DIGITAL FIRST

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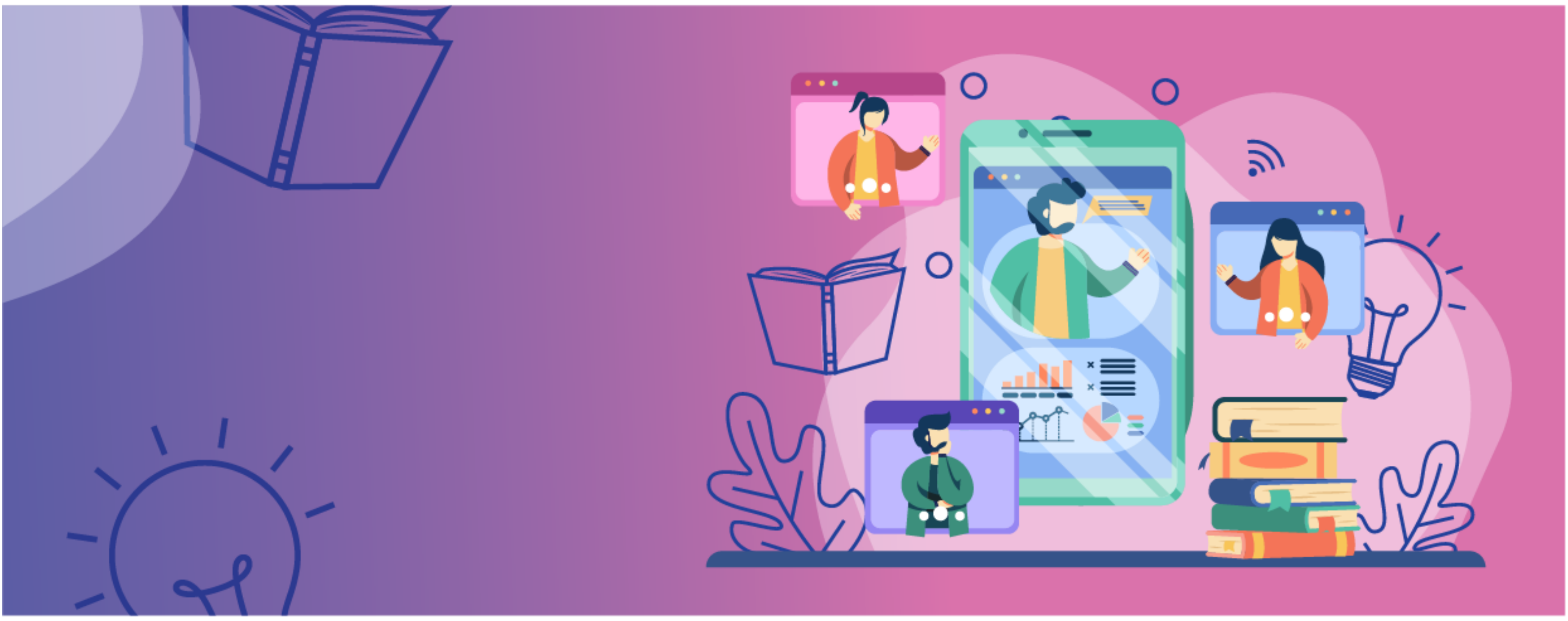
Digital Tech as the First Language:

Informatics for Digital Natives

D4.1 Informatics teacher education and training in the EU today – research



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1 Introduction

The Digital First project aims to strengthen informatics education across Europe by developing and promoting a functional approach to teaching digital technologies, which is aligned with the needs of today's digital natives. Within this broader objective, Work Package 4 (WP4), titled *The Picture of the Teacher*, focuses specifically on those who teach informatics in schools. It investigates how teachers are currently prepared for this role, examining the qualifications and training they receive, and evaluating the support structures in place to support their professional growth and competence development.

Deliverable D4.1, *Informatics teacher education and training in the EU today – research*, presents the results of Task 4.1, which explores the current state of informatics teacher education and training in the participating countries. The goal of this task is to build a comprehensive understanding of how informatics teachers are prepared at different ISCED levels (1 – primary school, 24 – lower secondary school, and 34 – upper secondary school), including both initial teacher education and in-service training. By analysing national models, university programmes, and teacher experiences, **this deliverable lays the groundwork for deliverables D4.2 to D4.5**, which build on its findings to develop competencies, educational programmes, and training models for informatics teachers.

This report draws on contributions from the ten partner countries (Bulgaria, Croatia, Cyprus, Finland, Greece, Italy, Lithuania, Portugal, Slovenia, and Spain), offering a diverse yet interconnected view of informatics teacher education in Europe. The findings reflect diverse national contexts but also reveal shared challenges and common trends. The insights from this deliverable are expected to support the development of high-quality, inclusive, and future-oriented teacher education models that respond to the evolving demands of informatics education in Europe.

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2 Methodology

Teacher education for informatics varies significantly across European education systems, with different qualification pathways, competency frameworks, and support structures. To build a comprehensive picture of how informatics teachers are educated across Europe, Task 4.1 of the Digital First project followed a three-step methodological approach, involving ten project partner countries. This approach combined institutional data, programme-level insights, and individual teacher experiences to capture both systemic structures and the lived realities of informatics teacher education.

Our three-phase research approach systematically captured multiple dimensions of teacher education. First, a structured questionnaire enabled each partner country to provide information on national pathways, qualification requirements, professional development opportunities, and support systems for informatics teachers at primary (ISCED 1), lower secondary (ISCED 24), and upper secondary (ISCED 34) levels. Second, we collected detailed profiles of representative university programmes in each country, examining learning objectives, general and subject-specific competences, and course structures with ECTS credit allocations. Third, semi-structured interviews with practising teachers provided first-hand insight into their experiences with education, training pathways, and professional practice realities.

Together, these three phases generated layered, comprehensive data that supports the project's efforts to map teacher competencies and improve informatics education across the EU.

2.1 National questionnaires

Each partner country completed a comprehensive questionnaire (Annex 1 – Questionnaire for project partners) documenting their national approaches to informatics teachers' education and training at primary (ISCED 1), lower secondary (ISCED 24), and upper secondary (ISCED 34) levels. The primary purpose of these questionnaires was to collect comparable and context-rich data across the ten participating countries regarding their national practices, formal qualifications, and institutional frameworks related to the preparation of informatics teachers.

The questionnaires allowed the project consortium to systematically explore how different education systems define and support the professional profile of informatics teachers – what qualifications are required, what pedagogical preparation is expected, and how classroom practice is embedded in teacher education. In addition to formal education routes, the questionnaires also gathered information on professional development opportunities, support organisations, and the presence of teacher communities, providing a broader picture of the support ecosystem available to informatics educators.

The questionnaire explored three key dimensions of teacher preparation: formal qualification requirements and pedagogical training expectations; embedding of classroom practice within teacher education programmes; and the broader support ecosystem, including professional development opportunities, teacher organizations, and professional communities.

Beyond institutional structures, partners documented the reality of current practice – identifying who teaches informatics in classrooms, what diverse pathways they followed into the profession, and how systems accommodate teachers with varying backgrounds (from formally trained informatics educators to STEAM specialists integrating computing content).

These national profiles establish a foundational understanding of the current landscape of informatics teacher education in Europe. This work also supports the goal of WP4 to develop a competencies map for informatics teachers and to identify models of teacher education.

2.2 University programmes

Following the initial questionnaire phase, each project country partner was asked to identify a typical university programme for future informatics teachers in their country. The purpose of this task was to highlight a representative

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model of initial teacher education – typically the programme most commonly completed by prospective informatics teachers in each country. To enable a detailed comparison across countries, partners were also asked to translate key elements of the selected programme into English, including its objectives, general and subject-specific competences, and a list of courses with their corresponding ECTS credits.

This activity was designed to deepen the understanding of how formal teacher education in informatics is structured across partner countries, with a particular focus on the competencies being developed and the curricular emphasis placed on different areas of content and pedagogy. This step provides a valuable foundation for the development of a competencies map and contributes to the project's broader aim of supporting high-quality and coherent informatics teacher education across Europe.

2.3 Interviews with teachers

The interviews conducted serve to explore the current landscape of teacher education and training for informatics across Europe. The objective of the present study is to provide an in-depth understanding of *who* is teaching informatics at the primary (ISCED 1), lower secondary (ISCED 24), and upper secondary (ISCED 34) levels. The project's objective is to identify the strengths, challenges, and gaps in the current system by gathering the lived experiences, educational pathways, and professional development opportunities of current informatics teachers.

In total, 135 interviews were conducted across the ten participating countries. These included 39 interviews at the primary level, 54 at the lower secondary level, and 42 at the upper secondary level. While the number of interviews per country varied depending on national contexts and teacher availability, each partner conducted interviews with at least three (ideally five) teachers per level, aiming to capture a broad range of teacher profiles.

Interviewed teachers represented a variety of backgrounds, including formally trained informatics teachers, STEAM educators integrating informatics, and informatics specialists without pedagogical qualifications. During the interview, teachers were invited to share their experiences on topics such as how they integrate informatics into their teaching, their pedagogical approaches, the use of resources, participation in professional development, and support networks.

A consistent set of interview questions (Annex 2 – Questions for interviews with teachers from ISCED 1, Annex 3 – Questions for interviews with teachers from ISCED 24 and Annex 4 – Questions for interviews with teachers from ISCED 34) was used across countries to ensure comparability, while allowing room for individual teachers to elaborate on their own experiences. The data obtained from the interviews were analysed thematically, with a focus on teacher profiles, pedagogical practices, knowledge areas, use of digital tools, professional development, and challenges and opportunities in informatics education. The insights gained from these interviews contribute to the establishment of a detailed and human-centred understanding of the reality of informatics teaching in European schools today. These findings complement the results of the questionnaire and university programme analyses.

Moreover, the interviews contribute to the development of a comprehensive competencies map for informatics teachers, a key objective of WP4, which will be described in Deliverables D4.2 *Competencies Map for Informatics Teachers in Primary School* and D4.3 *Competencies Map for Informatics Teachers in Secondary School*. The insights derived from these conversations will inform the future development of teacher education and training programmes, ensuring their alignment with actual classroom practices and needs. This work ultimately supports the project's ambition to promote high-quality, inclusive, and forward-looking informatics education across Europe.

3 Findings

This chapter presents the key findings from the three phases of data collection carried out in Task 4.1 of the Digital First project: questionnaire responses, university programme descriptions, and teacher interviews. Together, these results offer a multi-dimensional view of how informatics teachers are currently being educated and trained across Europe. The following sections summarise key national approaches, highlight similarities and differences between countries, and reflect on teacher experiences and institutional practices. The insights gathered here form the basis for further analysis and contribute directly to the development of a competencies map for informatics teachers.

3.1 Findings from the national questionnaires

In this chapter, we present the key findings from the questionnaire responses, highlighting the diverse approaches to informatics teacher education across partner countries. The findings are organized sequentially by each question, providing a clear and structured overview of the similarities, differences, and unique practices observed in teacher qualifications, training models, professional development opportunities, and support structures. This analysis aims to offer a comprehensive understanding of the current state of informatics teacher preparation and identify potential areas for improvement and collaboration.

3.1.1 Formal informatics teacher education

- **Describe your most typical model for informatics teachers teaching in ISCED 1:**
  At the ISCED 1 level, the teaching of informatics varies significantly across countries. In **Bulgaria**, informatics is introduced in grades 3 and 4 as a compulsory subject. It is taught by either specialist informatics teachers or generalist teachers with additional professional qualifications in informatics and/or information technology (IT). **Croatia** relies on generalist teachers, provided they have relevant informatics modules in their training, and teachers specialising in informatics. In **Cyprus**, generalist teachers handle informatics integration within other subjects, as there are no specialist informatics teachers. **Finland** also uses generalist teachers to incorporate digital competence into broader curricula. In **Greece**, specialist informatics teachers or generalist teachers with ICT certification teach the subject. **Italy** introduces foundational informatics concepts through other subjects but without dedicated informatics teachers. In **Lithuania**, informatics is integrated into other subjects, with generalist teachers covering informatics topics. **Portugal** does not teach informatics as a distinct subject at this level, leaving digital literacy integrated into generalist teaching. **Slovenia** mandates that only specialist teachers can teach informatics if schools include it in the curriculum. **Spain** allows generalist teachers or those specialized in other areas (e.g., music, physical education) to teach informatics if included in the regional curriculum.
  - **What is informatics teacher required qualification?** In **Bulgaria**, teachers need either a master's degree in primary education with informatics specialisation or a specialist qualification in informatics with a pedagogical certification program. In **Croatia**, teachers need to hold a master's degree. Generalist teachers are allowed to teach informatics if they have completed relevant training modules, and teachers specialising in informatics (study program Master of Education in Informatics) can teach as well. In **Cyprus**, generalist teachers are responsible for all subjects, including informatics. Similarly, in **Finland**, the informatics curriculum is also taught by generalist teachers, as part of their broader teaching responsibilities. **Greece** mandates a degree in informatics with pedagogical training or ICT certification for generalist teachers in certain contexts. Teachers need to be certified by the Ministry of Education. In **Italy**, a master's degree in primary school sciences is required. The qualification focuses on broader teaching competencies rather than informatics-specific training. **Lithuania** integrates informatics into the qualifications of generalist teachers. **Portugal** similarly focuses on generalist teacher qualifications without specialization. **Slovenia** requires informatics teachers to hold a master's degree in informatics education or a master's degree in informatics with additional pedagogical training, while **Spain** permits generalist teachers or other specialist teachers to teach informatics curricula at ISCED 1.
  - **How many ECTS are intended for informatics courses?** The allocation of ECTS for informatics courses is uneven across countries. **Bulgaria** allocates 60–100 ECTS within teacher training programs. **Croatia** assigns

30–40 ECTS for informatics modules in generalist training, and 55–90 ECTS for the Master of Education in Informatics program. **Cyprus** includes one informatics-related course worth 5 ECTS. **Finland** does not allocate specific ECTS for informatics, focusing on integrated digital competence. **Greece** offers 180–240 ECTS within informatics degrees, but lacks details for primary teacher qualifications. **Italy** and **Portugal** do not allocate distinct ECTS for informatics courses, since informatics is not taught at this level. **Lithuania** integrates informatics topics into broader pedagogical training, while **Slovenia** assigns 106 ECTS, reflecting its emphasis on specialist teacher training. **Spain** includes 6–12 ECTS related to ICT in generalist teacher programs.

- **How many ECTS are intended for didactic courses?** Countries show significant variation in pedagogical ECTS allocation. **Bulgaria** allocates 20–30 ECTS for didactic courses. **Croatia** allocates 30–60 ECTS for didactics courses depending on the educational path of the teacher. **Cyprus** does not specify for didactics in informatics, but they have 240 ECTS for general didactics courses, while **Finland** integrates pedagogy into overall teacher training. **Greece** allocates 40–60 ECTS to pedagogical training, focusing on teaching methodologies, child psychology, and classroom management. **Italy** and **Portugal** include pedagogical training for generalist teachers but without distinct informatics didactics, since informatics is not taught at this level. **Lithuania** provides 5 ECTS for didactics courses, while **Slovenia** allocates 42 ECTS within specialist teacher training. **Spain** emphasizes didactics with 60–90 ECTS in its primary education programs.
- **How many hours of classroom practice must they complete?** Classroom practice ranges widely. **Italy** specifies 10 hours of weekly classroom practice integrated into broader teaching. **Cyprus** includes classroom practice within broader teaching requirements but does not specify hours for informatics. **Portugal** lacks specific informatics-related practice requirements, since informatics is not taught at this level. **Finland** integrates classroom practice into general teacher training without specifying informatics content. Depending on the chosen educational path, **Croatia** mandates 100–300 hours, **Slovenia** 140 hours, and **Bulgaria** up to 180 hours, combining observation and active teaching. **Greece** requires approximately 300 hours of supervised practice. **Lithuania** includes up to six months of practice as part of pedagogical training. **Spain** requires approximately 1000–1200 hours as part of broader teacher education.

Table 1 Comparative Overview of Informatics Teacher Education for Primary Level (ISCED 1)

Country	Teacher Qualification & Profile	Informatics ECTS	Didactics ECTS	Classroom Practice
Bulgaria	Master’s degree; generalist teachers with informatics specialisation or informatics specialist with pedagogy	60–100	20–30	Up to 180 hours
Croatia	Master’s degree; generalist teachers with informatics modules or informatics teachers (Master of Education in Informatics)	30–40 or 55–90	30–60	100–300 hours
Cyprus	Generalist teachers are responsible for all subjects, including informatics	5	240 (general didactics)	Integrated
Finland	Generalist teachers integrate digital competence across the curriculum	Not specified	Integrated	Integrated
Greece	Degree in informatics with pedagogy or generalist teacher with ICT certification; must be certified by Ministry	180–240	40–60	Approximately 300 hours

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Country	Teacher Qualification & Profile	Informatics ECTS	Didactics ECTS	Classroom Practice
Italy	Master's in primary school sciences; no specific informatics preparation	Integrated	Included	10 hours per week of classroom practice
Lithuania	Generalist teachers integrate informatics into other subjects (informatics content is covered during the initial education)	Integrated	5	Up to 6 months
Portugal	Generalist teachers integrate digital literacy across the curriculum	None	Included	Not specified
Slovenia	Master's degree; informatics teacher or informatics with pedagogical training	106	42	140 hours
Spain	Generalist teachers or subject teachers (if informatics is included in the regional curriculum)	6–12	60–90	1000–1200 hours

The findings reveal varying levels of specialisation, from generalist-based approaches to more structured qualification models with significant ECTS allocations and classroom practice. These differences point to the need for a clearer shared understanding of foundational informatics competencies in primary education.

- **Describe your most typical model for informatics teachers teaching in ISCED 24:**
  At ISCED 24, informatics is more structured and often requires specialist teachers. **Bulgaria** employs specialist teachers with degrees in informatics or related fields, often requiring additional pedagogical training. **Croatia** also relies on specialist teachers, supported by retraining programs for those from related disciplines. In **Cyprus**, teachers must hold a bachelor's degree in computer science. **Finland** integrates informatics into subjects like mathematics and science, often taught by teachers specializing in those areas. **Greece** mandates specialist informatics teachers, though earlier hires from mathematics and science fields may continue teaching. **Italy** incorporates informatics into broader subjects like mathematics and technology, taught by specialist teachers in those fields. **Lithuania** provides retraining programs for in-service teachers to obtain a qualification for teaching informatics, often requiring a bachelor's degree and pedagogical studies, but one can also become an informatics teacher by completing an informatics degree followed by pedagogical professional studies. **Portugal** requires specialist teachers with both a bachelor's degree and a master's in pedagogy. **Slovenia** mandates only specialist informatics teachers, while **Spain** integrates informatics into other subjects, taught by teachers specializing in technology or mathematics.
  - **What is informatics teacher required qualification?** Specialist qualifications dominate at this level. **Bulgaria**, **Croatia, Portugal**, and **Slovenia** have special study programmes for specialist informatics teachers. As an alternative, it is also possible to graduate from informatics and obtain pedagogical training later. **Greece** and **Lithuania** require formal degrees in informatics or related fields, supplemented by pedagogical training. **Lithuania** emphasizes retraining programs for teachers transitioning to informatics. **Cyprus** mandates a bachelor's degree in computer science. **Finland**, **Italy**, and **Spain** rely on teachers with expertise in related disciplines.
  - **How many ECTS are intended for informatics courses?** Allocations for informatics courses vary. **Bulgaria** allocates 60–90 ECTS, **Croatia** 55–150 ECTS, **Cyprus** 240 ECTS, **Greece** 180–240 ECTS, **Lithuania** 60 ECTS, **Slovenia** 106 ECTS, and **Spain** 6–12 ECTS. **Finland** and **Italy** integrate informatics into broader subject training, offering minimal specific ECTS. **Portugal** mandates 180 ECTS within bachelor's program.

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- **How many ECTS are intended for didactic courses?** Countries allocate between 20 and 120 ECTS for pedagogy. **Bulgaria**, **Croatia**, **Greece**, and **Slovenia** allocate 30–60 ECTS, while **Lithuania** emphasizes 60–120 ECTS for didactics. **Cyprus**, **Italy** and **Finland** integrate didactic training into broader teacher education, without specifying. In **Spain**, didactic training is also integrated with 20–30 ECTS. **Portugal** allocates 120 ECTS for didactics at master's program.
- **How many hours of classroom practice must they complete? Portugal** mandates 10–12 hours during training, followed by **Croatia** with 100–200 hours. **Slovenia** requires 140 hours, and **Bulgaria** approximately 180 hours. **Finland** integrates classroom practice into general teacher training without a specified requirement for informatics. **Greece** mandates around 300 hours, while **Spain** requires 300–400 hours within master's programs. **Lithuania** includes up to six months of practice. In **Italy**, teachers require 10 hours of practice weekly during pedagogical training. **Cyprus** integrates practice into broader teacher training without specific allocations for informatics.

Table 2 Comparative Overview of Informatics Teacher Education for Lower Secondary Level (ISCED 24)

Country	Teacher Qualification & Profile	Informatics ECTS	Didactics ECTS	Classroom Practice
Bulgaria	Degree in informatics or related field with pedagogical training	60–90	30–60	Approximately 180 hours
Croatia	Informatics teachers (Master of Education in Informatics), teacher of polytechnics or degree in related fields with pedagogy education	55–150	30–60	100–200 hours
Cyprus	Bachelor's degree in computer science	240	Integrated	Integrated
Finland	Teachers of related fields (mathematics, science) integrate informatics contents	Integrated	Integrated	Integrated
Greece	Degree in informatics or related field with pedagogy	180–240	40–60	Approximately 300 hours
Italy	Specialist teachers in related fields (e.g. mathematics, technology)	Integrated	Included	10 hours per week of classroom practice
Lithuania	Informatics degree with pedagogy or retrained teachers from related fields	60	60–120	Up to 6 months
Portugal	Bachelor's in informatics + master's in pedagogy	180	120	10–12 hours
Slovenia	Master's in informatics education or informatics specialist with pedagogical training	106	42	140 hours
Spain	Teachers of technology or mathematics integrate informatics	6-12 (integrated)	20–30	300–400 hours

These findings demonstrate that while most countries rely on specialist teachers at the lower secondary level, the routes to qualification vary significantly in terms of academic background, ECTS allocations, and the integration of informatics

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content. This diversity underscores the need for greater alignment and clarity in defining core informatics teaching competencies at this level.

- **Describe your most typical model for informatics teachers teaching in ISCED 34:**
  ISCED 34 focuses on advanced qualifications and specialization. In **Croatia**, informatics teachers usually hold a master's degree or higher (such as a PhD) in informatics, computer science, or a closely related field. **Bulgaria**, and **Slovenia** require a master's degree in informatics education or in informatics with pedagogical training. **Portugal** also requires a master's degree in pedagogy. **Cyprus** requires bachelor's degree in computer science. **Finland** embeds informatics into broader subjects taught by teachers from related disciplines. **Greece** requires specialist informatics teachers to hold bachelor's degree in informatics and pedagogical courses. **Italy** requires specialist informatics teachers with a master's degree in informatics and special qualification to teach informatics. **Lithuania** requires initial teacher education but also emphasizes retraining to prepare teachers for this level. While in **Spain** informatics is rarely taught as a standalone subject, teachers who teach it are specialist informatics teachers with specific training in informatics or computer science, teachers of related disciplines or have bachelor's or a master's degree in technology, informatics, or engineering, along with the Teacher Training Master's Degree.
    - **What is informatics teacher required qualification?** Specialist qualifications, often at the master's level, are the norm. **Bulgaria**, **Croatia**, **Greece**, **Italy**, **Portugal, Slovenia**, and **Spain** require degrees in informatics with additional pedagogical training or master's in informatics education, while **Lithuania** requires bachelor's degree in informatics followed by pedagogical qualification. **Bulgaria** and **Lithuania** also offer retraining programmes for teachers from related fields. **Cyprus** emphasizes subject expertise. In **Finland,** there are no specialist informatics teachers as informatics is integrated in other subjects.
    - **How many ECTS are intended for informatics courses?**
      Allocations range widely. **Bulgaria** requires 90–180 ECTS, **Croatia** 60-300 ECTS, **Cyprus** 240 ECTS, **Greece** 180–240 ECTS, **Italy** 300 ECTS, **Lithuania** 60 ECTS, **Portugal** 180 ECTS, **Slovenia** 106 ECTS, and **Spain** teachers require at least around 6–12 ECTS, as informatics topics are mainly integrated into other subjects; similarly, in **Finland**, informatics is also integrated.
    - **How many ECTS are intended for didactic courses?** Pedagogical training varies. **Slovenia** allocates to didactical courses 42 ECTS, **Lithuania** 60–120 ECTS, **Greece** 40–60 ECTS, **Bulgaria** 15–30 ECTS, **Spain** 20–30 ECTS, and **Croatia** emphasizes 10–20 ECTS, while **Portugal** allocates 120 ECTS for didactics at master's program. In **Finland**, didactics training is integrated into broader teacher education.
    - **How many hours of classroom practice must they complete? Slovenia** requires 140 hours of classroom practice at ISCED 34, followed by **Bulgaria** with up to 180 hours. **Greece** mandates around 300 hours, while **Spain** requires 300–400 hours within master's programs. **Portugal** requires 10–12 hours of practice, and **Lithuania** includes up to six months. In **Italy**, teachers require 10 hours of practice weekly during pedagogical training. **Croatia** has no fixed requirement, incorporating practice within broader teacher training. **Finland** and **Cyprus** do not specify dedicated practice requirements for informatics teachers.

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Table 3 Comparative Overview of Informatics Teacher Education for Upper Secondary Level (ISCED 34)

Country	Teacher Qualification & Profile	Informatics ECTS	Didactics ECTS	Classroom Practice
Bulgaria	Master's in informatics education or informatics with pedagogical training	90–180	15–30	Up to 180 hours
Croatia	Master's or PhD in informatics or related field with additional pedagogy education or Master of Education in Informatics	60–300	10–20	Integrated
Cyprus	Bachelor's degree in computer science	240	Not specified	Not specified
Finland	Teachers of related fields integrate informatics	Integrated	Integrated	Not specified
Greece	Bachelor's degree in informatics with pedagogical training	180–240	40–60	Approximately 300 hours
Italy	Master's in Informatics, Mathematics or Engineering with special qualification to teach informatics	300	Not specified	10 hours per week
Lithuania	Bachelor's in informatics with pedagogical qualification or retraining from related fields	60	60–120	Up to 6 months
Portugal	Bachelor's in informatics + master's in pedagogy	180	120	10–12 hours
Slovenia	Master's in informatics education or informatics specialist with pedagogical training	106	42	140 hours
Spain	Teachers with informatics, technology, or engineering degrees and pedagogical qualification	6–12 (integrated)	20–30	300–400 hours

The findings reveal consistently high qualification requirements for teaching informatics at the upper secondary level, often centred around specialist degrees and dedicated pedagogical training. However, the structure and depth of preparation vary considerably across countries, particularly in terms of ECTS allocations and classroom practice. These differences indicate a need for greater coherence in defining advanced informatics teaching competencies across education systems.

3.1.2 Support organizations

- **Are there organizations that provide in-service informatics teacher education, development and training?**
  Across the ten countries reviewed, in-service education, development, and training for informatics teachers are provided by a diverse mix of institutions, including governmental bodies, universities, specialized teacher associations, and regional training centres.
  In **Bulgaria**, organizations like Sofia University's Faculty of Mathematics and Informatics and Junior Achievement Bulgaria offer training programs. **Croatia** relies on the Ministry of Science, Education and Youth in collaboration with CARNET, as well as institutions like Algebra University and the University of Zagreb faculties. **Cyprus** benefits from the Cyprus Computer Society and the Ministry of Education's joint initiatives. **Finland's** courses are mainly

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offered by universities, often funded by the national agency of education, though without regular annual programs. **Greece** features the Institute of Educational Policy, Peripheral Training Centres, and the Computer Technology Institute "Diophantus." **Italy's** "Team Digitale" provides training, alongside emerging Ministry of Education initiatives. **Lithuania's** Lithuanian Informatics Teacher Association (LInMA) and Lithuanian Computer Society (LIKS) support teachers, while **Portugal's** ANPRI and Teacher Training Centres (CFAE) provide professional development. **Slovenia's** teacher education is mainly supported by university faculties such as those at the Universities of Ljubljana and Maribor, alongside associations like ACM Slovenia and projects like Napoj. **Spain** relies on regional informatics teacher associations such as AAPRI in Andalusia and APICV in Valencia, supported by organizations like Programamos and regional centres like Galicia's CFRs.

These examples highlight the varied, yet complementary roles played by ministries, educational institutions, and professional bodies across countries in fostering informatics teacher development.

- **Are there online communities and forums for computer science/informatics teachers?**

  Online communities and forums serve as an important resource for collaboration and knowledge sharing among informatics teachers in all countries. Platforms range from formal networks managed by educational institutions to informal social media groups and discussion forums.

  Bulgaria has informal social media groups to support each other. **Croatia** has various groups for teachers that integrate ICT in education, forums, and online communities of teachers, including those that focus on informatics education. Some of these communities are more formal than the others. **Lithuania** has the Lithuanian Teacher Association (LInMA) online community, as well as different social media communities. In **Slovenia**, there are structured forums supported by the National Education Institute Slovenia that facilitate professional dialogue and resource sharing and other educational communities of teachers that support teachers with examples of good practice as well as opening dialogue among informatics teachers on different topics, e.g. project NAPOJ. In **Spain,** there are some local informatics teachers' associations, like the Andalusian Association of Informatics Teachers (AAPRI), which provide online forums. There are also some different social media communities which provide peer support and exchange of teaching materials. In **Greece,** there are online communities and forums for informatics teachers to support collaboration, professional development and sharing of resources. They include formal academic networks and more informal initiatives. In Italy, they have local groups that support teachers with additional training and resources. In **Cyprus**, there are social media pages for informing informatics teachers about events, courses, and training offered. In **Portugal,** ANPRI - Associação Nacional de Professores de Informática supports informatics teachers. **Finland** relies heavily on informal networks on social media, with discussions often integrated into broader subject-specific teacher groups.

  Overall, online communities play a key role in supplementing formal training by offering ongoing support, collaborative opportunities, and access to resources tailored to informatics education.

3.1.3 Professional development

- **Do teachers have opportunities to attend additional Informatics courses, such as those focused on new topics? How frequently do teachers participate in these courses? Are these courses mandatory for teachers?**

  All participating countries offer professional development opportunities for informatics teachers, with courses focusing on topics such as emerging technologies, programming, artificial intelligence, robotics, and digital tools. In **Bulgaria**, **Lithuania**, **Portugal**, and **Greece**, professional development is actively promoted through national programs and in-service training initiatives. These countries generally provide specialized courses to address advancements in informatics education. **Cyprus**, **Slovenia**, **Croatia**, and **Italy** also offer ongoing training, often organized by teacher training centres, universities, or professional associations. **Finland** and **Spain** have more flexible systems, where participation in professional development depends on individual teachers or schools, with training opportunities tailored to emerging needs.

  Participation rates vary across countries, influenced by the availability of training and national policies. In **Finland, Lithuania,** and **Portugal**, teachers are required to complete specific hours of professional development within a set timeframe, ensuring consistent participation. Similarly, in **Cyprus** and **Greece**, mandatory training linked to career

progression or certifications increases participation levels. In countries like **Croatia**, **Italy**, and **Spain**, professional development is more voluntary, with participation driven by teachers' motivation and institutional encouragement. **Slovenia** promotes attendance through publicly funded training programs, though participation is not mandated.
Professional development requirements vary widely. **Lithuania**, **Portugal**, **Cyprus**, and **Greece** mandate participation under certain conditions, such as certification renewal or career advancement. In contrast, **Croatia**, **Finland**, **Slovenia**, **Italy**, and **Spain** provide voluntary training opportunities, emphasizing teacher autonomy and institutional support to encourage engagement. Regardless of whether training is mandatory or voluntary, all countries recognize the importance of continuous professional development to keep teachers updated on technological advancements and enhance their pedagogical skills.

3.1.4 Other

- **Please describe the differences in qualification requirements between teachers teaching in public and private schools.**
  The qualification requirements for teachers in public and private schools vary across participating countries. In **Bulgaria**, **Portugal**, **Slovenia**, **Cyprus**, and **Spain**, the same standards apply to both public and private school teachers, as qualifications are regulated by national laws. These countries require formal degrees and teaching certifications to ensure uniformity across educational sectors.
  In **Greece**, **Croatia**, and **Lithuania**, private schools have more flexibility in hiring criteria. While public schools require strict adherence to national standards, private schools may prioritize practical skills or teaching experience over formal qualifications. **Lithuania** particularly highlights that private schools may hire teachers without formal teaching certifications if they demonstrate sufficient expertise in informatics. In **Italy**, no differences exist between public and private school requirements, as both sectors adhere to identical national regulations. **Finland** similarly aligns requirements for both sectors, though private schools may sometimes require specialized knowledge of alternative teaching methodologies.
  Overall, while most countries enforce consistent standards for both public and private schools, some private institutions benefit from greater autonomy in recruitment and qualification requirements.

- **Would you like to share anything else regarding informatics teacher education in your country?**
  Several countries shared further reflections on informatics teacher education. **Slovenian partners** expressed a desire to make informatics a mandatory subject, emphasizing its importance for modern education. **Lithuania** highlighted active retraining programs supported by national funding, which have encouraged teachers from various fields to acquire qualifications in informatics. **Spain** underscored the need for a specialized informatics teacher role, suggesting that such a position could enhance both teaching quality and support for colleagues in integrating digital tools across the curriculum. **Finland** reflected on the lack of a dedicated "informatics" subject, instead focusing on integrating digital competencies into broader teaching frameworks. **Italy** pointed to ongoing efforts to refine teaching methodologies through digital tools, supported by national and regional initiatives.

These insights reflect a shared recognition among countries of the growing importance of informatics education and the need for systemic improvements to teacher training, curriculum design, and professional development opportunities.

3.2 Findings from the University programmes

This chapter summarises key findings from the national overviews of university programmes for future informatics teachers in *Digital First* partner countries. It highlights common features, differences, and identifiable gaps in how informatics teachers are trained across Europe. The summary is organised around selected themes that emerged as particularly relevant: entry requirements and degree structure, the balance between informatics and pedagogy, curriculum content and thematic areas, and national specificities and gaps.

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3.2.1 Entry Requirements and Degree Structure

The entry requirements and structure of university programmes for becoming an informatics teacher differ across the *Digital First* partner countries, reflecting diverse educational models.

In **Bulgaria**, prospective informatics teachers typically begin with a bachelor's degree in informatics or a related field. During their studies, they take pedagogical courses alongside their main subject. To become certified, graduates must complete additional coursework in teaching methods and gain practical teaching experience. Some teachers pursue a master's degree to deepen their knowledge, although it is optional.

In **Croatia**, there are different pathways for the education of informatics teachers. Students may enter the profession through integrated undergraduate and graduate teacher education studies with an informatics module, or by completing a degree in informatics (Master of Education in Informatics, Master of Education in Polytechnics and Informatics), or some related field as mathematics or computer science, followed by pedagogical education.

In **Cyprus**, prospective informatics teachers typically complete a 4-year bachelor's programme (240 ECTS) in Applied Informatics or Computer Science at institutions like Neapolis University Pafos or American College. While these degrees offer a strong foundation in ICT, they do not formally include pedagogical training. Graduates may pursue a master's degree, such as the MSc in Information Systems, but this too is not designed specifically for school-level teaching, pointing to a lack of structured pathways into teaching.

In **Finland**, primary school teachers (grades 1–6) follow a generalist education path and are required to complete a master's degree that includes at least 60 ECTS of pedagogical studies and 60 ECTS of multidisciplinary subject studies, which may include informatics. For lower and upper secondary school teachers (grades 7–12), subject teachers must complete a master's degree, including at least 60 ECTS of subject-specific studies and 60 ECTS of pedagogy studies. Teachers typically study two or three teaching subjects.

In **Greece**, prospective informatics teachers are required to hold either a bachelor's or a master's degree in computer science or a closely related field. Typical bachelor's programmes span 4 or 5 years and combine foundational computing courses with specialised electives. Pedagogical qualifications can be acquired through various recognised pathways, including a degree in education, a relevant postgraduate programme, or certification from accredited institutions such as ASPETE (School of Pedagogical and Technological Education).

In **Italy**, the educational path for future informatics teachers typically begins with a relevant academic degree that covers core areas such as programming, computer architecture, operating systems, computer networks, databases, multimedia systems and cybersecurity. This is followed by a nationally regulated teacher qualification programme, which includes pedagogical training and a classroom practicum.

In **Lithuania**, there is currently no dedicated bachelor's programme for informatics teacher education. Instead, retraining programmes are available for qualified teachers of other subjects. These consist of a 60 ECTS module that covers core informatics topics. An alternative route is to complete a bachelor's degree in informatics and then choose to pursue Pedagogical Professional Studies, which lasts one year (60 ECTS) and includes courses such as Pedagogy, Educational Psychology, Didactics of Informatics, Pedagogical Practice, and the Final Thesis in Pedagogical Studies. Relevant master's programmes are also available, such as the master's in Information Technology Management offered by Vilnius University, which may include a pedagogical component or be followed by additional pedagogical studies.

In **Portugal**, teacher education follows a two-stage model. Candidates first complete a bachelor's degree in computer science or a related field**,** followed by a two-year master's degree in teaching. The master's programme includes coursework in didactics, educational psychology, and a supervised teaching practice.

In **Slovenia**, informatics teachers are educated within university programmes that typically combine informatics with another subject, such as mathematics. At the master's level, both single-major and double-major options are available. These programmes include subject-specific courses, didactics, and extensive teaching practice. Informatics is not a compulsory subject in primary and lower secondary education, but teacher education programmes still include preparation for teaching it as an elective subject. In upper secondary schools, there is a mandatory one-year subject called Informatics, and in many vocational education programmes, informatics topics are also included.

In **Spain**, there is no specific specialization in computer science for teachers in primary school. To become a teacher at this educational level, it is not necessary to have training in computer science; a degree in Primary Education is sufficient. Some programmes include one or two elective courses related to computing, but these are not mandatory**.** To teach informatics in secondary schools, educators must have prior technical studies, such as a degree in Physics, Engineering, Architecture, or similar fields. Additionally, they must complete a master's in education, which does not necessarily have to be in a specific speciality. However, some universities offer the master's programme with a specialization in computer science.

Overall, countries follow either a two-stage model (bachelor's degree in informatics followed by pedagogical studies) or an integrated approach (combining subject-specific and pedagogical training within the same programme). This diversity in structure offers multiple entry points but also highlights the complexity of comparing qualification frameworks across Europe.

3.2.2 Balance of Informatics and Pedagogy

The balance between disciplinary knowledge in informatics and pedagogical training varies across the *Digital First* partner countries, depending on whether teacher education programmes are integrated (concurrent) or follow a two-stage (sequential) model.

In **Bulgaria**, pedagogical training is offered alongside bachelor's studies in informatics or a related field. Students typically complete courses in pedagogy, educational psychology, teaching methodologies, and curriculum development. In addition, they complete teaching practice and often continue with optional master's-level studies to deepen both subject knowledge and pedagogical competence.

In **Croatia**, the integration of informatics and pedagogy depends on the chosen educational path. In the integrated teacher education programme with an informatics module and in Master of Education in Informatics, students acquire pedagogical, psychological, and didactic competencies along with subject knowledge. Alternatively, graduates with a background in informatics or related fields may enrol in pedagogical education programmes after completing their degree or during their studies. The curriculum often includes courses in informatics didactics and practical teaching preparation.

The programmes in **Cyprus** are strongly focused on technical informatics content, with limited pedagogical components. Courses in communication or psychology are offered sporadically, but there is no integrated pedagogical framework. Neither the bachelor's nor the master's programmes include teaching practice or dedicated didactics, which results in a gap in preparing graduates specifically for classroom teaching.

In **Finland**, the structure differs by ISCED level. At the primary level, pedagogical studies form a significant part of the degree, with at least 120 ECTS devoted to educational studies and a minimum of 60 ECTS for multidisciplinary subject studies, which include informatics. For secondary level, pedagogical studies (minimum 60 ECTS) are complemented by in-depth subject studies in informatics. This structure supports both strong content knowledge and classroom competence.

In **Greece**, while the bachelor's curriculum is heavily focused on informatics, pedagogical skills are usually acquired through postgraduate studies or parallel certification routes. For those aiming to become teachers, master's programmes in ICT education offer a structured blend of didactics, assessment methods, and practical training in educational technologies.

In **Italy**, disciplinary content is extensive and well-structured, covering all major areas of computer science. Pedagogical training is not part of the initial academic degree but is provided through a separate teacher qualification programme, which includes coursework in didactics, curriculum planning, and classroom practice.

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In **Lithuania**, pedagogical training is delivered through pedagogical professional studies, which include courses in pedagogy, psychology, didactics of informatics, and teaching practice. While the initial focus is often on retraining, the programmes ensure a structured approach to developing teaching competencies in informatics.

In **Portugal**, the bachelor's degree in computer science provides a solid disciplinary foundation, with courses such as programming, algorithms, networks, databases, ethics and society, web and mobile development, multimedia, and virtual reality. The master's degree in teaching includes a strong pedagogical component, including courses in educational psychology, informatics didactics, assessment, and the use of digital technologies in education. Supervised teaching practice is integrated into both years of the programme, ensuring a strong link between theory and classroom application. As a result, both content and pedagogy are comprehensively addressed.

In **Slovenia**, pedagogical training is embedded within university-based teacher education. These programmes combine informatics-specific content with coursework in general pedagogy and subject didactics, along with extensive teaching practice. Specific courses, such as *Didactics of computing with practice* focus directly on planning, delivering, and evaluating informatics lessons.

In **Spain**, pedagogical training is concentrated in the master's degree in secondary education, which includes coursework in pedagogy, subject didactics, and practical training. This ensures that the disciplinary knowledge gained during bachelor's studies is complemented by the necessary teaching competencies.

Overall, most partner countries aim to strike a balance between content and pedagogy by integrating or layering dedicated coursework and teaching practice. However, the intensity and structure of this integration vary depending on national frameworks and teacher qualification models.

3.2.3 Curriculum Content and Thematic Areas

The curricula of informatics teacher education programmes in *Digital First* partner countries commonly include foundational computer science content such as programming, algorithms, data structures, computer networks, and databases. However, the scope and depth of topics, as well as the inclusion of newer fields like AI or cybersecurity, vary between countries.

In **Bulgaria**, the curriculum is organised into several thematic cores: Informatics and Computer Science (including programming, algorithms, software engineering, databases, computer networks, and operating systems), Educational Sciences and Pedagogy, Mathematics and Logic, Information Technology and Applications (such as multimedia and web development and cybersecurity), and Practical Training. The structure ensures coverage of both technical and pedagogical components.

Croatia offers various courses through integrated or modular teacher education. In one example from the University of Zagreb, content includes *Computer Structure*, *Information Systems*, *Introduction to Databases*, *Computer Networks*, *Programming*, *Advanced Use of Computers and the Internet*, and *Programming Educational Software Packages*. Importantly, the curriculum also features courses like Informatics *Methodology I* and *II* and *Educational Robots and Microcomputers in Education*, which directly connect informatics knowledge with classroom teaching.

The curriculum in **Cyprus** offers a broad and modern range of informatics topics, including programming (object-oriented and mobile computing), data structures, databases, operating systems, networks, software engineering, web development, and emerging areas like AI, cloud computing, and cybersecurity. Specialisations are available at both bachelor's and master's levels. However, the curriculum does not include coursework in informatics didactics, curriculum planning, or practicum teaching experiences, which are essential for effective classroom instruction.

In **Finland**, curriculum content differs by educational level. For primary education, informatics is integrated into broader multidisciplinary studies – for example, *Mathematical Problem Solving, Modelling, and Coding* or *Digital Learning and Teaching* and *Digital Competence and Artificial Intelligence*. At the secondary level, subject teachers may study courses such as *Foundations of Artificial Intelligence*, *Basics of Programming*, *Automata Theory*, *Scientific Computing*, and *Learning Analytics for Education Systems*.

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Greece includes a wide range of topics in its bachelor's degree programmes: programming (in multiple languages), software engineering, algorithms, operating systems and architecture, networks and cybersecurity, databases, and in specialized electives such as artificial intelligence and human-computer interaction. Master's programmes for ICT teaching build on this foundation with topics such as educational strategies, digital games, instructional design, and digital applications in education.

The curriculum in **Italy** is detailed and extensive. It includes problem-solving, programming across different paradigms, software development, microcontroller programming, AI, computer systems, networks, cybersecurity, operating systems, databases, multimedia systems, and even project and business management. Legal and ethical topics like digital identity, data protection, and digital administration are also addressed.

In **Lithuania**, retraining modules for teachers cover a broad selection of technical subjects: Procedural and Object-Oriented Programming, Algorithms, Databases, Computer Networks, Web Programming, AI, Data Security, and Data Mining. These are designed to provide comprehensive informatics training within one academic year (60 ECTS). When completing a bachelor's degree in informatics, continuing with Pedagogical Professional Studies covers a wide range of pedagogy and didactics.

Portugal splits informatics teacher education between a bachelor's and a master's degree. The bachelor's level covers core scientific areas like programming, algorithms, operating systems, and databases, while the master's degree includes courses in didactics, digital technologies in education, and supervised teaching practice.

In **Slovenia**, teacher education programme for informatics (combined with another subject) includes courses that cover core topic areas, such as Data and information, Programming, Algorithms, Computing Systems, Networks and communication, Design and Development, and Digital Creativity. The programme also addresses pedagogical aspects through pedagogy subjects, coursework in didactics and teaching practice.

In **Spain**, the structure typically includes a bachelor's degree in informatics, or a related field such as Physics, Engineering or Architecture. In this case, the informatics knowledge varies according to the selected bachelor's programme. Afterwards, graduates continue with a master's in education with strong pedagogical and didactical training.

In summary, while all partner countries share a core of technical informatics subjects, some countries include more applied or emerging areas like artificial intelligence, educational robotics, and cybersecurity. The extent to which these topics are linked to school-level pedagogy varies and may indicate opportunities for curriculum development.

3.2.4 National Specificities and Gaps

An examination of university programmes across the *Digital First* partner countries reveals both unique national characteristics and identifiable gaps in how informatics teachers are educated.

Bulgaria adopts an integrated model, where students begin pedagogical training during their bachelor's studies. The curriculum is structured into thematic cores that combine informatics, pedagogy, mathematics, and practical experience. This approach supports a balanced preparation for teaching. While the structure is coherent, there is limited emphasis on newer informatics education topics or specialised didactics for different school levels.

Croatia reflects a degree of diversity. There are multiple programmes for informatics teachers. Education pathways are diverse and include integrated study programmes, postgraduate pedagogical training, master's degrees specialising in informatics education, or combinations with mathematics, physics, or polytechnics. This variety may lead to inconsistent teacher qualifications and expertise across schools. List of profiles eligible to teach Informatics in Croatian primary schools (grades 1 – 8) are part of the policy document: Policy on the appropriate type of education of teachers and experts in primary school (Pravilnik o odgovarajućoj vrsti obrazovanja učitelja i stručnih suradnika u osnovnoj školi) which list around 50 possible degrees.

Croatia reflects a degree of fragmentation. There is no single, standardised programme for informatics teachers. Education pathways are diverse and include integrated study programmes, postgraduate pedagogical training, master's

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degrees specialising in informatics education, or combinations with mathematics or technical culture. This variety may lead to inconsistent teacher qualifications and expertise across schools.

In **Cyprus**, informatics teacher education reflects an academic–industry blend, with a strong ICT focus and interdisciplinary content (e.g., management, economics, business) but lacks school-level pedagogical training. There is no dedicated pedagogical component or national standard for teaching qualifications in informatics. Although graduates are eligible to teach in secondary schools, the pathway to pedagogical proficiency is inconsistent, relying on content-heavy programmes without formal classroom preparation.

Finland demonstrates a unique dual approach: primary school teachers are trained as generalists with some exposure to informatics within broader multidisciplinary studies, while secondary school teachers specialise in specific subjects. This system ensures broad digital competence in early education but might limit deep subject expertise at the primary level unless further training is pursued.

In **Greece**, the training of informatics teachers typically follows a two-phase model: a bachelor's or master’s degree in computer science is followed by a specialised teaching qualification. Pedagogical preparation is obtained through postgraduate studies or certification pathways. While the academic foundation is strong, the separation of content and pedagogy may make it harder to integrate teaching practice early in the training process.

Italy stands out for the depth and scope of its informatics curriculum, which spans a wide array of computer science domains. However, pedagogical training is acquired separately after academic studies, creating a clear distinction between disciplinary and didactical preparation.

One clear specificity appears in **Lithuania**, where there is currently no dedicated bachelor’s programme for informatics teachers. Instead, the system relies on retraining pathways – 60 ECTS module in Informatics designed for qualified teachers from other subjects. This model allows flexibility and rapid capacity-building but may result in varying levels of depth in pedagogical preparation specifically for informatics.

In **Portugal**, teacher education also follows a two-stage model, with a bachelor’s degree in computer science or a related field followed by a master’s in teaching. The master’s programme includes coursework in informatics didactics, educational psychology, and supervised teaching practice. This structure ensures a more comprehensive preparation, although the delay in introducing pedagogical content may pose integration challenges similar to those in Greece.

In **Slovenia**, the non-compulsory status of informatics in primary education means that teacher training programmes are primarily aimed at secondary-level teaching. Informatics is often paired with another subject (e.g., mathematics), and although pedagogical preparation is included, there may be fewer specialised modules focused exclusively on informatics didactics for primary levels (ISCED 1), as informatics is not taught as a separate mandatory subject at this level.

In **Spain**, there is no specific preparation for informatics teachers at the primary level, as informatics is not part of the core curriculum and ICT-related courses are only offered as electives. At the secondary level, informatics teachers typically hold a technical or scientific degree and complete a master's in education. Some universities offer a specialisation in computer science within the master’s programme, combining disciplinary and pedagogical training.

Across countries, some gaps are evident in the lack of national standardisation or uniform qualification frameworks for informatics teachers. Additionally, while topics such as artificial intelligence or cybersecurity appear in some curricula (e.g., Greece, Italy, Lithuania), they are absent or less visible in others, which may limit responsiveness to emerging trends in digital education.

In sum, while all partner countries recognise the importance of combining technical and pedagogical training, the degree of integration, consistency, and curricular innovation varies widely. These differences highlight both opportunities for mutual learning and the need for adaptable frameworks like those envisioned in the *Digital First* project.

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3.2.5 Conclusion

The preliminary analysis of university programmes for future informatics teachers across *Digital First* partner countries reveals a landscape that is both rich in tradition and in urgent need of modernisation. Despite the growing relevance of informatics in today's digital society, university-level teacher education has not yet fully adapted to the field's dynamic and interdisciplinary nature. Variability between countries, and even within them, points to systemic inconsistencies that hinder efforts to develop a unified, future-oriented profile of the informatics teacher.

One of the key observations is the diversity of approaches to initial teacher education. While all partner countries combine disciplinary content and pedagogical preparation, the structure and emphasis of these components vary widely. In some cases, pedagogical elements are integrated into bachelor's programmes. In others, they are introduced later through master's degrees or additional certification. This diversity reflects national contexts and educational traditions but also raises concerns about the consistency and coherence of informatics teacher preparation across Europe.

The data further suggests that informatics is still often treated as a specialised or optional subject, rather than as a transversal, foundational competence essential for all students. As a result, many teacher training programmes maintain a structuralist approach that reinforces traditional disciplinary boundaries, rather than equipping future educators to foster digital fluency in everyday, meaningful ways.

The findings in this report underscore the relevance and timeliness of the *Digital First* project's objectives. They highlight a clear need for a new pedagogical approach that recognises informatics as a horizontal competence and views digital natives not as passive recipients of technology, but as active participants in its use and development. Realising this vision requires teacher education to embrace broader notions of digital citizenship, creativity, inclusivity, and problem-solving. It must also provide future teachers with access to research, collaborative networks, and cross-border professional learning opportunities.

Looking ahead, the presented insights support the development of a comprehensive catalogue of informatics teacher competences (Deliverables D4.2 and D4.3), as well as the design of future training and education programmes (Deliverables D4.4 and D4.5). In doing so, WP4 will contribute not only to the implementation of Digital First's goals but also to broader European efforts to strengthen the digital capacities of education systems in an inclusive and sustainable way.

3.3 Findings from the Teacher Interviews

This section presents the results of the interviews conducted with informatics teachers across ten partner countries (Bulgaria, Croatia, Cyprus, Finland, Greece, Italy, Lithuania, Portugal, Slovenia, and Spain) at all three ISCED levels (ISCED 1, ISCED 24, ISCED 34).

It highlights the educational backgrounds, teaching practices, integration of informatics into school curricula, and professional development opportunities of teachers working at the primary, lower secondary, and upper secondary levels. The focus of the analysis is to explore who teaches informatics at each educational level, how informatics is organised and delivered in different countries, which tools and resources are used, and what challenges and opportunities teachers identify in their work. The following sections summarise the main findings from the interviews, organised by educational level. Each ISCED level is analysed using the same structure, divided into four thematic subsections:

- **Teacher Profiles and Preparation** – describing who teaches informatics and how teachers are prepared for their role.
- **Integration and Teaching Practice** – describing how informatics is integrated into the curriculum and which topics are taught.
- **Tools and Resources** – summarising the tools, platforms, and resources used by teachers.

- **Challenges and Opportunities** – highlighting teachers' main challenges and opportunities for further development.
- **SWOT Analysis** – summarising the main strengths, weaknesses, opportunities, and threats identified for each ISCED level.

3.3.1 Findings for Primary level (ISCED 1)

Teacher Profiles and Preparation

In the analysed partner countries, various types of teachers are involved in teaching informatics at the ISCED 1 level, reflecting the diversity of national curricula and local practices.

In several countries (Bulgaria, Cyprus, Finland, Italy, and Spain), informatics is primarily integrated into other school subjects and taught by **primary teachers** with general education backgrounds. Some of these teachers have acquired additional knowledge in informatics or related areas through in-service training, but formal pre-service preparation for informatics is often limited. In Portugal, informatics content is also delivered by primary school teachers, who typically have general pedagogical qualifications. Some teachers have backgrounds in STEAM or engineering, while many acquire informatics competencies through professional development, self-learning, or collaboration with companies and EdTech providers.

In other countries, such as Croatia, Greece, Lithuania, and Slovenia, informatics at the ISCED 1 level is more often taught as a **separate subject**, delivered by teachers with a stronger **informatics or STEAM-related background**. These teachers typically hold degrees in informatics, computer science, mathematics, technology, or related STEAM disciplines, and are more systematically prepared to cover informatics content within the curriculum.

Across all countries, teachers emphasised the importance of **continuous professional development and self-directed learning** to maintain and expand their informatics teaching competencies. Participation in national conferences, professional networks, workshops, online courses, and international projects was frequently mentioned as essential. Many teachers collaborate with peers to exchange practical experiences and teaching materials. Despite these opportunities, several teachers indicated that **formal initial teacher education programmes often provide limited preparation for teaching informatics at the primary level**, especially where it is integrated across subjects, requiring teachers to build competences progressively during their teaching careers.

Integration and Teaching Practice

The integration of informatics into the ISCED 1 curriculum varies considerably across the partner countries, reflecting national policies and traditions regarding the role of informatics at the primary level.

In **Bulgaria, Cyprus, Finland, Italy, Portugal, and Spain**, informatics content is **mainly integrated into other subjects**, rather than being taught as a standalone subject. Teachers in these countries reported embedding informatics-related topics within **mathematics, science, language, or general STEAM** activities. The focus is often on basic digital skills, problem-solving, computational thinking, and introductory programming activities. In these contexts, the teaching of informatics often depends on the individual teacher's interest, available resources, and school-level decisions. For example, in Finland, some schools offer informatics topics as part of cross-curricular projects or optional modules, while in Cyprus, STEAM approaches play an important role in integrating informatics-related content into general lessons. Similarly, in Portugal, informatics topics are integrated into STEAM and project-based activities, focusing on problem-solving, creativity, and autonomy. Students engage in projects involving mechanics, circuits, robotics arms, pneumatics, and sometimes simplified AI demonstrations to explore real-world problems in an accessible way.

In contrast, in **Croatia, Greece, Lithuania, and Slovenia**, informatics is taught as a **separate subject** at the ISCED 1 level, following a defined curriculum. In these countries, students receive specific lessons dedicated to informatics topics, allowing for more systematic coverage of subject matter. The curricula typically include programming, computational thinking, algorithms, problem-solving, and robotics.

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The content taught across countries covers a range of topics that align with the I4All framework. **Programming and robotics** were frequently mentioned across all countries, often introduced through visual programming languages such as Scratch, ScratchJr, Blockly, and similar tools. **Algorithms and problem-solving** are commonly addressed through unplugged activities, puzzles, or introductory coding tasks. In some cases, topics such as **data, digital ethics, security, and artificial intelligence** are occasionally discussed in simplified, real-life contexts, but are generally not taught as technical subjects at this level.

Teachers reported using a variety of **pedagogical approaches**, often combining hands-on activities, play-based learning, project work, and scaffolding techniques to adapt content to the students' developmental level. Many teachers emphasised the importance of engaging students through **practical tasks, gamification, collaboration, and real-world problem-solving**. In several countries, **differentiation** is applied to address diverse student needs, allowing for more personalised learning trajectories within the class. Teachers also frequently use interdisciplinary connections to contextualise informatics topics within broader educational goals.

Overall, teaching practice in ISCED 1 reflects a wide range of approaches, shaped by national curriculum models, school organisation, teacher expertise, and access to resources. While some countries offer more structured and comprehensive informatics education from an early stage, others integrate informatics topics flexibly across subjects depending on school-level priorities and teacher capacities.

Tools and Resources

Teachers across partner countries reported using a broad range of tools and resources to support informatics teaching at the ISCED 1 level. The availability of resources often depends on national curriculum frameworks, school infrastructure, teacher initiative, and external partnerships.

Programming platforms are widely used to introduce basic coding concepts across almost all countries. Block-based visual programming environments such as **Scratch, ScratchJr, Blockly, and Code.org** are commonly mentioned in Bulgaria, Croatia, Cyprus, Finland, Greece, Italy, Lithuania, Slovenia, Spain, and Portugal. These tools allow young students to engage with programming concepts through intuitive and playful interfaces.

Robotics kits play an important role in several countries, supporting hands-on and engaging learning experiences. Teachers reported using a variety of robotics kits, including **Lego WeDo, Lego Mindstorms, Bee-Bot, Blue-Bot, and Micro:bit**. Robotics is especially prominent in Bulgaria, Croatia, Cyprus, Finland, Greece, Lithuania, Slovenia, Italy, Spain, and Portugal. In Portugal, teachers also described the use of more advanced equipment, such as robotics arms and pneumatic systems, often obtained through collaboration with external companies.

In addition to technology-based tools, teachers in countries such as Portugal, Cyprus, and Italy highlighted the use of **simple and recycled materials** (e.g. wood, paper, glue, colours) to complement robotics and support creative problem-solving projects.

Unplugged activities are widely used across all countries, including Bulgaria, Croatia, Cyprus, Finland, Greece, Italy, Lithuania, Slovenia, Spain, and Portugal. These activities introduce computational thinking, logic, and problem-solving without requiring digital devices, using games, puzzles, and physical movement.

Access to **digital devices** (computers, laptops, tablets) varied across schools and regions. While most schools in Croatia, Finland, Lithuania, Slovenia, and Spain report relatively good equipment, others in Bulgaria, Cyprus, Greece, Italy, and Portugal still face limitations in hardware availability and internet connectivity.

Teachers also utilise **online resources and platforms**, provided by ministries, professional associations, or private providers, to access teaching materials and exercises. In several countries, including Portugal, Croatia, and Slovenia, **partnerships with companies, municipalities, or external organisations** provide valuable additional resources, equipment, and training opportunities.

Despite the diversity of tools and resources used, teachers across countries emphasised the continuing need for **adequate, stable, and regularly updated equipment** to support high-quality informatics teaching at the ISCED 1 level.

Challenges and Opportunities

Teachers across partner countries identified a range of challenges and opportunities related to teaching informatics at the ISCED 1 level.

A common challenge reported in **Bulgaria, Cyprus, Finland, Greece, Italy, Portugal, and Spain** is the **lack of systematic preparation in informatics as part of initial teacher education**. Primary teachers in these countries often enter teaching without formal training in informatics and must acquire the necessary knowledge through self-learning or in-service training. In **Croatia, Lithuania, and Slovenia**, where specialised informatics teachers are involved, initial preparation is generally stronger but still evolving to meet new content demands.

Limited or outdated **equipment and infrastructure** were mentioned as a challenge in Bulgaria, Cyprus, Greece, Italy, Portugal, and Spain. While some schools in countries like Croatia, Finland, Lithuania, and Slovenia report better access to devices, many schools across the partnership still face variability depending on local resources and funding.

The availability of **continuous professional development (CPD)** opportunities specifically targeting informatics at the primary level remains a concern in many countries, including Bulgaria, Cyprus, Greece, Italy, Portugal, and Spain. Teachers in Croatia, Finland, Lithuania, and Slovenia reported more developed national or municipal CPD systems, but ongoing development is still needed to address emerging topics.

Despite these challenges, teachers across all partner countries demonstrated strong **personal motivation and commitment** to developing their informatics teaching competences. In Croatia, Finland, Lithuania, Portugal, Slovenia, and Spain, teachers **actively participate** in national and international projects, workshops, and communities of practice. Participation in programmes such as Erasmus+ (Croatia, Greece, Portugal), national competitions, and collaborations with external companies and EdTech providers (Croatia, Portugal, Slovenia) offers valuable opportunities to access resources, exchange practices, and strengthen teaching competences.

Overall, while challenges remain, teachers emphasised the importance of ongoing support, targeted professional learning, resource availability, and external partnerships to strengthen informatics teaching at the ISCED 1 level.

SWOT Analysis for ISCED 1

Table 4 Teacher interviews SWOT analysis for ISCED 1

Strengths	Weaknesses
• High teacher motivation and willingness to develop. • Use of engaging tools: block-based programming, robotics, unplugged activities. • Active teacher networks and peer support. • Participation in national, international and external partnership projects.	• Lack of systematic pre-service informatics preparation. • Unequal access to equipment and infrastructure. • Limited targeted CPD opportunities for the ISCED 1 level. • Lack of dedicated curriculum space for informatics in some countries.
Opportunities	**Threats**
• Expand CPD tailored for primary informatics teachers. • Strengthen initial teacher education with informatics content. • Foster partnerships with companies and external organisations. • Promote interdisciplinary integration of informatics topics.	• Growing gap between well-resourced and under-resourced schools. • Rapid technology changes outpace existing teacher training systems. • Lack of stable long-term policy or funding support. • Overreliance on individual teacher self-initiative.

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While primary-level informatics teaching is driven by highly motivated teachers and creative practices, the absence of systematic training and infrastructure highlights the urgent need for structured support and policy-level commitment.

3.3.2 Findings for Lower Secondary Level (ISCED 24)

Teacher Profiles and Preparation

Across the partner countries analysed, informatics at ISCED 24 level is primarily taught by **specialised informatics teachers**, especially in Croatia, Greece, Italy, Lithuania, Slovenia, and Spain. These teachers typically hold degrees in informatics, computer science, or closely related disciplines.

In Bulgaria, Cyprus, and Portugal, teacher profiles are more diverse, **combining informatics with STEAM, science, engineering, or even language** teaching backgrounds. In these cases, informatics is sometimes taught both as a separate subject and integrated into other disciplines, depending on school organisation and teacher expertise.

In Finland, teachers commonly hold qualifications in **mathematics, physics, or related STEAM fields**, with some having formal ICT or programming training either through teacher education or additional courses. Informatics teaching is often combined with other subjects, reflecting interdisciplinary profiles.

Teachers across countries often reported that while formal academic preparation provided the foundation, they have **continued to expand their informatics competences through professional development and self-learning**. Many participate in workshops, conferences, national training programmes, MOOCs, online networks, or collaborative projects to stay current with technological developments and to strengthen their teaching competences. For example, teachers from Cyprus, Lithuania, and Slovenia mentioned specific national and international training programmes, while teachers from Portugal described participation in collaborative projects, digital transition programmes, and Erasmus+ mobility.

Despite the generally high professional qualification of informatics teachers at ISCED 24, some teachers, particularly those coming from other disciplines, highlighted the need for **continuous training** to keep up with rapidly evolving topics such as artificial intelligence, cybersecurity, and new programming paradigms. This ongoing professional development is often driven by personal motivation and supported through peer collaboration and professional networks.

Integration and Teaching Practice

The organisation and integration of informatics teaching at ISCED 24 varies across partner countries, though in most cases informatics is taught as a **separate subject**, while interdisciplinary elements are sometimes included through collaborative projects or specific topics.

In **Croatia, Greece, Lithuania, and Slovenia**, informatics is **predominantly delivered as a separate subject**, following a national curriculum with clearly defined learning outcomes. In these countries, students typically attend dedicated informatics lessons where core areas such as programming, algorithms, data handling, computing systems, networks, privacy, and security are taught. In Croatia, for example, programming is gradually introduced through visual languages (e.g. Scratch) before progressing to text-based programming (e.g. Python). Similar scaffolding is reported in Greece, Lithuania, Slovenia, and Spain, where students build competences step-by-step, starting from basic logic structures and moving towards more advanced topics such as data structures, databases, object-oriented programming, and even elements of web development.

In **Bulgaria, Cyprus, Finland, Italy, Portugal, and Spain**, while informatics may also be taught as a standalone subject, it is often **integrated into** other disciplines, especially in **STEAM areas**. In these contexts, integration typically occurs within mathematics, physics, chemistry, engineering, or technology courses. Teachers embed informatics-related content into subject-specific lessons, where programming, simulations, data analysis, and modelling are applied to real-world problems. Informatics is also integrated into STEAM projects, combining it with physics, biology, chemistry, economics, environmental studies, mathematics, geography, and engineering, often using tools such as Micro:bit, simulations, or data modelling. Interdisciplinary activities also extend into non-STEAM contexts, including visual arts and social sciences.

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Across all countries, informatics teaching at ISCED 24 covers a wide range of **I4All framework topics**, including programming, algorithms, data and information, modelling and simulation, privacy and security, digital creativity, responsibility and empowerment, and design and development. Contemporary topics such as **artificial intelligence, robotics, ethics, cybersecurity, and digital citizenship** are increasingly introduced across countries, either as formal content or through exploratory activities, class discussions, and applied projects. In Croatia, Finland, Greece, Lithuania, Portugal, and Slovenia, for example, students may be engaged in AI-related discussions or use AI tools (such as generative AI applications, simple AI models, or AI for environmental data analysis) as part of their learning.

Pedagogically, teachers widely apply **project-based learning, collaborative learning, self-guided exploration, and differentiated instruction**. Activities often include practical problem-solving, real-world simulations, game-based tasks, group work, and progressive scaffolding from unplugged activities and block-based coding to text-based programming (such as Python, Arduino, or web development tools). Teachers adapt content and complexity to the students' levels, aiming to promote autonomy, creativity, and a deeper understanding of informatics concepts. In many countries, student-centred approaches are emphasised to foster motivation, critical thinking, and responsibility for learning.

Overall, while the structure of informatics teaching shows some national differences between more formally separated and more integrated models, teachers across partner countries demonstrate diverse and innovative approaches to prepare students for the challenges of informatics in a digital society.

Tools and Resources

Teachers across partner countries reported a wide variety of tools and resources used to support informatics teaching at the ISCED 24 level, reflecting national curricula, available infrastructure, teacher preferences, and external partnerships.

Programming platforms play a central role in teaching. In all countries, teachers widely use visual block-based programming tools such as **Scratch** and **Blockly** in earlier stages, gradually progressing toward text-based programming languages, especially **Python**, and in some cases **JavaScript, PHP, or C++**. AppInventor is mentioned in several countries as a platform for mobile app development, and some teachers also use tools like **Minecraft Education**, **Arduino**, and **Micro:bit** for physical computing and interactive projects. Additional platforms such as GeoGebra, ViLLE, and Code.org are commonly used to support programming, data analysis, and modelling across countries.

Robotics tools are also widely used. Teachers report frequent use of kits such as **Lego Mindstorms, KUBO, Bee-Bot**, and programmable robotics arms. In Croatia, Finland, Portugal, and Slovenia, teachers particularly emphasized the use of robotics arms, microcontrollers, and 3D printing equipment in multidisciplinary projects, sometimes in collaboration with companies or universities.

In several countries, including Cyprus, Italy, and Portugal, teachers mentioned the creative use of **simple or recycled materials** (e.g. paper, wood, glue, and small electronics) to complement robotics and stimulate problem-solving activities, especially when funding or equipment is limited.

Online learning platforms and tools are extensively used. Teachers across countries mentioned platforms such as **Moodle, Google Classroom, Microsoft Teams, SharePoint, Code.org, Tinkercad, Canva, Inkscape, WordPress, and cloud-based tools** to support programming, simulation, design, video editing, and data analysis. In some countries, national or regional platforms play an important role in providing access to training materials and digital content.

Professional development resources include MOOCs, Code Week activities, teacher networks, regional conferences, training centres, and Erasmus+ projects. Teachers from Cyprus, Finland, Lithuania, Portugal, and Slovenia reported frequent participation in national or international workshops that allow them to update their skills and introduce new tools into teaching practice.

Access to digital devices (computers, laptops, tablets, interactive boards) still varies. While many schools are reasonably well equipped, some teachers, particularly in Bulgaria, Cyprus, and Portugal, reported occasional infrastructure limitations, especially when larger groups need access to devices or when specific equipment (e.g. advanced robotics kits) is lacking.

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Overall, teachers across partner countries demonstrate great flexibility and creativity in using a broad spectrum of resources to engage students and address diverse informatics topics at the ISCED 24 level.

Challenges and Opportunities

Teachers across partner countries identified several recurring challenges and opportunities that influence the implementation of informatics teaching at ISCED 24.

One of the most frequently mentioned challenges is the **continuous need for professional development** to keep up with fast-evolving informatics content. Teachers from countries such as Bulgaria, Cyprus, Finland, Lithuania, Portugal, Slovenia, and Spain report that while various training opportunities exist (e.g., MOOCs, workshops, CFR programmes, national conferences), many still need to invest significant personal time and effort to stay updated with emerging topics like AI, cybersecurity, robotics, and advanced programming frameworks. In some cases, especially for more advanced teachers, the available professional development is sometimes perceived as too basic, leaving gaps for advanced-level training. In some countries, insufficient financial support limits teachers' access to high-quality paid training and conferences.

A second major challenge is **infrastructure limitations**, with teachers from Bulgaria, Cyprus, and Portugal highlighting occasional shortages in devices, robotics equipment, and access to advanced tools, particularly in schools with limited budgets. In Finland, while infrastructure in most schools is generally strong, some teachers expressed concerns about the long-term availability and maintenance of certain digital learning platforms, which may affect continuity of teaching resources over time. In some countries, technical support is lacking, leaving teachers responsible for managing and maintaining school equipment. This contributes to uneven learning opportunities and sometimes restricts the depth of practical informatics experiences offered to students.

Several teachers across countries, including Portugal, Cyprus, and Italy, also noted that **curricular time constraints** can limit the amount of time available for deeper engagement with advanced programming, project work, or emerging topics despite student interest and available resources. Similarly, in Finland, both teachers and students face time pressures, balancing digital learning with other teaching duties or extracurricular activities.

At the same time, teachers across all countries emphasised **strong personal motivation and intrinsic interest** in developing their teaching competences. Many are actively involved in national or European projects, professional networks, teacher communities, and Erasmus+ mobility projects, as mentioned in Croatia, Finland, Greece, Lithuania, Portugal, Slovenia, and Spain. **Collaboration with external companies** and EdTech providers in countries such as Portugal, Croatia, and Slovenia additionally creates valuable opportunities to access equipment, real-world projects, and expertise that enrich student learning.

Teachers also identified increasing opportunities to integrate **new technologies such as artificial intelligence, robotics, virtual reality, and 3D printing** into their practice, as mentioned in Finland, Greece, Lithuania, Portugal, and Slovenia. However, the rapid evolution of these tools also raises concerns about keeping up with new demands and ensuring consistent quality of implementation.

Finally, across multiple countries, teachers pointed to **growing interest and student engagement** in informatics, supported by extracurricular activities such as coding competitions, robotics challenges, and interdisciplinary STEAM projects. Nevertheless, some teachers noted that the need for ongoing guidance in topics such as **digital citizenship, online safety, copyright, and responsible AI use** is growing, especially as students encounter increasingly complex digital environments.

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SWOT Analysis for ISCED 24

Table 5 Teacher interviews SWOT analysis for ISCED 24

Strengths	Weaknesses
• High teacher motivation and strong engagement in professional growth. • Broad coverage of I4All topics, including advanced topics like AI, robotics, data science, and cybersecurity. • Use of diverse tools: programming platforms, robotics kits, physical computing, and interdisciplinary projects. • Active participation in national and international projects, teacher networks, and Erasmus+ programmes.	• Ongoing need for continuous professional development to keep pace with evolving technologies. • Infrastructure limitations in some countries (lack of advanced robotics, insufficient devices). • Limited financial support for training and advanced equipment in some schools. • Time constraints within curricula limiting deeper exploration of advanced topics.
Opportunities	**Threats**
• Further development of CPD programmes targeting emerging informatics topics. • Strengthening partnerships with companies, universities, and external organisations. • Expansion of interdisciplinary and project-based learning across STEAM subjects. • Integration of cutting-edge technologies (AI, VR, 3D printing, big data) into teaching practice.	• Rapid technological changes are challenging teachers' ability to stay fully up to date. • Growing inequality between well-resourced and under-resourced schools. • Insufficient long-term funding stability for equipment and professional development. • Risk of over-reliance on individual teacher initiative without systemic support structures.

Informatics teaching at the lower secondary level is marked by motivated teachers and rich curricular content. However, systemic challenges such as uneven infrastructure, limited funding, and the fast pace of technological change highlight the need for sustained investment and structured professional development.

3.3.3 Findings for Upper Secondary Level (ISCED 34)

Teacher Profiles and Preparation

At the ISCED 34 level, the profiles of informatics teachers across partner countries display a combination of **specialised informatics qualifications** and **interdisciplinary backgrounds**, depending on national education systems and school types.

In many countries, including Croatia, Finland, Greece, Italy, Lithuania, Slovenia, Spain, and Portugal, informatics is predominantly taught by teachers who hold formal degrees in **informatics, computer science** or related **STEAM disciplines** such as engineering, mathematics or polytechnic studies. These teachers often graduated from technical faculties or completed dedicated **teacher education programmes** in informatics and mathematics, sometimes supplemented with additional pedagogical training.

In Bulgaria, Cyprus Finland, and Italy, teachers may also **combine informatics with physics, technology, or other STEAM and vocational disciplines**. In these cases, informatics content is often integrated into elective courses, interdisciplinary projects or vocational programmes, where teachers apply informatics concepts alongside their other subject areas.

Across all countries, teachers highlighted the importance of **continuous professional development** to maintain and expand their expertise, particularly in response to rapid technological changes. Many teachers actively engage in

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workshops, online courses, national training programmes and conferences to stay current with new technologies and pedagogical approaches.

In addition to formal education and in-service training, several teachers emphasised the role of **self-directed learning, peer collaboration** and **project-based development** in acquiring knowledge related to contemporary informatics topics such as **artificial intelligence, cybersecurity, robotics, and advanced programming concepts**.

While most teachers at ISCED 34 have strong subject-specific knowledge, some challenges remain, particularly for those who initially specialised in other disciplines and are now expanding their expertise in informatics through ongoing professional learning.

Integration and Teaching Practice

In most partner countries, informatics at ISCED 34 level is taught as a **separate subject**, though integration into other disciplines occurs in some contexts, particularly in vocational or interdisciplinary programmes.

In Croatia, Greece, Lithuania, Slovenia, Spain, and Portugal, informatics is generally delivered as a **separate subject** with well-defined curricula. Students engage with advanced topics such as **algorithms, programming, data modelling, cybersecurity, databases, and computer networks**. Programming is often introduced progressively, beginning with basic logic and algorithms, and developing into text-based languages such as **Python, JavaScript, C++** or database languages such as **SQL**.

In Bulgaria, Cyprus, Finland, and Italy, informatics may also be **integrated into other subjects** or vocational programmes, combining it with **technology, engineering, science** or applied fields. Teachers in these countries report using informatics knowledge in cross-curricular projects that combine multiple domains. For example, in Bulgaria and Cyprus, informatics is combined with **technology and engineering topics** such as fluid mechanics, pneumatic simulations, and 3D design. In Italy and Finland, vocational and interdisciplinary education includes informatics content combined with applied engineering, mathematics, physics, STEAM courses. Additionally, students in these countries work on research projects, numerical simulations, visual arts, and cross-curricular problem-solving.

Teachers across countries reported that **interdisciplinary projects** allow students to apply informatics skills in real-world contexts. Students work on projects related to biology, physics, mathematics, business applications, economics, entrepreneurship, decision modelling, environmental studies, and management. In Spain, for instance, teachers connect informatics with information literacy, citation tools, and digital project development. In Portugal, integration into economics, finance and management is reported in some vocational contexts. In Finland, research projects include work on neural networks, fractal modelling, and social science simulations.

The content taught widely follows the **I4All framework**, covering areas such as **algorithms, programming, digital creativity, databases, privacy, security, modelling, and contemporary informatics topics**. Teachers in several countries, such as Finland, Greece, Lithuania, Portugal, Slovenia, Croatia, and Spain, reported introducing **artificial intelligence, robotics, virtual reality, and generative AI** (e.g. ChatGPT, Gemini) through discussions, exploratory projects or elective courses.

In terms of **pedagogical approaches**, project-based learning is widely used across all partner countries. Teachers apply hands-on tasks, collaborative learning, simulation exercises, design-based learning, scaffolding from unplugged activities to advanced coding, and individualised learning paths. Some teachers organise interdisciplinary projects in cooperation with colleagues from other departments such as mathematics, physics or economics. Teachers emphasise practical, real-life problem-solving, and design tasks to motivate students and foster deeper understanding.

Tools and Resources

Teachers across partner countries reported a wide range of **tools and resources** used to support informatics teaching at ISCED 34 level. The selection of tools reflects national curricula, teacher preferences, school infrastructure, and opportunities for project-based learning.

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Programming platforms and coding tools are used extensively in all countries. Teachers work with both block-based and text-based programming languages, progressing from visual tools such as Scratch and App Inventor and web technologies like HTML, CSS and JavaScript, to more advanced languages such as Python, C++ and SQL. In some countries, additional tools such as Anaconda, Spyder, Unity for game development and online programming courses with integrated code testing platforms (e.g. TestMyCode plugin) are also used to support advanced programming education. Several teachers reported using integrated development environments and coding platforms such as Visual Studio Code, Moodle, and Jupyter.

Simulation software is applied in various interdisciplinary and vocational contexts. Teachers in Bulgaria, Cyprus, and Italy reported using simulators for electrical circuits, pneumatics, fluid dynamics, mathematical modelling, and 3D design, often as part of engineering, technology, and applied informatics courses. Examples of tools include Algodoo, FluidSim, Tinkercad, GeoGebra, TI-Nspire, Octave, and other advanced computational platforms.

Digital creativity and multimedia tools are also part of teaching practice. Teachers reported using tools such as GIMP, Canva, Audacity, and video editing software for developing multimedia projects, presentations, and digital portfolios. These tools allow students to combine programming, design, and creativity in project-based assignments.

Robotics and physical computing are integrated into the curriculum in several countries. Teachers reported using robotics platforms and physical computing kits such as Arduino, Raspberry Pi, Lego Mindstorms, Lego Spike, Micro:bit, and 3D printing technologies. In several countries, additional equipment such as laser cutters, vinyl cutters, and drawing tablets is also available for creative STEAM-based projects.

Professional development resources include participation in national training centres, online courses, peer learning, industry-based workshops, and Erasmus+ mobility projects. Teachers also participate in school-based AI trainings, professional networks, national conferences, and international events, depending on country-specific opportunities.

Extracurricular activities and external collaborations are widely used to complement formal learning. Teachers support student participation in competitions, coding challenges, robotics leagues, science fairs, and external STEAM projects. Partnerships with universities, companies, foundations, and external STEAM organisations are also established in several countries to enrich teaching and provide access to advanced technologies.

While many schools are well-equipped, some countries, such as Bulgaria and Cyprus, reported that certain schools still face infrastructure limitations, particularly regarding high-end equipment such as robotics, advanced hardware or physical computing devices.

Challenges and Opportunities

Teachers across partner countries identified several key challenges and opportunities that shape the teaching of informatics at the ISCED 34 level.

A frequently mentioned challenge concerns the **complexity of advanced informatics concepts** such as algorithms, AI, cybersecurity, networks, and programming. Teachers in countries such as Croatia, Cyprus, Finland, Greece, Portugal, and Spain reported that these topics require structured scaffolding and significant hands-on practice to ensure student comprehension. The limited time available within the curriculum often restricts in-depth exploration of advanced content and complex projects.

Several countries, including Bulgaria, Cyprus, Finland, Italy, Lithuania, and Portugal, also reported that **infrastructure differences between schools** create unequal access to robotics equipment, high-end hardware, or advanced simulation tools. In some schools, the availability of physical computing platforms such as robotics arms, advanced microcontrollers or 3D printers remains limited.

Teachers in countries like Cyprus, Finland, Lithuania, Portugal, and Spain highlighted growing concerns related to **students' misuse of AI tools** for superficial answers or copy-paste solutions, undermining deeper learning processes. Teachers also raised issues related to **student online behaviour, digital citizenship, cybersecurity, data protection, and responsible AI use**, which increasingly demand pedagogical attention.

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Another challenge reported across several countries is **the lack of formal systemic professional development structures** for advanced informatics teaching. While many teachers actively pursue training through self-learning, peer networks, MOOCs, national programmes (such as CFR in Portugal, IP 5.0 in Lithuania or ARNES in Slovenia), some teachers still expressed a need for more practical, hands-on workshops and stronger institutional support to address emerging technologies.

At the same time, teachers across all countries demonstrate **strong intrinsic motivation** to improve their knowledge and teaching practice. Many actively participate in professional communities, peer mentoring, Erasmus+ mobility, international collaborations, and STEAM outreach activities. Teachers across countries, including Croatia, Finland, Lithuania, Slovenia, Portugal, and Spain, reported high levels of engagement in national and international competitions, coding challenges, robotics leagues, and interdisciplinary projects.

The increasing availability of **new technologies such as artificial intelligence, robotics, virtual reality, 3D printing, Internet of Things, and cybersecurity** was identified as an important opportunity for enriching teaching practice, particularly for project-based learning. Teachers in Finland, Greece, Lithuania, Portugal, and Slovenia noted that these technologies are already being introduced in informatics teaching or pilot programmes.

Finally, teachers in several countries recognised opportunities for **closer collaboration with external partners**, including universities, companies, creative hubs, and industry, which help schools to access equipment, up-to-date knowledge, and real-world applications.

SWOT Analysis for ISCED 34

Table 6 Teacher interviews SWOT analysis for ISCED 34

Strengths	**Weaknesses**
• High teacher motivation and engagement in professional development. • Broad coverage of advanced informatics topics, including AI, cybersecurity, robotics, and data science. • Diverse use of programming languages, simulation software, robotics, and physical computing. • Active participation in national and international projects, Erasmus+, and professional networks.	• Limited time in curricula to explore advanced topics in greater depth. • Infrastructure inequalities between schools (advanced robotics, simulation tools, high-end equipment). • Lack of formalised systemic professional development structures for emerging informatics topics. • Growing challenges in addressing responsible technology use, AI misuse, and digital citizenship.
Opportunities	**Threats**
• Further development of CPD programmes for advanced informatics topics. • Integration of AI, robotics, VR, 3D printing, IoT, and cybersecurity into project-based learning. • Strengthening collaborations with universities, companies, and industry partners. • Development of interdisciplinary projects connecting informatics with applied STEAM and vocational fields.	• Rapid technological change creating continuous pressure to update teaching competences. • Widening gap between well-resourced and under-resourced schools. • Lack of stable long-term funding for infrastructure and advanced equipment. • Increasing risk of student over-reliance on AI tools undermining deeper learning processes.

At the upper secondary level, informatics teachers demonstrate strong expertise and professional engagement, supported by advanced content and tools. Nevertheless, limited curriculum time, unequal access to infrastructure, and

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the fast pace of technological change point to the need for systemic support and sustainable investment in high-level informatics education.

3.3.4 Cross-Level Summary and Reflections

This subsection synthesises key insights from the interviews across primary, lower secondary, and upper secondary levels. It highlights common trends, differences, and reflections that emerge from teachers' experiences in delivering informatics education across the educational continuum.

The analysis of informatics teaching **across ISCED levels 1, 24, and 34** highlights both clear progression patterns and significant national differences in how informatics is approached, organised, and delivered across educational stages in partner countries. While informatics topics are present at all levels, the nature of teaching shifts considerably depending on student age, curriculum structures, and teacher profiles.

At the **ISCED 1** level, informatics content is **typically integrated** into broader subjects such as mathematics, science, or STEAM activities. Informatics at this stage is often introduced through basic digital skills, problem-solving, computational thinking, and creative projects, frequently relying on **unplugged activities**, block-based programming, and early robotics tools. Informatics is rarely taught as a standalone subject at this level, and teachers usually hold general education qualifications, often acquiring informatics knowledge through in-service training, professional development, or self-directed learning.

At the **ISCED 24** level, informatics teaching becomes more structured, though considerable diversity remains between countries. In some systems, informatics is taught as a **separate subject** with a defined national curriculum, covering programming, algorithms, data management, cybersecurity, and modelling. In others, **integration into STEAM** and interdisciplinary projects remains prominent, combining informatics with mathematics, physics, engineering, and creative disciplines. Teachers at this level generally hold subject-specific qualifications in informatics, STEAM, or related fields, though many still emphasise the need for continuous professional development to stay abreast of rapidly evolving content and technologies.

At the **ISCED 34** level, informatics teaching reaches its most advanced form, with in-depth coverage of specialised areas such as object-oriented programming, databases, artificial intelligence, data science, networks, cybersecurity, and software engineering. Informatics is **generally taught as a standalone subject by specialised teachers** with formal qualifications in informatics or computer science. However, interdisciplinary integration is also present, especially in vocational or applied programmes where informatics knowledge is combined with engineering, science, economics, or social sciences. Advanced tools, simulations, robotics platforms, and emerging technologies such as generative AI, VR, and 3D printing are increasingly incorporated at this level.

Across all levels, common strengths emerge in the form of highly **motivated teachers**, strong participation in national and international professional networks, and creative use of diverse teaching tools and pedagogies. Teachers actively engage students through **project-based learning, real-world problem-solving, and interdisciplinary approaches** adapted to different age groups and curriculum frameworks.

At the same time, common challenges persist across levels and countries. Teachers face **continuous pressure to update their knowledge** in light of fast technological developments, while financial constraints, unequal access to equipment, and limited curriculum time often restrict the depth and consistency of informatics teaching. The reliance on teachers' initiative remains significant, particularly where systemic support structures are not yet fully developed.

Overall, the cross-level analysis underscores both the impressive efforts of teachers and systems in advancing informatics education, as well as the need for ongoing investment in curriculum development, infrastructure, professional development, and policy support to ensure consistent and high-quality informatics teaching across all educational stages.

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3.4 Key Insights on Teacher Education and Training

The analysis across ten partner countries reveals several recurring themes and structural differences in how informatics teachers are educated and supported across Europe. These key findings offer a comparative perspective on the current state of teacher preparation for informatics.

- **Diverse qualification pathways:** At the primary level, informatics is often taught by generalist teachers with limited formal preparation. In contrast, secondary levels typically rely on specialist teachers, but the structure of their qualifications varies significantly, including differences in degree types, ECTS allocations for informatics and pedagogy, and requirements for teaching practice.
- **Imbalance between technical and pedagogical preparation:** Some countries integrate pedagogical training within informatics programmes, while others treat it as an add-on or rely on post-degree certifications. This imbalance often leaves teachers well-versed in content but underprepared for classroom realities.
- **Fragmented professional development systems:** While in-service training is available in all countries, the extent to which it is mandatory, relevant, and tied to career progression differs widely. In many cases, teachers must rely on personal initiative or informal networks to access meaningful learning opportunities.
- **Lack of standardisation across levels and countries:** The data confirm that there is no common European standard for informatics teacher education. National systems remain highly varied in terms of policy, institutional responsibility, and the perceived role of informatics in general education.

These insights highlight the need for greater coherence between subject knowledge, didactics, and classroom practice, as well as more inclusive access to high-quality teacher education and training.

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4 The State of Informatics Teacher Education and Training in the EU

This chapter builds on the contextual and comparative insights from **Deliverable D2.2**, which explored how informatics is positioned in national curricula and initial teacher preparation across Europe. Formal education pathways for informatics teachers are shaped by national contexts, institutional frameworks, and varying perceptions of informatics as a school subject. Informed by those findings, WP4 conducted its own in-depth research to examine the realities of **informatics teacher education and training** in the ten partner countries. Using questionnaires, university programme data, and teacher interviews, this chapter presents a synthesis of the evidence gathered to describe the **diverse and evolving** landscape of teacher preparation across ISCED levels.

4.1 Teacher Education in the EU

The findings presented in this section reflect how formal **informatics teacher education** is currently organised across the primary, lower secondary, and upper secondary levels, highlighting both national specificities and shared structural patterns. Each level reveals distinct approaches to qualification pathways, subject-specific preparation, and pedagogical emphasis.

At the **primary level** (ISCED 1), informatics is often **integrated into broader curricular domains** rather than offered as a distinct subject. As a result, **generalist teachers** are commonly responsible for introducing basic digital competence, with formal education rarely including dedicated informatics components. While some countries, like Slovenia and Bulgaria, offer specialised qualifications for teaching informatics even at this level, many others rely on generalist teacher training programmes with minimal or no coursework in informatics. The university programme data show a general lack of consistency in the amount of subject-specific and pedagogical preparation in informatics at this level, and the interviews confirm that many primary school teachers feel underprepared to teach even basic digital literacy.

At the **lower secondary level** (ISCED 24), there is greater alignment across countries in recognising informatics as a specialised subject. Most participating countries require teachers at this level to hold a **bachelor's degree or equivalent in informatics, computer science, or a related technical field**. However, the routes to achieving pedagogical qualifications differ significantly. In some cases, such as Croatia and Lithuania, pedagogical training is obtained through additional certification or one-year postgraduate programmes. In others, such as Portugal and Finland, pedagogical elements are fully integrated into two-stage or unified teacher education programmes. The university programmes reviewed show a broad range of informatics topics covered, from programming and data structures to AI and cybersecurity, but often lack harmonisation in the inclusion of didactics and teaching practice. The interviews further reveal that while many ISCED 24 teachers are confident in their technical knowledge, they often feel the need for stronger preparation in pedagogy and classroom management.

In **upper secondary education** (ISCED 34), **specialist teachers with advanced qualifications**, typically at the master's level, are the norm. These teachers usually hold degrees in informatics or closely related disciplines and have completed formal pedagogical education. The university programme data indicate that most countries offer robust subject-specific training, though the level and structure vary. Pedagogical content ranges from embedded modules to entirely separate certification programmes. Interestingly, despite higher levels of formal education, teachers interviewed at this level still voiced concerns about the disconnect between academic training and classroom realities – particularly regarding the adaptation of complex informatics concepts to age-appropriate pedagogy and the lack of alignment with students' existing digital fluency.

Across all levels, **the balance between informatics content and pedagogy** in teacher education varies considerably. While some countries have begun integrating didactics of informatics into their programmes (e.g., Slovenia, Greece), others still treat pedagogy as an add-on to technical training. The extent of practical teaching experience (a critical component of effective teacher education) also differs, ranging from fewer than 100 hours in some countries to over 300 hours in others. Interviewed teachers frequently mentioned that their teaching practicums were too short or insufficiently focused on informatics.

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This **discrepancy between technical preparation and pedagogical depth** is one of the most recurrent themes across the data sources. In several countries, the emphasis on subject-specific informatics knowledge comes at the expense of didactic training and classroom practice. Conversely, in systems where pedagogical content is strong, technical components are often limited or outdated. The findings suggest that achieving an effective integration of these two dimensions remains a critical challenge in the design of initial teacher education programmes.

A key insight from all three data sources is **the lack of a standardised or unified European model for informatics teacher education**. National approaches differ in degree structure (e.g., bachelor's vs. master's entry), in the sequencing of pedagogical training, and the perceived role of informatics in general education. Moreover, informatics is still often treated as a niche or optional subject, rather than a transversal competency essential for full participation in digital society. As such, teacher education programmes frequently reflect this marginal status, lacking coherent pathways or sufficient content to prepare educators for the subject's growing complexity and relevance.

In summary, formal teacher education for informatics in the EU is marked by **fragmentation and inconsistency**. While there are promising practices, particularly in countries that integrate subject-specific and pedagogical training, the overall picture highlights the need for clearer standards, greater coherence, and stronger alignment between technical and educational preparation. These findings underline **the importance of developing a shared competence framework** and informing future policy through the work of the Digital First project.

4.2 Teacher Training in the EU

Informatics teacher training across the participating countries shows a **wide range of structures**, priorities, and levels of institutional support. While all partners recognise the **importance of continuous professional development**, the systems for organising and delivering in-service training are often decentralised, inconsistent, or reliant on individual initiative. This chapter presents a synthesis of findings from the questionnaires, university programme reviews (especially where continuing education components exist), and teacher interviews, highlighting current practices in in-service teacher training and identifying common strengths and gaps.

Most countries offer some form of **in-service training** for informatics teachers, though the nature of this training varies significantly. **Ministries of education or national agencies** play a central role in coordinating and funding professional development in countries such as Bulgaria, Croatia, Cyprus, Greece, Portugal, Slovenia, and Italy. In these systems, training may be mandatory, linked to certification or career progression, or provided through structured national catalogues. In contrast, countries like Finland and Spain rely more heavily on decentralized mechanisms such as **universities, municipal authorities, or online platforms** to offer training based on local or individual needs. In-service training often focuses on curriculum updates, emerging technologies, digital tools, and pedagogical strategies for teaching informatics.

Online learning has become an increasingly important element of teacher training. Across all partner countries, online platforms, webinars, and informal digital communities provide additional avenues for teacher development. Many teachers reported participating in online groups, including social media forums and specialised communities for informatics educators. These communities offer flexible and responsive professional support, often filling the gaps left by formal training systems.

The **frequency and structure of in-service training differ significantly**. In some countries, participation in professional development is **mandatory** and linked to certification renewal or career progression. For instance, Italy, Lithuania, and Portugal have formal requirements for training hours, while Cyprus and Greece also tie participation to professional advancement, particularly for promotions. In Bulgaria, some training is mandatory, especially when related to career development, whereas other opportunities remain voluntary. On the other hand, Croatia, Finland, Slovenia, and Spain primarily offer **voluntary** training, with participation driven by personal motivation, local arrangements, or school-level encouragement. In Slovenia, while training is not compulsory, teachers receive promotion points for participation, and in Spain, courses are highly recommended to maintain up-to-date competencies, even if not formally required.

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The differences in how CPD is structured and required across countries are summarised in the table below, offering a clearer comparison of national approaches to ongoing teacher development.

Table 7 Overview of CPD Requirements for Informatics Teachers Across Countries

Country	CPD Requirement Type	Mandatory/Voluntary	Linked to Promotion/Certification
Bulgaria	National programmes, university and international training opportunities	Mixed: some courses mandatory, others voluntary	Yes – mandatory courses tied to certification and career progression
Croatia	Ministry-led programmes (e.g., e-Škole), AZOO seminars, CARNet online courses	Voluntary (except in special cases like curriculum reform)	No – generally not linked to formal certification or promotion
Cyprus	Courses offered by the Pedagogical Institute, Ministry of Education, and private initiatives	Mandatory for the Ministry courses	Yes (Ministry courses count towards evaluation and career progression)
Finland	Occasional courses available; participation depends on availability and local arrangements	Voluntary	No
Greece	Ministry and Institute of Educational Policy led courses on ICT, robotics, and digital tools	Voluntary (mandatory for some advancement roles)	Yes, required for administrative promotions
Italy	National and school-based CPD system; courses offered annually, including informatics topics	Mandatory (especially for new teachers); choice among available options	Yes, particularly for induction and career progression
Lithuania	Teachers choose among 4 in-service programmes (6–40 hours)	Mandatory 5 days per year	Not explicitly linked
Portugal	Offered by ANPRI (focused on emerging technologies) and CFAEs (aligned with teacher needs and national priorities)	Mandatory: 50 hours every 4 years (25 in informatics)	Yes, required for career progression
Slovenia	Training offered through Ministry-approved programmes (KATIS) and national seminars ("Študijska srečanja")	Voluntary	Yes, participation earns points and counts toward promotion
Spain	Training offered via online platforms (e.g., Platega) and regional centres (e.g., CFRs) on new technologies and pedagogy	Voluntary, but highly recommended	No

This comparison underscores the uneven landscape of professional development for informatics teachers across Europe and highlights the need for stronger systemic frameworks that ensure equal access and pedagogical relevance.

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Training content tends to focus on specific **technical topics**, such as programming languages, robotics, cybersecurity, and AI. However, several teachers noted that insufficient **attention is given to pedagogy and didactics** within these courses. This lack of focus on didactics and classroom application is particularly concerning, given the fast pace of technological change and the evolving needs of students. Teachers in several countries expressed a desire for training that not only updates their technical knowledge but also helps them translate that knowledge into effective, **age-appropriate lessons**.

Support for **newly qualified teachers** also varies. While some systems offer **structured mentoring** or induction programmes, others leave early-career teachers to navigate their professional development **independently**. This gap was especially visible in the interviews, where early-career informatics teachers reported feeling isolated, particularly when they were the only informatics teacher in their school.

Another recurring theme was the importance of **networking**. Teachers repeatedly highlighted the value of connecting with peers, **sharing lesson materials**, **discussing challenges**, and learning from others' experiences. In some countries, such as Slovenia and Greece, professional associations and teacher networks facilitate these connections. Elsewhere, teachers rely on more informal mechanisms to stay engaged and up to date.

Despite the range of available training opportunities, several systemic challenges remain. In many cases, training is not specifically designed for informatics teachers but is instead generic or aimed at broader groups of educators. As a result, the unique **pedagogical and technical needs** of informatics teachers are not always addressed. Furthermore, access to high-quality training can be uneven, with rural or smaller schools often having fewer resources or opportunities for their staff.

In summary, while **teacher training in informatics is available** in all partner countries, its structure, accessibility, and **relevance vary significantly**. Teachers are often proactive in seeking out training, especially through online and peer-based platforms, but systemic support remains uneven. To ensure quality and consistency, there is a need for targeted, pedagogically sound training programmes that reflect both the technological and educational dimensions of informatics. Strengthening national frameworks and supporting cross-border professional learning can help address current gaps and support the development of a confident and well-equipped teaching workforce across Europe.

5 Conclusion

This deliverable has provided a **comprehensive overview** of the current state of informatics teacher education and training across ten European partner countries. By combining insights from **national questionnaires, representative university programmes, and interviews with teachers** working at ISCED levels 1, 24, and 34, the report provides a multi-layered understanding of how teachers are prepared to meet the demands of modern informatics education.

One of the most striking findings is **the diversity of pathways** into the profession. While some countries offer **structured and integrated programmes** that combine strong subject-specific knowledge with pedagogical preparation, others rely on fragmented or retraining-based approaches. This results in significant variability in how well-prepared teachers feel when entering the classroom, particularly in terms of **adapting informatics content to age-appropriate**, engaging instruction.

The report also shows that informatics continues to occupy a **somewhat marginal position** in many national education systems, especially at the **primary level**. Where it is present, it is often integrated into broader subjects or taught by generalist teachers with little formal preparation in informatics. Even at the secondary levels, where specialist teachers are more common, gaps remain in the coherence and alignment of their training, especially between disciplinary and pedagogical components.

Professional development emerges as an essential but **unevenly supported** element of informatics teaching. While many countries offer in-service training, the availability, accessibility, and relevance of these programmes vary. Teachers frequently rely on **informal networks, online communities, and personal initiative** to stay up to date, especially in rapidly evolving areas like artificial intelligence, digital ethics, and educational technologies. There is a clear demand for more targeted, practical, and pedagogically oriented training opportunities that reflect the realities of classroom practice.

Together, these findings highlight the importance of WP4 within the Digital First project. They confirm that **developing a shared competencies map**, along with forward-looking education and training models, is not only timely but **necessary**. Such models must support both **content mastery and pedagogical innovation**, aligning with the project's vision of a functional, inclusive, and future-proof approach to teaching informatics.

Looking ahead, the insights presented in this deliverable lay the groundwork for the next steps in WP4. They will directly inform the development of Deliverables D4.2 and D4.3 (competency maps), and subsequently, D4.4 and D4.5 (teacher training programmes). Most importantly, they reaffirm the need to **place teachers at the centre** of digital transformation – not just as transmitters of knowledge, but as **empowered guides** who can help learners navigate, shape, and contribute to the digital world.

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6 References

Digital First Consortium. (2024). *D2.2 Transnational research report: What and how we teach/learn in informatics and how happy we are with the results*. https://digitalfirstnetwork.eu/deliverables/

Digital First Consortium. (2024). *D2.3. Recommendations for the future of informatics (best practices and areas for improvement)* [internal report].

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7 Annexes

7.1 Annex 1 – Questionnaire for project partners

Current state of teacher education

Formal Informatics Teacher Education

1. Describe your most typical model for informatics teachers teaching in ISCED 1: …
   a. What is informatics teacher required qualification?
   b. How many ECTS are intended for informatics courses?
   c. How many ECTS are intended for didactic courses?
   d. How many hours of classroom practice must they complete?

2. Describe your most typical model for informatics teachers teaching in ISCED 24: …
   a. What is informatics teacher required qualification?
   b. How many ECTS are intended for informatics courses?
   c. How many ECTS are intended for didactic courses?
   d. How many hours of classroom practice must they complete?

3. Describe your most typical model for informatics teachers teaching in ISCED 34: …
   a. What is informatics teacher required qualification?
   b. How many ECTS are intended for informatics courses?
   c. How many ECTS are intended for didactic courses?
   d. How many hours of classroom practice must they complete?

Support Organizations

4. Are there organizations that provide in-service informatics teacher education, development and training? If yes, please provide the URLs of these organizations.
5. Are there online communities and forums for computer science/informatics teachers? If yes, please describe them:

Professional Development

6. Do teachers have opportunities to attend additional Informatics courses, such as those focused on new topics? How frequently do teachers participate in these courses? Are these courses mandatory for teachers?

Other

7. Please describe the differences in qualification requirements between teachers teaching in public and private schools.
8. Would you like to share anything else regarding informatics teacher education in your country?

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7.2 Annex 2 – Questions for interviews with teachers from ISCED 1

1. Choose your profile:
    a. Primary teacher without informatics background
    b. Primary teacher with informatics background
    c. Informatics teacher
    d. Other: __________

2. Age group:
    a. up to 35 years
    b. 36-45 years
    c. 46-55 years
    d. more than 56 years

3. Informatics related teaching experience:
    a. 0-5 years
    b. 6-15 years
    c. 16-25 years
    d. more than 25 years

4. Do you teach Informatics as a separate subject or integrated into other subjects?

5. What topic areas from I4All do you teach and where have you acquired the knowledge (formal or informal education)?
    a. Data and information
    b. Algorithms
    c. Programming
    d. Computing systems
    e. Networks and communication
    f. Human-computer interaction
    g. Design and development
    h. Digital creativity
    i. Modelling and simulation
    j. Privacy, safety and security
    k. Responsibility and empowerment

6. If informatics is integrated, which topics do you integrate in which subject?

7. How do you connect informatics lessons with other school subjects? For example, using educational robots in math or creating digital stories in language class.

8. What kind of resources do you use for teaching informatics?
    a. Physical materials (textbooks, workbooks, handouts): __________
    b. Digital resources (interactive websites, apps, educational software): __________
    c. Hardware (computers, tablets, educational robots, microcontrollers): __________
    d. Unplugged activities (CS unplugged materials, board games, card games): __________
    e. Online platforms and tools (coding platforms, learning management systems): __________
    f. Other: __________

9. How do you make abstract informatics concepts accessible to students?

10. How would you describe your key teaching approaches when teaching informatics to primary students?

11. What teaching methods work best when students in your class have different levels of informatics knowledge?

12. How do you keep up with the latest trends and advancements in informatics?

13. Do you collaborate with other teachers?

14. Do you have any support from computer science teachers or specialist?
    a. If yes, what kind of support and do you use it? Do you miss any other type of support?
    b. If not, do you wish to have it and what type of support?

15. What opportunities for professional development in informatics education are available to you?

16. Have you participated in any recent training programs, workshops, or courses related to informatics education?

17. Do you participate in any professional networks, conferences, or online communities related to informatics education?

18. Do you encourage your students to engage in extracurricular activities, such as competitions, or other projects? How do you support them?

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7.3 Annex 3 – Questions for interviews with teachers from ISCED 24

1. Choose your profile:
    a. Informatics teacher
    b. STEAM teacher
    c. Informatics specialist
    d. Other: __________

2. Age group:
    a. up to 35 years
    b. 36-45 years
    c. 46-55 years
    d. more than 56 years

3. Informatics related teaching experience:
    a. 0-5 years
    b. 6-15 years
    c. 16-25 years
    d. more than 25 years

4. Do you teach Informatics as a separate subject or integrated into other subjects?

5. What topic areas from I4All do you teach and where have you acquired the knowledge (formal or informal education)?
    a. Data and information
    b. Algorithms
    c. Programming
    d. Computing systems
    e. Networks and communication
    f. Human-computer interaction
    g. Design and development
    h. Digital creativity
    i. Modelling and simulation
    j. Privacy, safety and security
    k. Responsibility and empowerment

6. If informatics is integrated, which topics do you integrate in which subject?

7. How do you implement interdisciplinary projects that integrate informatics with other subject areas, such as science, mathematics, or social studies?

8. How do you guide students from basic to more advanced understanding of informatics concepts in your class? Provide examples for:
    a. Algorithms and data structures
    b. Programming
    c. Computer systems

9. How do you introduce computational thinking through real-world problems? Could you share a specific example?

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10. What resources (tools, platforms and materials) do you use to teach informatics?

11. Which teaching approaches work best with lower secondary students in informatics?

12. How do you assess students' progress in informatics?

13. How do you keep up with the latest trends and advancements in informatics (e.g. use of generative AI, safety and security …)?

14. Do you have access to professional development programs in informatics? What type of training or support would you find most valuable?

15. Do you participate in any professional networks, conferences, or online communities related to informatics education?

16. Do you encourage your students to engage in extracurricular activities, such as competitions or other projects? How do you support them?

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7.4 Annex 4 – Questions for interviews with teachers from ISCED 34

1. Choose your profile:
    a. Informatics teacher
    b. Informatics specialist
    c. Other: __________

2. Age group:
    a. up to 35 years
    b. 36-45 years
    c. 46-55 years
    d. more than 56 years

3. Informatics related teaching experience:
    a. 0-5 years
    b. 6-15 years
    c. 16-25 years
    d. more than 25 years

4. Do you teach Informatics as a separate subject or integrated into other subjects?

5. What topic areas from I4All do you teach and where have you acquired the knowledge (formal or informal education)?
    a. Data and information
    b. Algorithms
    c. Programming
    d. Computing systems
    e. Networks and communication
    f. Human-computer interaction
    g. Design and development
    h. Digital creativity
    i. Modelling and simulation
    j. Privacy, safety and security
    k. Responsibility and empowerment

6. If informatics is integrated, which topics do you integrate in which subject?

7. How do you implement interdisciplinary projects that integrate informatics with other subject areas, such as science, mathematics, or social studies?

8. How do you guide students from basic to more advanced understanding of specific informatics concepts in your class? Provide example for:
    a. Computational Thinking and Problem Solving (decomposition, abstraction…)
    b. Programming Fundamentals (control structures, functions, debugging…)
    c. Algorithms and Data Structures (stacks, queues, sorting, searching…)
    d. Computer Architecture Fundamentals (CPU, memory, binary logic…)
    e. Networking and Cybersecurity Basics (internet protocols, data security and privacy…)
    f. Software Development and Databases (Git, development lifecycle, SQL…)

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9. How do you acquired the knowledge of the following topics and how do you incorporate them in your teaching:
    a. Robotics and physical computing (microcontrollers...)
    b. Artificial Intelligence / Machine Learning
    c. Generative AI
    d. Virtual or Augmented Reality
    e. Ethical issues, licensing and copyrighting

10. What resources (tools, platforms and materials) do you use to teach informatics?

11. What student-centred teaching methods do you use?

12. How do you keep up with the latest trends and advancements in informatics?

13. Do you have access to professional development programs in informatics? What type of training or support would you find most valuable?

14. Do you participate in any professional networks, conferences, or online communities related to informatics education?

18. Do you encourage your students to engage in extracurricular activities, such as competitions, or other projects? How do you support them?

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