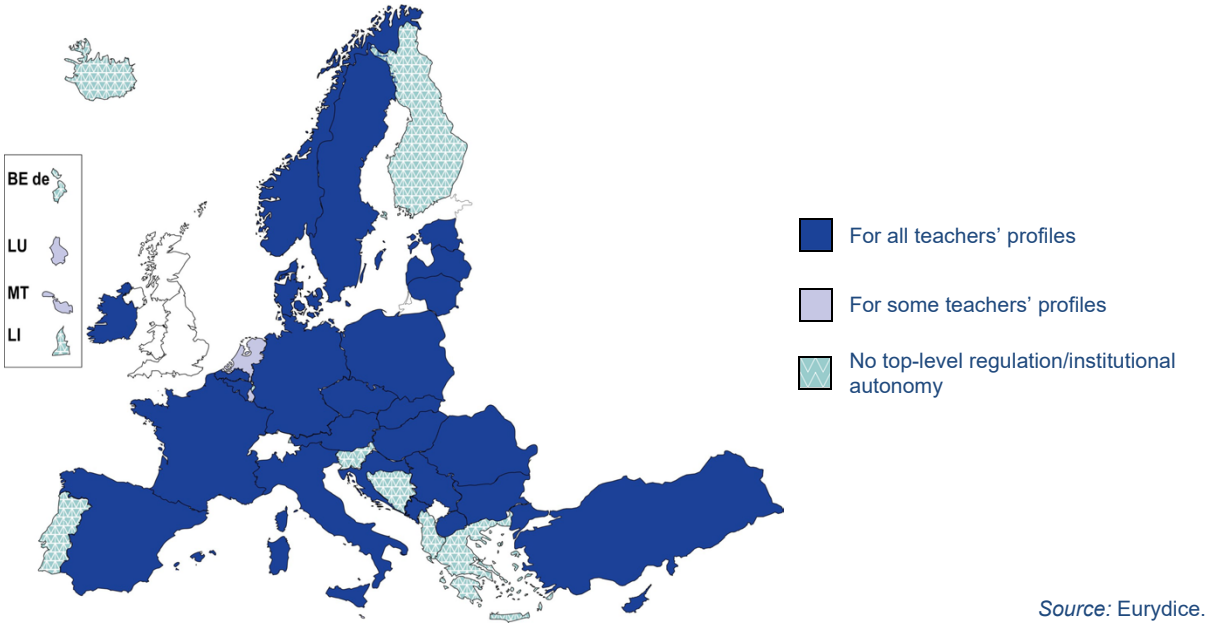
The two following indicators provide information, respectively, on the inclusion of teacher-specific digital competence in ITE, and on the existence of alternative pathways or retraining possibilities to become a specialist informatics teacher, aiming at increasing the pool of available teachers for the provision of informatics education.

## 2.1. Teacher-specific digital competence in initial teacher education

Teacher-specific digital competencies are the competencies needed to support and improve teaching and learning by using digital technologies, along with the ability to use digital technologies for communication, collaboration and professional development. They extend to all areas of a teacher's work, including teaching and learning, assessment, communicating and collaborating with colleagues and parents, and creating and sharing content and resources.

If teachers are to become digitally competent, then the basic knowledge and skills to do so need to be integrated into ITE programmes. This indicator examines whether teacher-specific digital competencies are included in ITE curriculum as mandatory competencies to be developed.

**Figure 3: Mandatory inclusion of teacher-specific digital competence in ITE curricula in primary and general secondary education (ISCED 1, 24 and 34), 2022/2023**




*Source:* Eurydice.

**Country-specific notes**

**Croatia and Norway**: only applies to ISCED 34.
**Denmark**: only applies to ISCED 1 and 24.
**Malta**: for some teachers' profiles in ISCED 24 and 34.
**Netherlands**: for some teachers' profiles in ISCED 34.
**Austria**: only applies to ISCED 24 and 34.
**Serbia**: only applies to ISCED 1.

More than half of the European education systems, top-level authorities require that teacher-specific digital competencies be included in ITE curricula as a mandatory element for all teachers' profiles. In several other systems, such competencies are only compulsory for some teacher profiles (e.g. informatics, mathematics, languages). This is the case regarding prospective teachers of all school education levels in Luxembourg, prospective secondary teachers in Malta and upper secondary teachers for the informatics subject in the Netherlands.

In a few other education systems, the regulation to include teacher-specific digital competence as a mandatory part of ITE only applies to prospective teachers of some education levels, in particular for all upper secondary teachers in Croatia and Norway, all primary and lower secondary teachers in Denmark, and all primary teachers in Serbia.

In the rest of the European education systems, there are no top-level requirements explicitly specifying the digital competencies all prospective teachers need to acquire. In some of these cases, the providers of ITE have institutional autonomy regarding the content of the courses they offer (Greece, Portugal, Slovenia and Iceland). The data from the Eurydice report *Digital Education at School* (European Commission / EACEA / Eurydice, 2019a) points to the fact that at least some ITE institutions provide prospective teachers with the option to develop their digital competence, despite the absence of top-level requirements.

The top-level requirements on the inclusion of teacher-specific digital competence can incorporate a different level of detail. For instance, in Slovakia, higher education institutions have a large degree of autonomy in creating the content of study programmes. Descriptions are very brief but contain a short profile of graduates' competencies. The description of the study field 'Teacher Training and Education Science' only mentions that graduates have skills in the field of information and communication technologies, without further describing specific competencies or learning outcomes.

In Austria, the ongoing strategy to equip pupils with digital devices (eight-point plan) further increased the mandatory teaching of digital skills for teachers at the secondary level ([15]).

In Sweden, the Higher Education Ordinance on teachers' qualifications defines that a teacher must be able to demonstrate the capacity to use digital aids assuredly and critically in educational processes and to take into account the significance of the role of different media and digital environments in this respect ([16]).

Overall, countries did not mention any significant changes related to regulations on the mandatory inclusion of teacher-specific digital competence in ITE curricula compared to the last reference year (2021/2022).

## 2.2. Availability of specialist informatics teachers

As for any other school discipline, teaching informatics requires having teachers prepared for this role. A lack of adequately prepared teachers not only compromises the quality of teaching but is also one of the main barriers to introducing informatics into the curriculum (Bocconi et al., 2022). To promote the provision of informatics education, education systems must ensure that specialist teachers are available. The *Informatics Education at School in Europe* report (European Commission / EACEA / Eurydice, 2022) shows that while in primary school informatics is still taught by generalist teachers, in secondary education, teachers in charge of informatics as a separate subject are always specialist teachers.

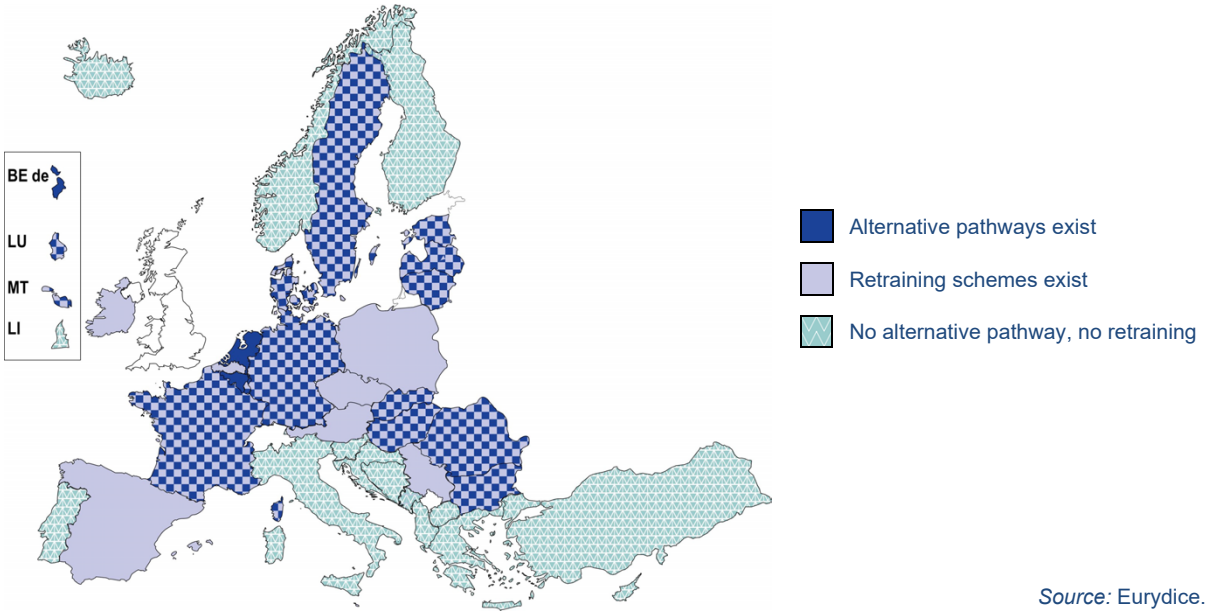
However, the difficulty in attracting specialist informatics teachers to the profession and retaining them seems to be a challenge shared by countries that are introducing informatics into their curriculum and those that have been providing it for a long time. One of the main reasons for informatics teacher shortages is that relatively few students obtain an academic degree in informatics compared with the number the labour market requires. Almost all the EU Member States are facing a shortage of digitally competent graduates, with 53 % of companies experimenting difficulties in 2019 in recruiting the digital

([15]) https://www.virtuelle-ph.at/digikomp/.

([16]) https://www.uhr.se/en/start/laws-and-regulations/Laws-and-regulations/The-Higher-Education-Ordinance/Annex-2/#BAMA_PrimEdu.
https://www.uhr.se/en/start/laws-and-regulations/Laws-and-regulations/The-Higher-Education-Ordinance/Annex-2/#MAMSc_SESEdu.

specialists they require (Informatics Europe, 2020). Therefore, the initial pool from which teachers are taken is small, even more so than usual considering the low percentage of women among graduating students and the salary disparities between industry and the education sector.

**Figure 4: Existence of alternative pathways or retraining programmes to prepare school informatics teachers (ISCED 1, 24 and 34), 2022/2023**




*Source:* Eurydice.

**Explanatory notes**

Figure 4 shows the existence of alternative pathways and/or retraining schemes to prepare specialist informatics teachers. The 'exist' categories apply if it exists at least at one education level (ISCED 1, 24 or 34).

Figure 4 looks at two specific alternative training possibilities beside ITE training that top-level education authorities can offer to address possible shortages in specialist informatics teachers. While alternative pathways are mainly designed for professionals in informatics without teaching qualifications, retraining aims at equipping teachers qualified to teach other subjects (e.g. teachers of mathematics, physics, engineering and business) with specific knowledge in informatics to allow them to teach this subject.

Both the alternative pathways and the retraining possibilities mostly relate to secondary education, given that in many education systems informatics is not yet taught as a distinct discipline in primary education, or is taught by generalist teachers. There are a few exceptions though. In Bulgaria, Lithuania and Slovakia, both alternative pathways and retraining programmes already exist in primary education to train specialist informatics teachers, while in Estonia and Romania, alternative pathways are offered for this education level. Spain, Latvia and Poland provide retraining possibilities for primary education teachers.

To increase the pool of specialist informatics teachers in secondary education, more than half of the education systems offer retraining programmes to allow teachers to obtain an additional qualification to teach informatics. Retraining programmes may be part of the CPD of in-service teachers or full-time studies. They give teachers the opportunity to extend their qualifications to another subject that they did not originally study. Therefore, one of the main criteria for admission is to be a fully qualified teacher. These programmes usually do not lead to an academic degree but certify participants' ability to teach informatics.

More than a third of the education systems have alternative pathways, among which professional-oriented programmes seem to be the most common. They are mainly designed for candidates with a

non-teaching academic degree in informatics or an informatics-related area who have some professional experience or none.

A third of the education systems offer both the possibility of retraining and alternative pathways.

Malta reports a new retraining scheme: the Institute for Education (IFE) offers various qualifications in education, which are offered in the evening. The Post-Graduate Certificate in Education offers qualified teachers the possibility to specialise in a new subject area. This qualification is subject-specific; it was offered as part of the 'Digital competence for education' subject for the first time in 2022/2023. Students can benefit from generic training and reskilling schemes, such as the 'Get qualified' tax rebate scheme and the Endeavour Scholarship Scheme ([17]).

Greece and Italy report that they are not facing any shortages in informatics teachers.

They are countries that did not establish alternative pathways into the teaching qualification or retraining schemes, but have put in place other policies or measures to face possible shortages in informatics teachers. For instance, Slovenia and Serbia have adopted measures to attract more students in ITE programmes (European Commission / EACEA / Eurydice, 2023).

## 3. Assessment of pupils' digital competence

Brečko et al. (2014, p. 17) highlight that there is a 'consensus among educational stakeholders that what is assessed and examined determine[s] what is valued and what is taught in real settings'. Nevertheless, the assessment of some of the key competences is not straightforward and still represents an important challenge for European education systems (European Commission, 2012).

This indicator focuses on the assessment of pupils' digital competence in national tests. Specifically, it looks at the existence of specific national tests for all or some students and of other forms of national tests, including the assessment of digital competence.

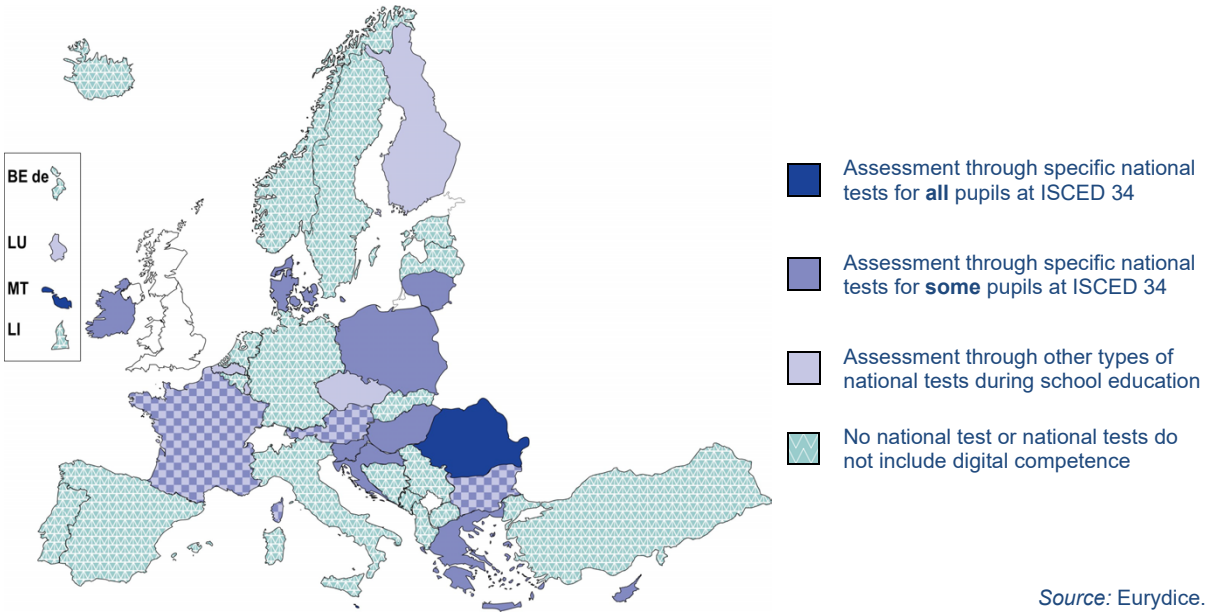
National tests are defined as standardised tests/examinations authorised by top-level public authorities and carried out under their responsibility. They include any form of test/exam that (a) requires all test takers to answer the same questions (or questions selected from a common bank of questions) and (b) is scored in a standard or consistent way. Tests based on samples of students aiming to monitor the quality of the education system rather than measuring the attainment levels of individual students are not the focus of this indicator but are taken into account, along with certified examinations assessing digital competence. Tests designed at the school level on the basis of a centrally designed framework of reference are not considered national tests. International tests are excluded from the data collection.

This indicator distinguishes between several criteria (as listed below). Figure 5 focuses on the existence of specific national tests in upper secondary education, given that these are very rare at lower education levels.

- Digital competence is assessed through **specific national tests**. These specific national tests are dedicated to digital competence, which may be included in subjects such as ICT or informatics. They seek to determine an individual student's level of attainment, usually in relation to a graded scale. For this criterion, the student base is considered as well, distinguishing tests where **all students** are assessed and where only **some students** take the test.
- Digital competence is assessed through **other national tests** (e.g. quality assurance tests and certified examinations).

([17]) https://www.maltaenterprise.com/support/get-qualified-2017-2023; https://education.gov.mt/en/education/myScholarship/Pages/ENDEAVOUR%20II.aspx.

**Figure 5: Assessment of students' digital competence through national tests, 2022/2023**




*Source:* Eurydice.

## Explanatory notes

The category 'Assessment through other types of national tests during school education' applies if the assessment of digital competence exists at least at one of the ISCED levels (1, 24 or 34) and relates to all or some pupils.

- In line with earlier findings in the Eurydice report *Digital Education at School* (European Commission / EACEA / Eurydice, 2019a), Figure 5 demonstrates that the assessment of digital competence through national tests remains uncommon, even in upper secondary education. Although not part of this figure, data shows that these are for the moment inexistent in primary education, and very rare in lower secondary education (only Malta has specific national tests, and Denmark and France have a non-specific national test assessing digital competence).
- At the upper secondary level, a dozen countries test digital competence through specific national tests, dedicated to digital competence. However, tests assessing **all** students only exist in Malta, where the subject ICT C3 has now been rolled out as a compulsory subject across secondary education ([18]), and Romania, where the digital competence national test is part of the Baccalaureate exam ([19]).
- Twelve education systems ([20]) are assessing digital competence through specific national tests, which are however only taken by **some** students. This is generally the case when the related subject is not compulsory for all students (e.g. informatics in Denmark, Greece, Austria, Poland and Slovenia; computer science in Ireland). In Ireland, the national test is also a certified examination, as it marks the end of full-time education ([21]). In Bulgaria, the external national assessment in IT measures digital competence in grade 10, but students can choose to take it or not. Its objectives are multiple: the diagnosis of individual progress and educational needs of students; monitoring the quality of the educational process; measuring the degree of achievement of individual expected learning outcomes by subject, etc. ([22]).

([18]) https://www.um.edu.mt/__data/assets/pdf_file/0003/427620/SEC09.pdf; https://onedrive.live.com/?authkey=%21AOkJ5hydMASDVZc&id=BD8EEDFF647627F7%211463&cid=BD8EEDFF647627F7.

([19]) https://edu.ro/bacalaureat.

([20]) Bulgaria, Denmark, France, Ireland, Greece, Croatia, Cyprus, Lithuania, Hungary, Poland, Austria, Slovenia.

([21]) https://www.examinations.ie/?l=en&mc=ex&sc=cs.

([22]) https://web.mon.bg/bg/100151; https://web.mon.bg/upload/32862/2DZI_INFORMATIKA.pdf ; https://web.mon.bg/upload/32861/2DZI_INFORMACIONNITEHNOLOGII.pdf.

- France reports that it assesses the digital competence of all students in lower secondary education through non-specific national tests as part of the written test in mathematics, science and technology, including a computer programming exercise ([23]). France also provides the possibility of certifying all students' digital skills profile in grade 9 of lower secondary education and at the end of upper secondary education through the PIX certification ([24]).
- In addition, in the Flemish Community of Belgium (lower secondary education), Bulgaria (upper secondary education), the Czechia, France (primary and lower secondary education) and Finland (primary and lower secondary education), digital competence is assessed through other national tests such as sample tests that aim at monitoring the quality of the education system rather than measuring the attainment levels of individual students. In Czechia, to assess the level, development and support of students' digital competence, the Czech School Inspectorate conducts thematic surveys. These are sample-based surveys carried out every year at ISCED levels 1–3; digital/information literacy is also regularly tested in the context of these surveys. Each year, one of five basic literacy skills (reading, mathematics, foreign language, information/digital and science literacy) is tested in predetermined grades of primary and secondary education. The next testing exercise in the area of digital competence is planned for 2023/2024 ([25]).

Many education systems where national tests are organised still do not include digital competence. This is the case in more than half of the education systems in primary and lower secondary education and in more than a third in upper secondary education.

Finally, in the German-speaking Community of Belgium, Spain ([26]) and Albania (all school levels), in Poland (primary education), Greece, Croatia, Cyprus, the Netherlands and Liechtenstein (primary and lower secondary education), and in the Flemish Community of Belgium and Bosnia and Herzegovina (primary and upper secondary education), there are no national tests.

There are only very few changes in the assessment of digital competence through national tests compared to the 2021/2022 school year. Nevertheless, the following example can be highlighted. In Spain, the reform of the Education Law in 2020 has led to the development of new national evaluations. As from the 2024/2025 school year, digital competence will be included in the evaluation at the end of primary education (end of grade 6), and as from the 2025/2026 school year, it will also be included in the evaluation at the end of compulsory secondary education (end of grade 10 – ISCED 3) ([27]).

## 4. Digital education ecosystem at school

The first strategic priority in the Digital Education Action Plan aims at fostering the development of high-performing digital education ecosystems. At school level, this involves effective digital capacity planning and development. The proposed indicator related to the digital education ecosystem looks at three different structural aspects that can contribute to better planning and development: first, top-level requirements to appoint a digital coordinator; second, top-level requirements to have a school digital plan; and third, the existence of specific criteria relating to digital education in external school evaluation frameworks.

([23]) https://eduscol.education.fr/716/les-epreuves-du-dnb.

([24]) https://eduscol.education.fr/721/evaluer-et-certifier-les-competences-numeriques.

([25]) For the sample-based thematic surveys results see the section entitled Documents/Thematic surveys: https://www.csicr.cz/cz/cz/DOKUMENTY/Tematicke-zpravy.

([26]) In Spain, national tests have been paused until 2023/2024. Nevertheless, some autonomous communities have continued to organise standardised assessments during the 2021/2022 school year.

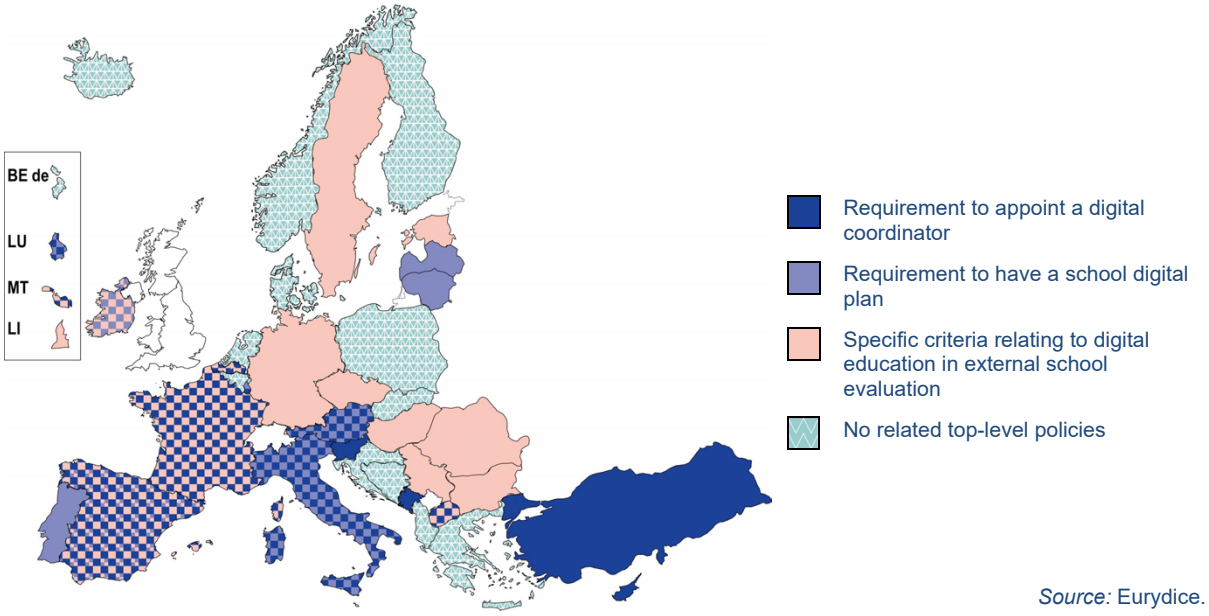
([27]) Article 143 of the Law 2/2006 on Education amended by Law 3/2020: https://www.educacionyfp.gob.es/inee/evaluaciones-nacionales/evaluaciones-lomloe/evaluaciones-generales-sistema-educativo.html.

## 4.1. Appointment of school digital coordinators

Delivering digital competence and ensuring that technology is used across the curriculum goes beyond the individual teacher's responsibility. Support for teachers and the wider school in the use of technologies in the education process is usually provided by digital coordinators, also known as ICT coordinators. Digital coordinators generally have responsibilities that cover both technical and pedagogical aspects (Devolder et al., 2010), although an explicit focus on either of these two aspects can also exist.

Figure 6 shows that only a dozen education systems have a top-level requirement to appoint a digital coordinator at school. This position is often held by a teacher whose teaching hours are reduced to provide technical and other support to the school community. It also involves allocating specific financial resources for these additional tasks. In more than half of the countries with a requirement to appoint a digital coordinator, their role is to support teachers and staff with both the technical aspects and pedagogical aspects of digital education (Flemish Community of Belgium, Spain, France, Italy, Malta, Austria and Montenegro). In three countries – Cyprus, North Macedonia and Türkiye – the role of the digital coordinator is mainly to manage and maintain the digital infrastructure and equipment of the school and to provide technical support. Finally, Luxembourg specifies that the role of their digital coordinators is mainly pedagogical. In Slovenia, this is the case in basic schools (ISCED 1 and 24), while in upper secondary school, the coordinators mainly cover technical aspects.

**Figure 6: Digital education ecosystem at school (ISCED 1, 24 and 34), 2022/2023**




*Source:* Eurydice.

Regarding new developments in this area, the following example can be mentioned: in the Flemish Community of Belgium, a reform has been prepared during the 2022/2023 school year focusing on team-based ICT support at the school level. The reform consists of the publication of a job profile for ICT coordinators, characteristics of ICT teams and a guideline to develop and establish ICT teams in schools ([28]). In Austria, while deploying the eight-point plan ([29]) and equipping pupils with devices, the time available for pedagogical IT support was expanded by 4 working hours per week. As for technical

([28]) https://www.vlaanderen.be/kenniscentrum-digisprong/themas/ict-coordinatie#teamgerichte-werking; https://www.vlaanderen.be/kenniscentrum-digisprong/themas/ict-coordinatie/digitale-transformatie-in-het-vlaamse-onderwijssysteem-hervorming-van-ict-teams-op-school ; https://www.vlaanderen.be/kenniscentrum-digisprong/themas/ict-coordinatie/digitale-transformatie-in-het-vlaamse-onderwijssysteem-hervorming-van-ict-teams-op-school#projectrapporten.

([29]) https://digitaleschule.gv.at/.

IT support in the federal schools, the number of full-time equivalents was increased by 19 additional positions (= + 12.5 %).

In more than a third of the education systems, the decision to appoint a digital coordinator is taken at the school/local level. In the German-speaking Community of Belgium, for example, since September 2022, the secondary schools have been given half a middle manager position (50 % of a full-time equivalent) to accompany information and media literacy, which also involves working on the school's internal media concept based on the new guide. In Sweden, the school heads and school organisers (a municipality or independent school organiser) has the responsibility to create conditions for the use of digital learning resources in teaching, ensuring that the staff are given time and opportunities to develop their skills and engage in collegial learning, ensuring access to digital learning resources and support ([30]).

A few countries, namely Czechia, Estonia, Ireland, Lithuania, the Netherlands and Portugal, report that while there is no top-level requirement, in practice a digital coordinator is appointed in most schools. In Portugal for example, within the scope of the programme for school digitisation, digital development teams were created, which are responsible for the digital development of schools in the organisational, pedagogical, technological and digital dimensions. The coordinator of these teams may or may not be an ICT teacher ([31]).

In nearly one quarter of the European education systems, there is no top-level requirement to appoint a digital coordinator at school. However, the absence of a top-level regulation does not necessarily mean that there are no digital coordinators. In Germany, in the *Land Rheinland-Pfalz*, for example, every school appoints a school digital coordinator. The digital strategy specifies the principles of this coordination, the main tasks and the working hours dedicated to this ([32]). In Poland, the appointment of a school digital coordinator is required only in those schools that have joined the 'Active blackboard' (*Aktywna tablica*) government programme. Joining the programme is voluntary and the decision is made by the school head with the consent of the school running body ([33]). In Slovakia, although there is no top-level requirement, the position of digital coordinator is defined by law (Act. 138/2019). In 2021, the education ministry provided financial support for their appointment in schools in the form of grants (Call for School Digital Coordinator) ([34]).

([30]) Education Act, chapter 2, paragraph 34 and 35, https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/skollag-2010800_sfs-2010-800/#K2.

([31]) https://digital.dge.mec.pt/.

([32]) https://digitalpakt.rlp.de/fileadmin/digitalpakt/Dokumente/2019-05-06_Merkblatt-Koordination-Bildung-in-der_digitalen-Welt.pdf.

([33]) https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20200001883/O/D20201883.pdf.

([34]) https://www.minedu.sk/skolsky-digitalny-koordinator/.

## 4.2. Top-level requirement to have a school digital plan

A requirement by top-level education authorities for schools to have a development plan which includes digital education, or a specific school digital plan, means that the development of both digital competence and innovative teaching and learning methods becomes central to school development as part of a school-wide approach.

Only a few education systems report having top-level requirement for schools to develop a school digital plan. In only two countries, namely Ireland and Portugal, schools need to draft a specific digital plan, while in six countries (Spain, Italy, Latvia, Lithuania, Luxembourg and Austria), this can be part of the general school-development plan. In Ireland, each school must have a digital learning plan, which is informed by the relevant Digital Learning Framework along with recent policies outlined in the 'Digital strategy for schools to 2027', which is in turn aligned with the EU Digital Education Action Plan and will run until 2027. The strategy sets out the high-level objectives that aim to ensure that the school system is prepared for and continues to make progress in embedding digital technologies in teaching, learning and assessment. In Portugal, also in the scope of the EU Digital Education Action Plan and the Portuguese Digital Transition Action Plan, all schools have developed and are implementing, monitoring and reformulating their action plans for digital development. They are designed based on the diagnosis carried out through the SELFIE for schools tool ([35]).

In a further dozen systems, developing a school digital plan is subject to school/local autonomy. In many cases, although a digital school plan is not compulsory, schools are encouraged to develop such plans and receive support in this endeavour. In the Flemish Community of Belgium for example, during the 2022/2023 school year, schools particularly received support in developing an ICT policy plan or in optimising existing policy plans. A specific policy planning tool was developed and is owned by the Knowledge Centre for Digital Education ([36]). In Sweden, the Education Act includes an obligation for every school organiser and school head to systematically and continuously plan, follow up and develop the education provided, and ensure quality, including in relation to the development of digital competence. The work must be documented ([37]).

Finally, half of the education systems do not have a top-level requirement for the development of school digital plans.

## 4.3. Criteria relating to digital education included in external school evaluations

External evaluators usually follow evaluation frameworks or have lists of topics and/or indicators to consider when evaluating the quality of a school (European Commission / EACEA / Eurydice, 2015). These documents might include criteria specifically relating to digital education, and therefore require evaluators to assess aspects in this area. This sub-indicator goes beyond a simple requirement for a subject-based evaluation of ICT or informatics. Instead, it focuses on whether there are wider evaluation criteria relating to the integration of digital technologies across the whole school. The criteria include the use of digital technologies across the curriculum and in school management processes, as well as the quality of digital infrastructure and the level of investment.

Only roughly one third of the European education systems report that their external school evaluation frameworks include specific criteria related to digital education. Where such criteria exist, these can be formulated either specifically for digital education and competences or as a part of wider areas.

([35]) https://digital.dge.mec.pt/.

([36]) https://www.vlaanderen.be/kenniscentrum-digisprong/tools/ict-beleidsplanner.

([37]) Education Act, chapter 4: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/skollag-2010800_sfs-2010-800.

In Czechia for example, the 2022/2023 plan of main objectives of the Czech School Inspectorate explicitly mentions the effective use of digital technologies as part of the wider goal of choosing teaching strategies and methods to reach the set goals ([38]).

In Hungary, the external school evaluation includes the questions of how teachers apply ICT tools and digital learning materials in the teaching process and how teachers manage to strike the optimal balance between traditional and information communication technologies ([39]).

In Sweden, the School Inspectorate states that the work is reviewed through regular supervision by assessing how students use digital tools in learning ([40]).

Still, in half of the education systems external school evaluation frameworks do not include any specific criteria related to digital education. In four systems, there is no external school evaluation at all (Luxembourg, Finland, Norway and Türkiye).

Overall, countries did not mention any substantial changes in regulations related to these three specific elements of the school digital education ecosystem compared to the last reference year (2021/2022). Only a bit more than a dozen education systems have specific criteria for reviewing digital education in external school evaluation frameworks; in less than a third of the education systems the appointment of a school digital coordinator is required; and in only about a fourth of education systems is there a school digital plan. Only in Spain do top-level regulations cover all three analysed aspects of the digital education ecosystem, while in other education systems two out of the three are regulated (Flemish Community of Belgium, Ireland, France, Italy, Luxembourg, Malta, Austria, and North Macedonia).

In practice, individual schools might be developing such an ecosystem, but in absence of top-level regulations, these initiatives rely on the commitment of school leaders, teachers and staff, instead of being more structural.

([38]) Plan of Main Objectives of the Czech School Inspectorate 2022/23 (p. 6: effective use of digital technologies) https://www.csicr.cz/cz/Dokumenty/Plan-hlavnich-ukolu/Plan-hlavnich-ukolu-Ceske-skolni-inspekce-na-skoln.
The Criteria for Evaluation of the Conditions, Course and Results of Education 2022/23 https://www.csicr.cz/cz/Dokumenty/Kriteria-hodnoceni/Kriteria-hodnoceni-podminek,-prubehu-a-vysledku-vz.

([39]) Országos pedagógiai-szakmai ellenőrzés: oktatas.hu.

([40]) https://www.skolinspektionen.se/globalassets/01-inspektion-och-tillstand/inspektion---steg-for-steg/under-inspektion/bedomningsgrunder-rt/uppdaterade-okt-2022/bedomningsgrunder-forskoleklass-och-grundskola-inkl-enskild-huvudman-version-2022-10-11.pdf.

## MAIN FINDINGS

This analysis reviews the situation of the 2022–2023 school year regarding key structures and policies that support the development of digital competence at school in Europe, based on information from 38 European education systems. In general, there are no major changes with respect to previous data collections. Recent changes in individual education systems have been highlighted in the text.

- In most European education systems, the compulsory teaching of digital competence for all pupils starts in primary education (ISCED level 1). In more than half of the education systems this is done as early as grade 1 of primary education. The latest compulsory starting grade that has been reported is grade 7 in lower secondary education (ISCED level 24) – this concerns the current situation in Cyprus, Malta and Albania. On the other hand, in the three Communities of Belgium, Germany, the Netherlands and Iceland the starting grade is defined at school/local or regional level. In Ireland, Croatia and Slovenia there is no compulsory starting grade but rather a recommended starting grade.
- Across Europe, digital competence is taught using several curricular approaches that may be applied in parallel and depending on the education level. Overall, in primary education, the most common approach is to teach digital competence as a cross-curricular subject, while in lower secondary education teaching is most often a compulsory separate subject; it is often compulsory for all pupils in lower secondary and increasingly optional in upper secondary education.
- Teaching informatics as a separate subject is not yet widespread in primary education. Several education systems start offering informatics at the end of primary education and then in a varying number of grades in secondary education. While in primary and lower secondary education the subjects are mostly compulsory for all students, these are mostly optional in upper secondary education.
- More than half of the European education systems, top-level authorities require that teacher-specific digital competence be included in ITE curricula as a mandatory element for all teachers' profiles, in different levels of detail. In the rest of the European education systems, there are no such top-level requirements, sometimes because providers of ITE have institutional autonomy regarding the content of the courses they offer. However, the absence of top-level requirement does not necessarily mean that ITE institutions do not offer teachers the opportunity to develop their digital competence.
- To increase the pool of specialist informatics teachers in secondary education, more than half of the education systems offer retraining programmes to allow teachers to obtain an additional qualification to teach informatics. More than a third offer alternative pathways for professionals without a teaching qualification, among which professional-oriented programmes seem to be the most common. A third of the education systems offer both retraining and alternative pathways.
- The assessment of students' digital competence through national tests remains rare, even in upper secondary education, where a dozen countries test digital competence through specific national tests. Only in Malta and Romania are these tests taken by all students, while in twelve other countries these are taken by some students only.
- The specific structural elements of a school digital ecosystem are not widely regulated. The appointment of school digital coordinators and the development of school digital plans are often left to the discretion of school heads, which means that in practice not all schools and students can benefit from better planning and the development of new digital learning. Similarly, specific criteria relating to digital education in external school evaluations exist in only one third of European education systems.

# ANNEX

## Annex 1: Curriculum approaches to teaching digital competence, 2022/2023

| | ISCED 1 | | | ISCED 24 | | | | ISCED 34 | | School/local autonomy |
|---|---|---|---|---|---|---|---|---|---|---|
| | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | |
| Belgium BE fr | ○ | | | ○ | | | ○ | | | ■ |
| Belgium BE de | | | | | | | | | | ■ |
| Belgium BE nl | | | × | | × | × | | × | × | |
| Bulgaria | ● | | | ● | | | ●○ | | | |
| Czechia | ● | × | × | ● | × | × | ● | × | × | |
| Denmark | | × | × | | × | × | ○ | × | × | |
| Germany | (-) | (-) | (-) | ○ | | | ○ | | | |
| Estonia | ○ | × | × | ○ | × | × | ○ | | × | |
| Ireland | ○ | × | × | ○ | × | × | ○ | × | × | |
| Greece | ● | × | | ● | × | | ●○ | × | | |
| Spain | ○ | × | × | ○ | × | × | ○ | × | × | ■ |
| France | | × | × | | × | × | ● | × | × | |
| Croatia | ○ | | | ●○ | | | ●○ | | | |
| Italy | | × | × | | × | × | | × | × | ■ |
| Cyprus | | × | × | ● | | | ●○ | | | |
| Latvia | ● | × | | ● | | | ●○ | × | | |
| Lithuania | ○ | × | × | ● | × | × | ○ | × | × | |
| Luxembourg | | × | × | ●○ | | | ○ | | | |
| Hungary | ● | | × | ● | | × | ● | | × | |
| Malta | | | × | ● | | × | ●○ | | × | |
| Netherlands | | | | | | | ○ | | | ■ |
| Austria | | × | × | ● | | × | ● | | × | |
| Poland | ● | | × | ● | | | ●○ | | | |
| Portugal | ● | | × | ● | | | ○ | | | |
| Romania | | | × | ● | | | ● | | | |
| Slovenia | ○ | × | × | ○ | × | × | ●○ | × | × | |
| Slovakia | ● | | | ● | | | ● | | × | |
| Finland | | × | × | | × | × | ○ | | × | |
| Sweden | | × | × | | × | × | ○ | × | × | |
| Albania | (-) | (-) | (-) | ● | × | × | ● | × | × | |
| Bosnia and Herzegovina | ● | | | ● | | | ● | | | |
| Iceland | | × | × | | × | × | | | × | ■ |

| | ISCED 1 | | | ISCED 24 | | | | ISCED 34 | | School/local autonomy |
|---|---|---|---|---|---|---|---|---|---|---|
| | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | Compulsory /optional separate subject | Integrated in other compulsory subjects | Cross-curricular | |
| Liechtenstein | ● | × | × | ● | × | × | ○ | × | × | |
| Montenegro | ● | | × | ●○ | | × | ●○ | | × | |
| North Macedonia | ● | × | × | ● | | | ● | | | |
| Norway | | × | | | × | | ○ | × | | |
| Serbia | ● | × | × | ● | × | × | ● | × | × | |
| Türkiye | ● | | | ● | | | ● | | | |

Symbols:

× Exist ● Compulsory ○ Optional ■ School/local autonomy (-) not included

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## GLOSSARY

**Alternative pathways to become an informatics teacher.** In the present report the definition of alternative pathways will be restricted to the training programmes/schema/mechanism other than mainstream ITE that allow a person becoming a qualified informatics teacher. It targets individuals who do not hold any formal teacher qualification but have professional experience (e.g. in informatics, ICT, educational activities).

**Certified examinations.** Final examinations that result in the award of an official proof of a qualification to a student following completion of a particular stage or a full course of education, for instance at the end of ISCED levels 1, 24 and 34.

**Curricula.** The official programmes of study issued for schools by top-level education authorities. The national curriculum may include learning content, learning objectives, attainment targets, syllabuses or assessment guidelines, and it may be published in any type or any number of official documents. In some countries, the national curriculum is contained in legal decrees. More than one type of curriculum document may contain provisions relating to informatics / computer science and these may impose different levels of obligation on schools to comply. They may, for example, contain advice, recommendations or regulations. However, whatever the level of obligation, they all establish the basic framework in which schools develop their own teaching methods to meet their pupils' needs.

**Digital competence.** Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual-property-related questions, problem-solving and critical thinking. (*Council Recommendation on Key Competences for Lifelong Learning*, 2018, p. 9).

**Digital education.** Broadly speaking, digital education comprises two different but complementary perspectives: the development of the digital competence of pupils/students and teachers; and the pedagogical use of digital technologies to support and enhance learning, teaching and assessment. In the European Commission's 2018 Digital Education Action Plan this is phrased as 'how education and training systems can make better use of innovation and digital technology and support the

development of relevant digital competences needed for life and work in an age of rapid digital change.'

**External school evaluation.** School evaluations focus on the activities carried out by school staff without seeking to assign responsibility to individual staff members. Evaluations of this kind seek to monitor or improve school quality and/or student results, and findings are presented in an overall report that does not include individual teacher appraisal information. The evaluation of schools may be external or internal. In this context, external school evaluations are conducted by evaluators who report to a local, regional or top-level education authority and who are not directly involved in the activities of the school being evaluated. Such evaluations cover a broad range of school activities, including teaching and learning and/or all aspects of the management of the school. Evaluations which are conducted by specialist evaluators and concerned with specific tasks (relating to accounting records, health, safety, archives, etc.) are not regarded as external school evaluations.

**Informatics.** Informatics, also known as computer science in many countries, is a distinct scientific discipline, characterised by its own concepts, methods, body of knowledge, and open issues. It covers the foundations of computational structures, processes, artefacts and systems, and their software designs, their applications and their impact on society ([41]). In short, while digital literacy enables a person to be a confident and critical user, computer science enables a person to understand how computing systems work and, therefore, empowers them to become authors and create new artefacts through them, going beyond being mere consumers of computing technologies ([42]). The Committee on European Computing Education defines it as follows: 'digital literacy are basic user skills, while computer science is knowledge and competences about computational structures, processes, artefacts and systems as a distinct scientific discipline.

**National/standardised tests.** Refers to standardised tests/examinations set by top-level public authorities and carried out under their responsibility. Standardised tests/examinations are any form of test that (a) requires all test takers to answer the same questions (or questions selected from a common bank of questions) and (b) is scored in a standard or consistent way. Tests designed at the school level on the basis of a centrally designed framework of reference are not considered as national tests. International tests or surveys such as PISA are not within the scope.

**Re-training.** Possibility for professionals holding a teacher qualification (e.g. teachers of mathematics, physics, engineering and business and generalist teachers) to develop the skills needed to become computer science/informatics teachers without completing full academic training.

**Specialist teacher.** A teacher qualified to teach one curriculum subject or a group of curriculum subjects which corresponds to less than half of all curriculum subjects.

**Top-level authority.** The highest level of authority with responsibility for education in a given country, usually located at the national (state) level. However, for Belgium, Germany and Spain, the *Communautés, Länder* and *Comunidades Autónomas* respectively are either wholly responsible or share responsibilities with the state level for all or most areas relating to education. Therefore, these administrations are considered as the top-level authority for the areas where they hold the responsibility, while for those areas for which they share the responsibility with the national (state) level, both are considered to be top-level authorities.

([41]) CECE (2017). Informatics Education in Europe: Are we all in the same boat? Available at: https://dl.acm.org/doi/pdf/10.1145/3106077.

([42]) K–12 Computer Science Framework. (2016). Retrieved from http://www.k12cs.org.

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- Early leaving from education and training
- The teaching profession
- Equity in school and higher education
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