European Schoolnet




Computing our future

Computer programming and coding - Priorities, school curricula and initiatives across Europe

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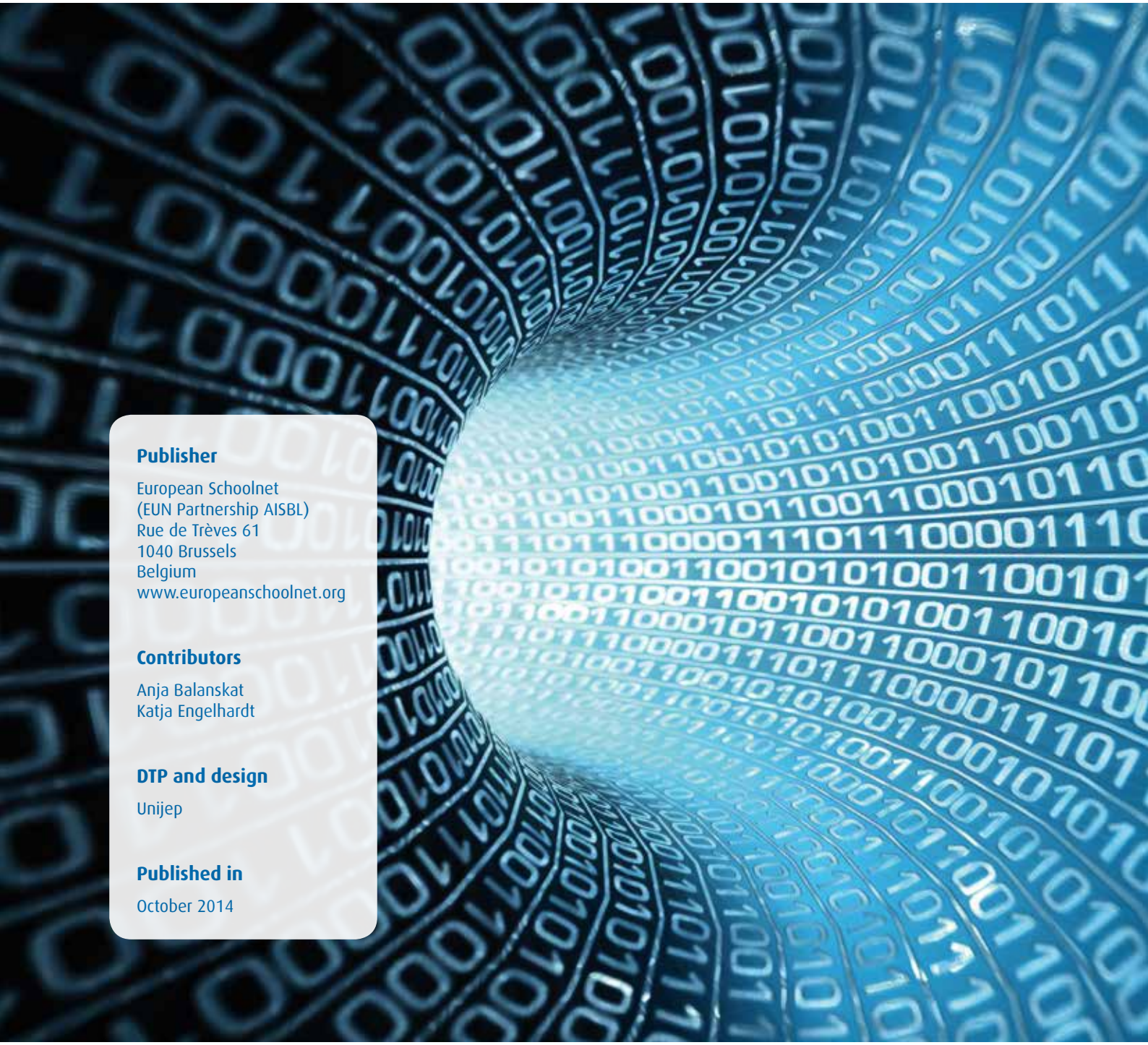

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Preface

Marc Durando
Executive Director of European Schoolnet

Coding is becoming increasingly a key competence which will have to be acquired by all young students and increasingly by workers in a wide range of industries and professions. Coding is part of logical reasoning and represents one of the key skills which are part of what is now called "21st century skills".

As programming skills become ever more important and a core competency for all kinds of 21st Century workers, this is leading individuals to seek out new ways of learning to code. Many new initiatives are appearing where start-ups and non-profit organisations offer innovative and engaging training approaches to coding and many businesses are also searching for innovative approaches to finding the coders they urgently need.

European Schoolnet has already started to monitor the very diverse range of coding initiatives that are developing all around Europe, including those that support informal activities on coding and which encourage young students to develop their coding skills within the school environment or outside of it. A number of large companies have already gained significant public visibility as they move to support schools and young students to develop their coding skills. In parallel, many NGOs and associations are also very active in developing coding activities for both young students and young people who have left school.

There are a growing number of countries in Europe and internationally which are refocusing their ICT curricula on developing students' computer programming and coding skills and introducing this topic in national, regional or school curricula. During July and August 2014 European Schoolnet launched a survey with its Ministries of Education to get a more consistent picture on the topic across European countries and to investigate some issues in depth.

This report presents the main findings of this survey where 20 Ministries of Education gave an overview of their current initiatives and plans.

Ministries of Education are responding to the challenge: in a significant number of countries they have already decided to enter into a revision of the curriculum, and to integrate coding as part of the curriculum activities, either as a compulsory or an optional part. Other countries are actively supporting the development of coding activities to complement school activities without these being a formal part of the curriculum.

Overall, much remains to be done, individually and collectively. It will be important to support teachers and students in coding initiatives, to consider new assessment approaches, to develop more awareness activities on the importance of coding in all schools in Europe, as well as promoting and scaling up any other initiative aiming at supporting coding activities in schools.

European Schoolnet and its network of Ministries of Education are fully engaged in this reflection and will contribute via its different actions and projects to support the development of more coding activities in schools in Europe and support teachers in that process.

Executive Summary

Coding is becoming increasingly a key competence which will have to be acquired by all young students and increasingly by workers in a wide range of industries and professions. Coding is part of logical reasoning and represents one of the key skills which are part of what is now called "21st century skills".

As programming skills become ever more important and a core competency for all kinds of 21st Century workers, this is leading individuals to seek out new ways of learning to code. Many new initiatives are appearing where start-ups and non-profit organisations offer innovative and engaging training approaches to coding and many businesses are also searching for innovative approaches to finding the coders they urgently need.

Computer programming is the process of developing and implementing various sets of instructions to enable a computer to perform a certain task, solve problems and provide human interactivity. These instructions (source codes which are written in a programming language) are considered computer programs and help the computer to operate smoothly.

For the purpose of this report both terms computing and **coding** are used interchangeably and refer to **activities enabling children not only to know how to use specific programmes but to programme computers, tablets, or other electronic devices**.

European Schoolnet has already started to monitor the very diverse range of coding initiatives that are developing all around Europe, including those that support informal activities on coding and which encourage young students to develop their coding skills within the school environment or outside of it. A number of large companies have already gained significant public visibility as they move to support schools and young students to develop their coding skills. In parallel, many NGOs and associations are also very active in developing coding activities for both young students and young people who have left school.

Participating Countries

20 Ministries of Education contributed to this overview of current initiatives and plans: Belgium (Flanders) (BE (FL)), Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (EL), Ireland (IE), Italy (IT), Lithuania (LT), Luxembourg (LU), The Netherlands (NL), Norway (NO), Portugal (PT), Poland (PL), Turkey (TR) and the United Kingdom (England).

This report presents the main findings of this survey where 20 Ministries of Education gave an overview of their current initiatives and plans.

This is a report on a lot of complex data which have to be set against extremely varied national and regional education contexts. There are nevertheless some "big picture" conclusions to be drawn:

- **Ministries of Education are responding to this challenge: in a significant number of countries they have already decided to enter into a revision of the curriculum, and to integrate coding as part of the curriculum activities, either as a compulsory or an optional part. Other countries are actively supporting the development of coding activities to complement school activities without these being a formal part of the curriculum.**
- **The assessment arrangements linked to programming/coding education appear to be understated or under-developed. There is scope for further study and exchange of expertise on approaches in place to be developed.**
- **As seems normal in a fast-changing world, there is a time lag between curriculum change and proper and widespread preparation of teachers to deal with this new curriculum, whether through pre-service or in-service training. Whilst recognizing that most national initiatives have integrated the training of teachers, all stakeholders involved need to invest in this area as a key determinant of successful curriculum change and learning achievement.**

Executive Summary

Key data from the study

➡ *Digital skills a key priority:*

Programming and coding is a priority for 11 countries. Countries usually have several named priorities (from 2 to 5) for developing ICT competencies. For the majority of countries, developing **students' digital competence** and **using ICT as a tool for learning** are among the main priorities. **Developing ICT user skills** is an important priority for 16 countries.

➡ *A higher profile for coding/computing in the curriculum:*

All countries participating in the survey, except Norway, **already integrate** coding/ computing in their curriculum (12 countries) or **have plans** to do so in the near future (7 countries - Belgium Flanders, Spain, Finland, France, Luxembourg, Netherlands and Turkey).

- Computer programming and coding is already **part of the curriculum** in 12 countries: Bulgaria, Cyprus, Czech Republic*, Denmark, Estonia, Greece, Ireland, Italy*, Lithuania*, Poland, Portugal and the UK (England). This integration is mostly through national curriculum requirements, although in the countries asterisked this happens at regional or local level.
- **Fostering logical thinking skills and problem solving skills** is an underlying rationale for almost all countries. For 10 countries, **attracting more students into studying computer sciences** and **fostering employability** in the ICT sector are also a rationale.
- 8 countries integrate coding/computing in the **general ICT/ technology curriculum**. BG, CY, EE, EL, and LT integrate programming not only in the general ICT/ technology course, but also as a **specific course.** IE integrates it only as a **specific subject**. In the UK (England) and Estonia, computing is a **distinct subject** in school curricula, but schools are free to teach it as an integrated subject or standalone.

Terminology

Programming is the common term used in most countries: BE (FL), BG, CY, CZ, DK, EE, EL, ES, FR, FI, LT, NO, PL, TR. PL and France. Lithuania and Poland specifically state that they prefer using the wider term such as programming instead of coding.

Some countries put the emphasis on using the term **computational thinking / algorithmic thinking** when talking about programming / coding ES, CY, BG, BE (FL), PT.

IE only uses the term **coding** while the UK (England) refers to **computing**.

- Computer/Programming/coding is integrated by most countries (10) at **upper secondary school level** in general education. Likewise, most of these countries also integrate it **at upper secondary level in vocational education.** Only three countries (Estonia, Greece, United Kingdom (England) integrate it in **primary education.** Estonia and Greece integrate coding and programming **at all levels** of school education. In 7 countries (BG, CZ, CY, EL, PL, PT, UK (England)) it is **compulsory** for specific levels of education and mainly part of a computer course.

➡ *Assessment of programming/coding skills:*

Almost all countries assess computing/ programming competencies (BG, CY, EE, EL, IE, IT, LT, PL, PT). In the Czech Republic and Denmark this depends on regional or school curricula. UK (England) offers qualifications that are not compulsory but that ae being revised to build on the skills gained via the computing curriculum, such as the GCSE Computer Science that assess programming skills.

➡ *Getting teachers alongside:*

- BG, CZ, CY, EE, IE, IT, LT, PT and the UK (England) **make training provision** (in in-service or pre-service training) to support teachers in teaching computer programming/coding. This training is offered by the Ministry of Education or other organisations. In EL and PL, no training of this type is offered.
- Ireland offers a variety of activities to teachers as part of initial teacher education (ITE) mainly for the Post Primary ITE sector. In the Primary ITE sector, coding is not included as a mandatory element but some electives may be offered.

➡ *Related initiatives and pilots:*

- 14 countries have reported on other initiatives with a focus on teaching computer programming or coding in place (BE (FL), BG, CZ, CY, EE, EL, ES, IE, FR, LT, NL, NO, PT, UK (England)).
- CY, DK and IT run pilots in the area of coding/computing.

➡ *Working with key stakeholders:*

10 (BG, CY, CZ, EL, EE, IE, IT, LT, PT, UK (England) of the 12 countries report on other **collaborative activities** with main actors in the field through the establishment of working groups involving industry, public organisations, representatives from unions, IT foundations, computer societies or universities. Activities include the development of coding courses for teachers, organising competitions, events, seminars or workshops for teachers and students.

Based on the findings above, it will be important to support teachers and students in coding initiatives, to consider new assessment approaches, to develop more awareness activities on the importance of coding in all schools in Europe, as well as promoting and scaling up any other initiative aiming at supporting coding activities in schools. The European Commission itself might review the support given to this important area by considering and/or strengthening actions such as:

- ❍ Promoting and scaling up initiatives from industry and NGOs and any other stakeholder active in teaching coding and supporting coding activities
- ❍ Supporting teachers and students in coding activities
- ❍ Offering a dialogue platform with policy makers in coding
- ❍ Developing a major awareness programme on coding.

1. Introduction

There are a growing number of countries in Europe and internationally which are refocusing their ICT curricula on developing students' computer programming and coding skills and introducing this topic in national, regional or school curricula. A review of press articles revealed a number of initiatives in various countries.

England is an exemplary case as it is one the first European countries to mandate computer programming in its primary and secondary education in state maintained schools from September 2014 onwards. Students will start learning to write code when they enter school at 5 years of age and continue with this until they finish at the age of 16. For example, by the end of key stage one (age 7) students should be able to create and debug simple programs, comprehend algorithms and how they are implemented as programs on digital devices, and understand that programs execute by following precise and unambiguous instructions.

Experts argue that an important reason for learning how to program a computer is that the underlying concepts will be valuable to you, regardless of whether or not you go on to make a career out of it. Programming will help you learn the importance of clarity of expression.

> *"A deep understanding of programming, in particular the notions of successive decomposition as a mode of analysis and debugging of trial solutions, results in significant educational benefits in many domains of discourse, including those unrelated to computers and information technology per se."*
>
> *(Seymour Papert, in "Mindstorms"[1])*

In July/August 2014 European Schoolnet launched a survey with its Ministries of Education to gain a more consistent picture on this topic across European countries and to investigate some issues in depth. The questionnaire investigated the following questions:

- *What is the Ministry of Education's current thinking about this topic? Which terms are used in the national, regional or local curricula? Which are the current priorities in ICT competence development including programming and coding?*
- *Is computer programming or coding already part of the school curriculum and how is it integrated? What activities are required and what competencies are developed? How are these assessed?*
- *Are there any plans to integrate computer programming and coding in school curricula in the future?*
- *What current or planned training provision is there to support teachers teaching computing/coding?*
- *Are there any school pilots or computer programming/coding initiatives and what are the main actors involved?*

20 Ministries of Education gave an overview of their current and future status of computer programming and coding in school curricula and initiatives in their countries: Belgium (Flanders) (BE(FL)), Bulgaria (BG), Cyprus (CY), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (EL), Luxembourg (LU), Ireland (IE), Italy (IT), the Netherlands (NL), Norway (NO), Portugal (PT), Poland (PL), Turkey (TR) and the United Kingdom (England)).

1 *Mindstorms: Children, Computers, and Powerful Ideas* (Basic Books (AZ)) – Trade paperback (1993)

2. Terminology

Computer programming is the process of developing and implementing various sets of instructions to enable a computer to perform a certain task, solve problems, and provide human interactivity. These instructions (*source code*s which are written in a programming language) are considered computer programs and help the computer to operate smoothly.

In this report both terms *computing* and *coding* are used interchangeably and refer to activities that enable children not only to know how to use specific programmes but to learn how to programme computers, tablets, or other electronic devices.

In order to write a program to instruct a computer, tablet, smart phone or any other electronic device which can be programmed, each problem needs to be clearly thought through, broken down into something called *methods* (or occasionally referred to as *functions*). A typical computer program will be constructed of lots of these methods, and each will contain commands and statements to perform the operations required.

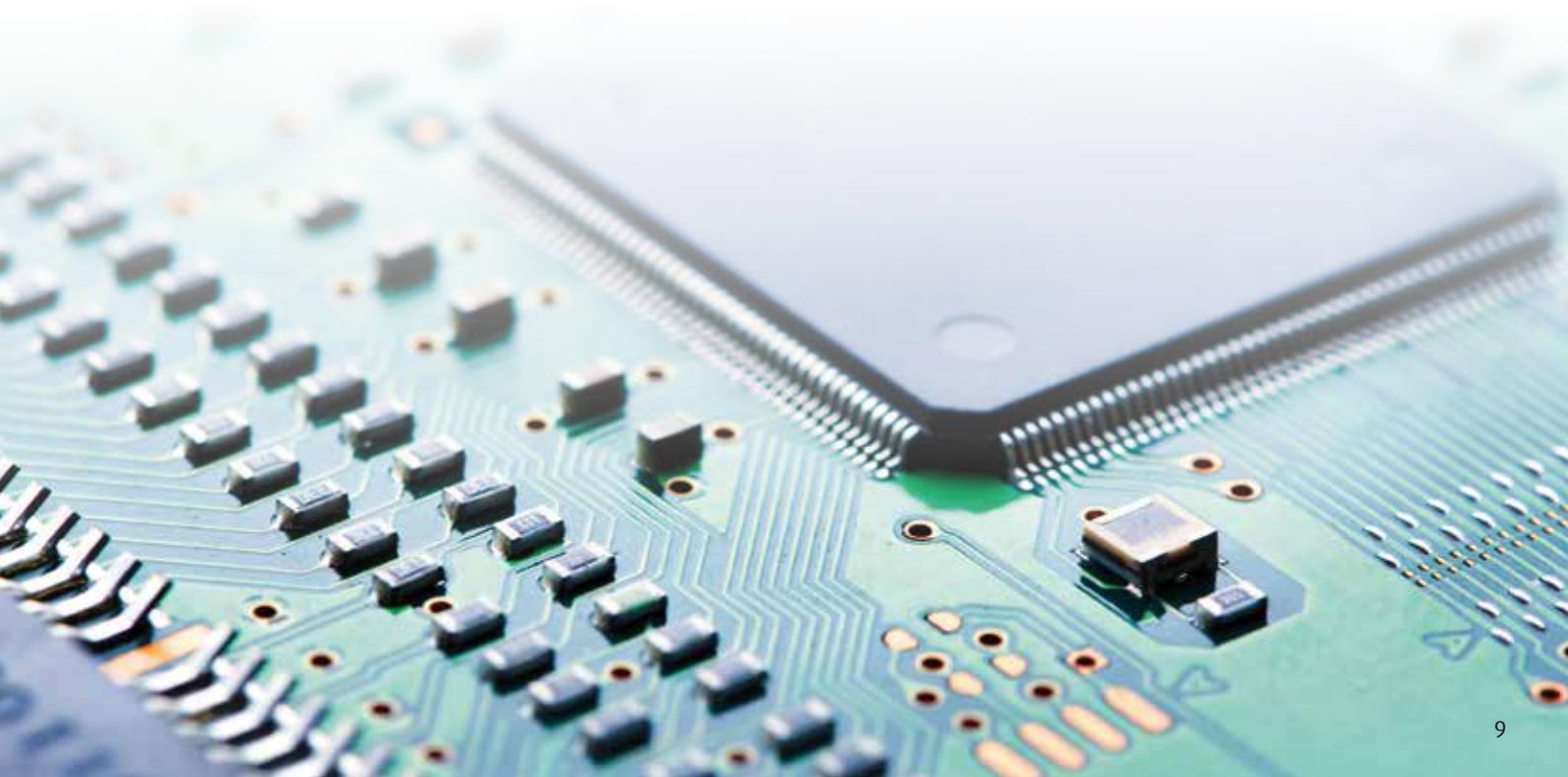
The process of programming often requires expertise in many different subjects, including knowledge of the application domain, specialized algorithms, and formal logic.

It involves activities such as:

- analysis, understanding, and generically solving such problems resulting in an algorithm
- verification of requirements of the algorithm including its correctness
- implementation (commonly referred to as coding) of the algorithm in a target programming language.

Coding on a technical level is a type of computer programming that closely or exactly represents what happens at the lowest (machine) level. However, when most people talk about coding, they usually mean something at a higher, more human-readable level which could be anything from problem-orientated languages like Java, C++ or PHP.

Often **computer programming** (when referring to software) and **coding** are used interchangeably and refer to more or less the same activities of writing the instructions (recipe) for the computer to perform a specific task following a logic. However, based on the definitions above, coding can also be seen as **a specific subtask of software computer programming** which arranges the implementation of the algorithm in the target programming language.



3. Integrating computer programming/ coding skills in the curriculum: current situation and rationale

From the 20 countries participating in the survey for 12 countries computer programming and coding is already **part of the curriculum:** Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Greece, Ireland, Italy, Lithuania, Poland, Portugal and the UK (England)[2]. 7 countries Belgium Flanders, Spain, Finland, France, Luxembourg, the Netherlands and Turkey still **plan to integrate it**.

The plans outlined by these countries are just indicative, reflect the current thinking, and are in no way binding for future implementation as in many countries the situation can still be affected by political changes.

The survey investigated the underlying **rationale** for integrating ICT in the curriculum. The following table indicates the rationale adopted both by countries which have already integrated coding/programming in the curriculum and those who still plan to do so (orange):

Table: Rationale for integrating coding/programming in the curriculum

Rationale	Countries	Total
Fostering logical thinking skills	BG, CY, CZ, DK, EE, EL, IE, IT, LT, PL, PT, UK (England) ES, FI, LU	15
Fostering coding and programming skills	BG, CY, CZ, DK, EE, EL, IE, IT, PL, UK (England), BE (FL), ES, FI, FR, LU	15
Fostering problem-solving skills	BG, CY, DK, EE, EL, IE, IT, LT, PL, PT, UK (England) BE (FL), ES, LU	14
Fostering employability in the ICT sector	CZ, IT, EL, LT, PL, UK (England) ES, FI, FR, LU	10
Attracting more students in studying computer sciences as part of higher education programmes	BG, CZ, EE, EL, IE, LT, PL, UK (England) BE (FL), LU	10
Fostering other key competences	CY, CZ, EE, IT, UK (England), ES, FR, LU	8
Other	NL	1

Countries generally have multiple rationales underlying their actual or planned integration of ICT in the curriculum. The main focus is to develop **logical thinking skills, coding and programming skills,** and **problem-solving skills**. For more than half of the countries all these reasons are key.

15 of the 19 countries (no statements on Norway can be given as only local initiatives) that have integrated or plan to integrate coding/computing in the curriculum, name **fostering logical thinking skills** as a rationale and 14 countries **problem-solving skills** and fostering coding and **programming skills**.

For 10 countries **fostering employability in the ICT sector** and **attracting more students in studying computer science**s as part of higher education programmes is a key rationale.

Around one third of countries aim to develop other key competencies when integrating programming/or coding into the curriculum.

In the Netherlands, schools are themselves responsible for the implementation of ICT in education. The ministry asked the national board to advise on the need and necessity of including 21st century skills in their educational objectives ("end-terms"). Media/digital literacy is part of this advice and computational thinking is part of media literacy. Coding and programming is therefore part of the advice being developed. The expectation is that the board will develop this advice into a framework for national "end-terms".

2 Norway has some local initiatives in this area. One of the optional subjects in the lower secondary level: grades 8-10 (age 13 to 16) is called "Technology in practice" and the curricula allows individual teachers to use this subject to teach programming and coding. There are have several examples of schools that do this.

4. Skill priorities

4.1 Terms used for coding/programming

Before going into detail of how this new competency is (or will be) actually integrated in the curriculum, we need to look at the terms that actually used in this educational context. There are various (technical) definitions of coding and programming and the Annex to this report gives an overview of the terms used in the national language and to what English term they correspond.

Programming is the common term used in NO, EE, FI, ES, EL, DK, CY, BG, BE (FL), TR. Some countries such as Lithuania and Poland prefer using a wider term such as programming instead of coding. Many countries put the emphasis on **computational thinking/algorithmic thinking** (ES, CY, BG, BE (FL) and PT. Ireland is the only country that exclusively refers to **coding.**

The choice of terms by countries reflects somewhat the thinking behind the type of skills or competencies to be developed. In that sense, programming and computational thinking are probably used interchangeably to describe:

Programming/ computational thinking: "to be able to define a set of instructions to reach a given goal from a given starting point; to be able to write a concrete set of instructions for a computer to let the computer run a certain task." (Belgium Flanders).

or

Algorithmic thinking: "The ability to propose a step by step solution to a problem (an algorithm), consisting of a finite, clearly defined set of simple (definite, unambiguous) steps. **Programming:** "The ability to realise an algorithm in a computer programming language, that is to interpret the steps of the algorithm as instructions in a programming language, as a computer programme, to compile, run and debug the programme, as well as to identify and reuse common design patterns." (CY). (see Annex for country details)

- In some countries coding/programming is part of a general ICT/computer science subject (BG, EL) or part of digital competence (CZ).

4. Skill priorities

4.2 ICT skill priorities

Another important aspect before looking at curriculum integration in greater detail is to examine the importance attached to computer/programming skills in relation to the ICT skill priorities set by Ministries of Education in recent years (e.g. the development of digital competence or integrating ICT as a tool for learning).

The table below looks how different countries express their ICT skill priorities:

TABLE: ICT SKILL PRIORITIES

Main priorities	Countries	Total
Developing students Digital Competence (including Media Literacy)	BE (FL), BG, CY, DK, IE, LT, NL, NO, EE, ES, FI, FR, LU, PL, TR, UK (England)	**16**
Developing how to use ICT as a tool for learning	BE (FL), CZ, CY, DK, EE, EL, ES, FR, IE, IT, LU, NL, NO, PL, PT, TR	**16**
Developing ICT user skills	BG, CZ, CY, DK, EE, EL, ES, FI, FR, IT, LT, LU, NO, PL, TR, UK	**16**
Developing how to use ICT for developing key competencies	CY, CZ, EE, ES, IE, FR, IT, LT, LU, NO, PL, PT, TR	**13**
Developing students computing programming skills including coding skills	BG, CY, EE, EL, FR, LT, FI, IE, IT, TR, UK (England)	**11**

All countries have usually adopted several priorities, in the range of 2 to 5, for developing ICT competencies. For the majority of countries participating in the survey developing **students' digital competence** and **using ICT as a tool for learning** is still the top priority. Developing **ICT user skills** is also prominent (16 countries). **Programming and coding** is mentioned as a priority amongst other priorities in the case of 11 countries. In addition to the priorities indicated by the Netherlands, a further priority is to investigate the need for ICT skills as part of the 21st century skillset.

Cyprus' observations on the recognition of computer programming merit reflection in this context: *"The fact that computer programming is not formally part of the curriculum of educational systems considered exemplary within the EU and the fact that education-related literature frequently focuses on the need to develop language, mathematics and natural sciences (but not ICT skills or programming, which are often considered tools), it is often difficult to convince policy makers of the importance of* ***computer programming as a core competence in problem solving and creativity in modern society.***

5. Level of curriculum integration (current and future)

We have reported above that in 12 of the 20 countries participating[3] in the survey computer programming and coding is already **part of the curriculum,** and that 7 countries still **plan to integrate it**.[4]

The table below looks at the level at which countries have provided for curriculum integration.

5.1 Level of integration

TABLE: LEVEL OF INTEGRATION

Level/ Countries	BG	CY	CZ	DK	EE	EL	IE	IT	LT	PL	PT	UK (England)	BE (FL)	ES	FI	FR	LU	NL
National level	X	X		X	X	X	X	X	X	X	X	X			X	X		
Regional level													X	X	X			
School level			X				X	X						X	X		X	X

11 of the 12 countries which already integrate coding/programming in the curriculum have done this at national level (in Ireland and Italy additionally at local level). In the Czech Republic this is provided for at local level. (This reflects the broader situation regarding responsibilities for ICT integration in the curriculum).

From countries having plans for integration in the future, Spain, Finland, Luxemburg and the Netherlands may do this at local level. Belgium (FL) and Spain likewise plan to integrate it at regional level, which is the level where curriculum responsibility lies. Finland, plans to integrate it at all 3 levels.

France is looking into measures at national level and these are currently being defined. Programming and coding is planned to be integrated at lower secondary level and will maybe feature during the last year of primary school. At the end of upper secondary education, an option is already offered to pupils specialized in science (A level) called « informatique et sciences du numérique" (computer science and ICT science").

3 Norway describes local initiatives in the area, which are outlined elsewhere in this report.
4 Turkey mentioned to plan coding/programming in the curricula but gives no further details on how it will be integrated.

5. Level of curriculum integration (current and future)

5.2 Integration by level of education

The next table looks at the age range of learners and education level for which coding/programming is currently offered or compulsory (compulsory is highlighted in red x).

TABLE: INTEGRATION BY LEVEL OF EDUCATION

Countries Level	BG	CY	CZ	DK	EE	EL	IE	IT	LT	PL	PT	UK (England)	BE (FL)	ES	FI	FR	LU	NL
Primary level					X	X		X				**X**	**X**	X	**X**			X
Lower secondary school level (general education)		**X**		X	X	**X**	X	X			**X**	**X**	**X**	X	**X**	**X**		X
Lower secondary school level (vocational education)				X								**X**	**X**				X	X
Upper secondary school level (general education)	**X**	**X**	X	X	X	**X**/X			X	**X**	**X**			X				X
Upper secondary school level (vocational education)	X	X	X	X	X	X		X			**X**			X				X
Depends on regional or school curricula							X											

Computer/ Programming/ coding is integrated by most countries (10) at **upper secondary school level** in general education. Likewise most of these countries also integrate it at **upper secondary level in vocational education**. Only three countries (Estonia, Greece, UK (England)) integrate coding/programming at **primary level.** Estonia and Greece (in the last year of primary school) integrate coding and programming **at all levels** of school education including vocational education at upper secondary level.

In 7 countries (BG, CY, CZ, EL, PL, PT, UK (England)) it is **compulsory** for specific levels of education and mainly part of a computer course. In Denmark to know about simple programming is a compulsory part of the Science curriculum.

Amongst the countries with plans to integrate programming/coding in the curriculum, the NL and ES aim to integrate coding/programming at **all levels** of school education. Belgium (FL) and Finland aim to integrate it at **primary school** level and **lower secondary level**. For Belgium (FL), plans to integrate programming/coding are already most concrete for adult education: programming will be part of a course that will replace the current (outdated) course on application software. For Luxembourg, it is not clear yet at what education level coding/computing will be integrated. In Belgium (FL), Finland and France the plan is to make it **compulsory**. For Luxembourg and the Netherlands, it is not clear yet whether coding/computing will be compulsory. In Spain, this will depend on regional or school curricula.

Country specific notes:

CY: lower secondary vocational education is not offered in Cyprus. Coding/Programming is compulsory in lower secondary and in the first year of upper secondary school (ages 13-16) as part of a specialised Computing course. It is offered as an elective in the last two years of upper secondary school (ages 17-18), where it comprises over 75% of teaching time.

DK, CZ, EE: it depends on regional or school curricula if coding is compulsory or not.

EL: coding is compulsory in the first year of upper secondary school only. In addition, coding is a core module of the Technology Programme of Study and thereby is examined in the context of National examinations to enter universities.

PL: computer programming/coding is compulsory for students who choose computer science

UK (England): Computing is a compulsory part of the curriculum from ages 5-16. This is not the case for academy schools which do not have to follow the national curriculum. However, many academies will choose to follow the national curriculum.

6. Curriculum location and integration

6.1 Curriculum location

This table looks at the part of the curriculum where computer programming/coding is taught and whether it is stand-alone or part of another subject.

TABLE: CURRICULUM LOCATION

Country Location	BG	CY	CZ	DK	EE	EL	IE	IT	LT	PL	PT	UK (England)	BE (FL)	ES	FI	FR	LU	NL
As a specific subject	X	X			X	X	X		X			X						
In the general ICT/ technology course	X	X			X	X		X	X	X	X	X				X		
In other subjects as cross curricular approach								X										
Depends on regional or school curricula				X				X						X				
Not clear yet													X		X		X	X

Most countries (9) locate coding/ computing within the general ICT/ technology course. CY, BG, EL, and LT and the UK (England) provide programming not only as part of the general ICT/ technology course, but also as a specific course. Ireland integrates it only as a specific course. Italy is the only country that provides Programming/coding as a cross curricular approach.

Country specific notes (Countries, which have integrated coding into the curriculum)

In **IT, CZ, DK, EL, IE** the location of computing/programming in the curriculum depends on regional or school curricula, e.g. if it is integrated in other subjects as part of a cross-curricular approach. In **IE**, some primary and secondary school teachers may use Scratch programming in the instruction of shape and space in Mathematics.

LT: The student can select one of three IT courses: Programming, Basics of Websites Creation, and Basics of Computer Publishing.

EL: "Application Development in Programming Environment"

IE: "Coding". All the key skills in the new Framework for Junior Cycle highlight the use of digital technology. It will permeate the experiences of all Junior Cycle students as the new Framework is implemented.

UK (England): the name of the subject is "computing". Computing is a distinct subject in school curricula but schools are free to teach it as an integrated subject or standalone.

NO: the optional subject "Technology in practice" is offered at lower secondary level: grades 8-10 (age 13-16). The curriculum allows individual teachers to use this subject to teach programming and coding. Several schools have taken up this possibility.

For the countries planning to integrate coding programming in the curriculum, curriculum location is not yet clear, with the exception of **France**, which aims to integrate it in the general ICT course and as a cross curricular approach in other subjects. Computer science and ICT science can also be extended to other subject specialisations during the final year. In terms of skills and competencies to be developed, countries stated the following:

In **Belgium Flanders,** coding/computing activities will include: modifying basic settings of software, a program or an application to change a computer program, understanding the basic notions of programming and how a program is constructed.

In Finland, coding should support the development of key competences and ICT skills. Programming will be a cross-curricula theme from the 1st to the 9th grade in the new core curricula. It will be come into effect in August 2016.

In **Spain**, competences to be developed with coding/computing are abstraction, logical thinking, flow control, user interactivity, data representation, parallelism, synchronism, problem-solving skills, simulations, etc.

6.2 Examples of current curriculum integration

The full diversity and complexity of Europe's education structure sand curricula are best illustrated by some specific examples from the contributing countries.

Bulgaria Informatics is a compulsory subject in grade 9, and students have 2 hours tuition per week. The course teaches basic knowledge of concepts in computer science and mathematical principles. Programming, algorithmic problem-solving and representing information through abstractions (e.g. models and simulations) are part of both subjects: Informatics and ICT.

Cyprus Algorithmic thinking and programming are part of the specialised computer science course and compulsory in lower secondary and in the first year of upper secondary school (ages 13-16). It is offered as an elective course in the last two years of upper secondary school (ages 17-18), where it comprises over 75% of teaching time. Moreover, afternoon courses are offered to students who wish to develop their knowledge and skills in this area.

Algorithmic thinking is seen as the ability to solve problems starting from simple ones using the Development Cycle of an application. Initially, graphical "drag and drop" programming environments are used (e.g. Scratch, Alice, etc.). Part of algorithmic thinking is the ability to compare algorithms based on their effectiveness and efficiency, as well as to identify common design patterns. Students are also taught to draw flowcharts for the solutions they develop and are introduced to dry runs and predicting the results for their programmes.

Gradually students are introduced to a programming language and have to code, compile, test and debug their programmes.

During all stages the work has to be documented. The Development Cycle forms the basis of coding throughout the curriculum, using different software tools and programming languages, depending on the maturity and the level of knowledge/experience of students.

Denmark ICT integration is determined at national level, but implementation depends on regional or school curricula. Programming is part of the science curriculum for *Folkeskolen* (grade 1-10), and in Math it is an integrated element of the curriculum specifications of pupils' competencies. Programming is also included as part of the ICT subject in upper secondary school (currently being piloted, and later any school can offer the course as an optional course in the curriculum.)

6. Curriculum location and integration

Estonia The *ProgeTiger* programme is aimed at pre-school, primary and vocational education to support the integration of IT education into the curriculum. It offers teachers educational resources and training, and gives financial support to kindergartens and schools to acquire different programmable devices. In primary education there is a national cross-curricular theme called "Technology and Innovation" which requires all teachers to implement technology in their teaching. Teachers have to integrate technology in different fields (for example using Scratch in mathematics, music programs in music lessons and so on). The curriculum does not prescribe what to use or how to use technology specifically. Teachers can choose themselves how they want to do this. There are also different national optional curricula in technology education (programming, robotics, 3D graphics, computer science, informatics etc.) which schools can choose to add to their school programme.

Greece Computer programming is integrated in the curriculum starting from the 3rd year of primary education (as part of computer science) up to upper secondary education as part of the subject called "Application Development in Programming Environment". Actual integration depends on the level and scope of each class. In primary education, students programme using LOGO a turtle, in upper secondary education students have to solve a specific problem with the development of an application.

Ireland Coding is integrated in lower secondary schools as a separate course called coding (depending on the region). Problem-solving and computational thinking skills are developed in this course as students build and create software projects using their own ideas and imagination. The course looks to build on any coding skills that primary students might have experienced while offering insight into possible future studies in computer science and software engineering.

Lithuania Programming is part of an ICT course in upper secondary education. There are six main competencies: Algorithms, Data bases, Programming languages, Program creation for simple tasks, Program creation stages, and the Culture of programming.

Portugal Programming (in the sense of Computational thinking) is part of the ICT subject, which is compulsory in lower and upper secondary education. Activities comprise the designing of multimedia projects (text, image, sound and video), e.g. games, animations, interactive stories and simulations. With these activities, it is intended to develop computational thinking, based on description and problem solving and logical organization of ideas, which are curricular goals of ICT.

UK (England) The statutory programmes of study and attainment targets for computing at key stages 1 to 4 give statutory guidance on how to integrate coding in the curriculum.

7. Assessment of programming/ coding skills

We established above the considerable degree of integration of coding/programming into the curriculum as well as the variety of skills and competencies aimed for. How then are these competencies assessed? The following table gives an overview of what the participating countries have reported:

BG	• Knowledge: Tests Skills • Evaluation of the submitted source codes
CY	• Through day-to-day assessment exercises, written assessment exercises and examinations
DK	• By the teacher as normal part of the learning process • Upper secondary: final examination, one part of the exams of ICT
EE	• Learning outcomes are described
EL	• According to curriculum they are assessed by the teacher during the final class examinations. However, there is a national program in which the Computer Technology Institute & Press "DIOFANTOS" (CTI) implements a project for "Certification of secondary school students in ICT" which aims to develop and provide a framework for the certification of student's ICT skills (including coding skills) acquired by the completion of compulsory education. Additionally, "Application Development in Programming Environment" is part of the national examination system for tertiary education.
IE	• In Ireland assessment for certification will be school-based. In the final strand of the course, students complete a significant piece of work in the form of a Final Project. The project is in two parts. In the first part, each individual student identifies and researches a topic/challenge in computer science. In the second part, students will work in a team. While they will be involved in a team, the student's individual role and contribution to the project will be the focus of assessment for certification.
LT	• By grades only. But students can further learn the course in gymnasiums and participate in state exam.
PL	• It depends on teachers
PT	• They are assessed by the curriculum goals in specific subjects.
UK (England)	• England offers qualifications that are not compulsory but are being revised to build on the skills gained via the computing curriculum, such as GCSE Computer Science, that assess programming skills
BE (FL)	• By the teacher or teacher team
ES	• It depends on regional and school curricula, though the possibilities might even include automatated web tools.
NL	• As part of the end-terms.

It seems clear that the reports on assessment arrangements vary according to detail: Bulgaria, Cyprus, Denmark, Estonia, Greece, Ireland, Lithuania, Poland, Portugal and the UK (England) describe how they assess computing/ programming competencies. For the Czech Republic and Denmark, regional or local variation does not allow a full insight into assessment arrangements. 3 of the 6 countries which aim to integrate coding/programming in the curriculum (BE (FL), ES, NL clearly plan to assess it but cannot report yet on details. For Luxembourg, Finland and France it is not clear yet if and how it will be assessed.

In general, assessment of coding/programming skills is usually not a separate activity but is understandably integrated in the general subject assessment (continuous, end term) where coding/programming is part of the curriculum. Estonia appears to be the only country that develops a specific certification for students "Certification of secondary school students in ICT" which aims to develop and provide a framework for the certification of student's ICT skills (including the coding skills) acquired by the completion of compulsory education.

8. Planned changes to the current situation

Clearly, the situation regarding programming/coding education is a fast-moving one, and many countries have reported ongoing evolution in their provision.

Cyprus, Czech Republic, Denmark, Lithuania and **Poland** have already integrated coding/computing in their curriculum plan but are already planning changes in their provision.

In **Cyprus**, a curriculum reform that started in 2009 is currently being evaluated. Part of this reform is the establishment/reinforcement of algorithmic thinking and programming starting in year 1 of secondary education. This effort has been accompanied by intensive teacher training, a new methodology (student-centred) and the development of new teaching materials. The new curriculum has been implemented in all lower secondary schools. A new curriculum for upper secondary education has also been proposed.

In the **Czech Republic,** the new Strategy of Digital Education 2020 is currently under preparation. This new strategy follows the document "The Conception of the Development of ICT in Education 2009-2013".

In **Denmark**, the subject IT will (probably) change status from a pilot/trial course to an optional course offered by a majority of upper secondary schools (pending decision at political level).

Lithuania plans to integrate coding/computing into Math courses in primary school.

Poland plans to change the core curriculum so that all students will learn programming starting in the first class of primary school.

9. Teacher Training

Integration into initial and in service training

This section looks at what the curriculum integration of programming/coding has meant for teacher training. Many countries endorse the analysis of one of the countries aiming to implement coding/programming in the curriculum – Belgium (Flanders) – that "*one of the biggest challenges will actually be how to train teachers in coding skills*."

9 of the countries which integrate programming/coding in the curriculum (BG, CY, CZ, EE, IE, IT, LT, PT, UK (England)) already offer in-service and/or pre-service training to support teachers in teaching computer programming/coding, but to various extents.[5] In Greece and Poland no training in this area is offered to teachers. Poland plans to do so in the future. In Cyprus and Ireland, ICT-related training is mandatory for incoming teachers. This training is offered by universities and pedagogical institutes as part of general initial teacher training, or by teacher training centres as part of in-service training.

In the case of Ireland and the UK (England), there are a number of collaboration activities with main stakeholders in the field, e.g. with the Computer Society in the UK (England) or the software engineering research centres in Ireland. The UK (England), as they have to support teachers in delivering the new computing curriculum which includes computer science, has a variety of actions in this field, including the establishment of teacher networks (see Case Study).

In **Bulgaria,** the mathematics and informatics faculties of most Bulgarian universities provide pre-service and in service teacher training.

In **Cyprus**, all teachers teaching ICT in secondary education are **required** to be computer science graduates or graduates of a computing-related field. In-service training in teaching computer programming is provided in the form of seminars. Seminars in various computer-related subjects, including programming languages, are offered as part of the teachers' life-long learning programme, through the Pedagogical Institute (the official teacher training authority with the Ministry of Education).

5 Not all of these countries gave more detailed information.

9. Teacher Training

Case study: United Kingdom

In the UK (England) in 2012 the Department for Education provided grant funding to **Computing at School** (CAS), through the British Computer Society (BCS), to establish the Network of Teaching Excellence for Computer Science teachers. This Network has forged links between schools, universities and employers and CAS has harnessed pro bono support from organisations such as Microsoft and Google. In April 2013, the Network was funded to build a network of 400 'Master Teachers' by March 2015. Schools can commission these Master Teachers to provide training for their teachers rather than directly creating a large CPD programme. BCS/CAS hope to expand the network even further in the future. Once fully established, the Network will be self-sustaining as participating schools will charge for the services of their Master Teachers. To date over 260 Master Teachers have been recruited and over 7,000 teachers have received training via the Network. In 2013, the Department for Education announced further funding for the CAS/BCS to run the Barefoot Computing programme. CAS is creating online resources to help primary school teachers with little or no experience in teaching computing to deliver the new curriculum. These resources will demonstrate how teachers can use their existing knowledge to teach computing, and how progression can be enhanced across other subjects such as literacy, maths and science by teaching computer science. They will also equip teachers with the basic computer science subject knowledge and confidence needed to begin teaching. To support this, BCS will deliver 800 in-school workshops to introduce primary schools to computing, showing them how to use the online resources and set up computing self-help groups. The Department for Education is also spending a further £500,000 on smaller projects that have managed to secure over £600,000 from partners including Microsoft, Arm, Google, Raspberry Pi and IBM amongst others.

In **Ireland,** ICT in Teaching and Learning is a **mandatory** element of all Initial Teacher Education (ITE) programmes and optional modules on coding/ programming may be offered by some providers. There are some ITE courses which include mandatory modules on coding/ programming in the Post Primary ITE sector. In the **Primary** ITE sector, coding is not included as a **mandatory element** but there are some electives offered, e.g. a Scratch Education Elective aimed at students interested in equipping themselves with the skills required to effectively use introductory computer programming (i.e. Scratch) to support teaching and learning across the curriculum. Moreover, summer and term-time professional development courses have been designed and mediated by the Professional Development Service for Teachers in conjunction with LERO (The Irish Software Engineering Research Centre) to interested Primary and Post-Primary teachers where the use of Scratch to develop literacy and numeracy has been explored.

In **Lithuania,** training is offered by Universities. The courses are paid.

In **Norway,** Teacher Training Centres offer workshops and communities, promoted by the Ministry of Education.

Countries such as **France, Spain and Luxembourg** plan to offer training (in-service or pre-service) for teachers to support them in teaching computer programming/coding.

In **Spain**, teachers already had the opportunity to attend summer courses on this issue in 2013 and 2014.[6] At national level, the summer course in 2013 is will be offered as an online course in October 2015, lasting for 2 months.

At regional level, training has included:

- In the region of "Navarra", teachers will be able to attend a summer course on coding with Scratch.
- In the region of "Galicia", teacher were able to attend in April a course on coding with Scratch.

There are no reports on planned training actions for **Belgium (Flanders), Finland**, or the **Netherlands**.

6 In 2013: Title: *De espectador a programador: El camino para entender la tecnología aprendiendo a manejarla*: Materials & Programme ; In 2014: Title: *Pensamiento computacional, la tecnología es tu amiga*. Materials & Programme

10. Supporting teaching and learning in computer programming/coding

The reports contain a wealth of information on related initiatives to support teaching and learning in computer programming/coding. Some are direct initiatives of Ministries of Education, some spurred by groups of committed teachers, some resulting from specific project funding – both national and EU, some benefiting from private funding.

The following table gives an overview of these activities:

Table: Complementary Activities

Location	Activity
EU	• Countries all around Europe (e.g. Czech Republic, Netherlands and Portugal) are participating in the Europe-wide Code Week, taking place from 11-17 October 2014. As part of the Coding week, Kennisnet brings professional programmers and schools together, inspiring them to have more school activities about coding.
Belgium Flanders	• There are currently 86 learning objects about programming in the educational repository Klascement.
Bulgaria	• The INFOS platform with information and tasks related to the National Olympiad and tournaments in informatics and the Telerik Kids Acedemy. • The Bulgarian Scratch society and Varna Free University "Chernorizets Hrabar" organised teachers training and competitions for students in primary and low secondary school level.
Cyprus	• In 2009 the Ministry established a team responsible for curriculum development. This team is responsible for the development of the curriculum, teaching materials and teacher training. The provision of resources online and online training are part of the activities offered. • A number of computer programming competitions are organised/sponsored by the Ministry of Education, in collaboration with local universities, the Cyprus Computer Society and Industry Partners. Through their participation, in these competitions, students who have an interest in computer programming are encouraged to develop their skills and to collaborate in small groups to develop an application (usually a computer game). Developing an idea into a programme can also be the subject of a R&D project, through which groups of students can participate in annual nationwide competitions among school students on Research and Development. • An annual algorithmic thinking competition (through an on-line test) is also held for lower secondary school students. Depending on their results, students are encouraged to participate in a computer programming summer school (bootcamp) or in free afternoon classes on computer programming, with the intention to prepare and possibly participate in regional or international programming competitions. • A school pilot: teachers with expertise/ professional experience in computer programming are encouraged to develop brief teaching proposals focusing on either teaching methodologies or new software tools, which after approval can be implemented in their schools and evaluated with the intention of being distributed to other schools as good practice. Similarly, new concepts proposed by the curriculum development team are frequently developed into teaching proposals with the participation and feedback of selected teachers or schools.
Czech Republic	• Regional activities take place and Czech teachers participated in an eTwinning PDW in Lithuania. The new Strategy for Digital Education 2020 is under preparation.
France	• The Ministry offers the website Eduthèque. A service will offer resources on coding in the course of 2015. The platform m@gistère also offers resources, tutorials and opportunities for exchange. A distance learning course via the m@gistere platform is under consideration.
Denmark	• The subject *Informationsteknologi* is currently offered as a pilot course.
Estonia	• The Information Technology Foundation for Education (HITSA) develops learning materials and training courses and organizes competitions. In Portugal, teacher training courses on Kodu and the Kodu Contest's, promoted by Microsoft promote coding/computing, are organised. • There are extra-curricular activities at all education levels in kindergartens and schools. Moreover, voluntary activities like robotics and coding clubs are offered.

10. Supporting teaching and learning in computer programming/coding

Location	Activity
Greece	• The Greek Schools' Network (GSN) is the educational intranet of the Ministry of Education which interlinks all schools and provides basic and advanced telematics services. It contributes to the creation of a new generation of educational communities, taking advantage of the new Informatics and communication technologies in education. • A national competition in Information Theory is organised. • Additionally, for the Computer Engineering and Science (CES) educators in public schools, a Hybrid Education Platform (HEP) was designed and implemented by the Greek School Network (GSN) and Networking Technologies Directorate in order to provide blended learning process to CES educators. The synchronous eLearning environment was developed for hosting tele-education courses.
Ireland	• Teachers' work on coding is supported by professional development for teachers and by digital content on the Scoilnet website. The Professional Development Service for Teachers (PDST) has provided an Irish language translation for Scratch to MIT (the developers of Scratch) so it is possible for pupils in Irish-speaking schools to code in Irish. Teachers' work on coding is supported by professional development for teachers and by digital content on the Scoilnet website. A short course (100 hours) will also be offered in Digital Media Literacy.
Lithuania	• There are plans to use European Structural Funds according to Informatics and Learning Guidelines 2014-2020 and ICT is integrated in the General and Vocational Education Activities Plan for 2014-2016.
Netherlands	• *Kennisnet* is a Dutch public organization dedicated to ICT innovation for primary and secondary education and vocational training. It provides educational content and information to teachers, pupils and parents, including *Codekinderen*, which is a free lesson plan for primary and secondary schools. • Mediawijzer.net is a network organisation for media literacy in which a small number of commercial organisations are active that offer lesson material on coding and programming. Other coding initiatives in place in the Netherlands are for example Robomind, SETUP, Digital Playground, Waagschool – Fabschool, Coderdojo, MOOC MEE! part of Cubiss and the Microsoft Kodekup. • All activities are generally started with pilots to test lesson plans and widescale implementation.
Norway	• "Lær Kidsa Koding" (teach the kids to code) offers a variety of teaching resources for teachers who want to get started with coding in their classroom. The resources include ready-made teaching plans and an overview of tools/programs/resources for different age groups. • "Lær kidsa koding" is a volunteer network of code enthusiasts who aim to teach kids programming and offer different courses throughout Norway. The network consists of members from the IT industry, schools, government and universities. Local initiatives keep popping up, and the program is mostly run from adults and parents in the IT industry. Further, Students attend ‚Kodeklubben" (the code club). Kodeklubben is a Norwegian version of the British initiative „Code Club". Kodeklubben offers readymade teaching plans which can be used by enthusiasts who to start a local code club. The idea behind Kodeklubben is that volunteers with programming experience teach kids to code during or after school hours.
Portugal	• Teacher training courses on Kodu and the Kodu Contest, promoted by Microsoft, are organised.
Spain	• The initiative "Programamos" has been developed by a group of teachers (non-profit organization) to introduce coding/programming in all educational stages (from kindergarten to university). They are creating educational materials for sharing (CC), visiting schools to develop workshops for teachers and students, offering both online and face-to-face training, helping other teachers through forums and social networks, and collaborating in a wide range of activities to help increase awareness across the educational world. • In some regions of Spain (for example Galicia), Regional Educational Authorities are organizing a competition in which students in teams have to generate a project in their schools about the "Camino de Santiago". There will be prizes for the participants (both schools and students) and an official acknowledgement for the teachers' work.
United Kingdom (England)	• There are a number of projects, funded by the Ministry for Education, industry and others, to produce resources for teachers (cf. earlier Case Study). The Department also funds Computing at School to deliver training for teachers (the Network of Excellence) and produce resources for primary teachers (Barefoot Computing). • There are a number of non governmental organisations that run programmes designed to engaged young people. Good examples are the Code Club, Coder Dojo, Computer Clubs for Girls or Young Rewired State.

11. Collaboration with key stakeholders in the field

As we have seen in the previous section, developing computing/coding skills for teachers and students often needs to be done in partnership with other bodies and also depends on active pioneer schoolteachers. This reflects the shared interest in ensuring that skill levels in this field match the aspirations and needs of society and industry over the coming decades.

Twelve countries (BE (FL), BG, CY, CZ, EE, EL, IE, IT, LT, NL, PT, UK (England)) have reported on their collaboration with a variety of key stakeholders in the field through mechanisms such as: industry partnerships, sector organisations, teacher and subject associations, computer society clubs, IT/medial literacy foundations and through activities to raise awareness (e.g. campaigns, competitions and media coverage).

Belgium (FL) There are plans to engage in collaboration activities with main actors in the field, e.g. through industry partnerships and the establishment of working groups. General support and awareness-raising initiatives are planned e.g. via the koderdojo initiatives and coding clubs teacher training infrastructure (e.g. framework agreements with reseller. The Ministry of Education organises information sessions for the intermediate education field such as school networks and coding is a topic during conferences. The "forum for informaticawetenschappen" raises awareness on the topic.

Bulgaria The Ministry of Education and Science organised a National Olympiad and tournaments in informatics, in partnership with the Union of Bulgarian Mathematicians.

Cyprus The Ministry of Education and Culture cooperates closely with the Cyprus Computer Society, the public and private universities and organisations offering training in computing, including programming languages.

Czech Republic There are partnerships with companies like Microsoft or CISCO as well as participation in European projects like "InGenious" and "Creative Classrooms Lab".

Estonia The Information Technology Foundation for Education (HITSA) informs and promotes the "ProgeTiger programme" for target groups (teachers and heads of schools), supports educational technologists and organises competitions, seminars and conferences.

In **Greece** the Ministry of Education participates in the "National Coalition for Digital Economy" initiative which is a multi-stakeholder partnership between the ICT industry, the education authorities and the Government committed to improve the variety, quality and quantity of ICT competences for economic growth in Greece. The General Secretary for Gender Equality coordinates a nation-wide multi-party initiative "Greek Girls Go Digital – National Action Plan for increasing female talent in digital jobs". The Computer Science School Advisors run the local "Computer Science Education Week" and "Hour of Code event" under the auspice of the Ministry. The first European Kodu Competition in Greece ran within the initiative e-Skills for Jobs 2014 that is under the auspice of the Federation of Hellenic ICT Enterprises (SEPE) and in collaboration with Microsoft. Furthermore, the Hellenic Association of Computer Science Teachers along with the WRO Hellas organize the yearly Educational Robotics Competition. Since more than six years the Ministry of Education has organised a yearly Student Computer Science Conference where students and CSE educators submit programming projects they have completed during the school year.

Ireland Two writers were commissioned by the National Council for Curriculum and Assessment (NCCA) to write the coding course. These writers were guided by NCCA executive offers, the NCCAs internal Board for Junior Cycle (which is made up of representative groups), some consultative focus groups, and finally by a wider public consultation process. The PDST Technology in Education has also collaborated with the Irish software engineering research centre "lero" for the design of Scratch courses for teachers (online and face-to-face courses).

Lithuania The Centre of Information Technologies in Education collaborates with universities.

Luxembourg There are plans to engage in collaboration activities with main actors in the field, e.g. through industry partnerships and the establishment of working groups.

Netherlands There are also here plans to engage in collaboration activities with main actors in the field, e.g. through industry partnerships and the establishment of working groups. The Ministry of Education will work together with the sector councils, schools, national media literacy organisations and teacher organisations.

Portugal The Ministry of Education works together with Microsoft and several universities promoting workshops and other activities.

UK (England) All the support provided by the Department of Education is provided via other organisations working in this area, often in partnership with industry. Groups such as Computing at School and NAACE help to shape the content of the curriculum and qualifications and advise the Department on the type of support needed by teachers to teach the new curriculum effectively.

12. Annex: Terms used for programming and coding at national level

Ministries were asked which terms they use for programming and coding if it is integrated into the curriculum.

Term used	Country
Computational thinking and programming: to be able to define a set of instructions to reach a given goal from a given starting point; to be able to write a concrete set of instructions for a computer to let the computer run a certain task.	BE (FL)
Algorithmic problem solving and programming (in the subject informatics)	BG
Algorithmic thinking: The ability to propose a step by step solution to a problem (an algorithm), consisting of a finite, clearly defined set of simple (definite, unambiguous) steps. The solution should be effective in solving the problem that it is meant for and have zero or more inputs and at least one output. part of algorithmic thinking is the ability to compare algorithms based on their effectiveness and efficiency, as well as to identify and reuse common design patterns. Προγραμματισμός **(Programming):** The ability to realise an algorithm in a computer programming language, that is to interpret the steps of the algorithm as instructions in a programming language, as a computer programme, to compile, run and debug the programme, as well as to identify and reuse common design patterns.	CY
Programming (part of the science curriculum)	DK
Digital Competence (Coding and programming are part of Digital competence)	CZ
Programming	EE
• **Coding/programming** is part of Computer science subject (in primary education) • **"Application Development in Programming Environment"** (in secondary education)	EL
Programming, Apps developing, Computational thinking	ES
Programming	FI
Langage informatique- Programming Computer language-Programming	FR
Coding	IE
Coding	IT
Programming (not Coding!) (part of IT course)	LT
• **Media literacy:** the skills and knowledge needed to use media and ICT in a successful way • **Digital literacy:** being able to use a computer and the computer skills: the skills needed to use a computer programme • **Coding:** building a computer program	NL
• **Programming** • **Coding**	NO
Programming	PL
Computational thinking	PT
Computer programming	TR
Computing	UK (England)

13. Acknowledgements

Country	Organisation
Belgium Flanders	Flemish Ministry of Education & Training
Bulgaria	Ministry of Education
Czech Republic	DZS (Centre for international services)
Denmark	National Agency for IT and Learning, Ministry of Education
Estonia	Information Technology Foundation for Education
France	Ministry of Education, Higher Education and Research
Greece	Ministry of Education - General Secretary for LLL
Luxembourg	Ministry of Education
Finland	Finnish National Board of Education
Italy	INDIRE/Ministry of Education
Ireland	Department of Education and Skills
Lithuania	Centre of Information Technologies in Education
The Netherlands	Kennisnet
Norway	Norwegian Centre for ICT in Education
Republic of Cyprus	Secondary Education Computer Science Inspectors Ministry of Education and Culture
Poland	Ministry of Education
Portugal	Directorate General for Education
Spain	Instituto Nacional de Tecnologías Educativas y de Formación del profesorado (INTEF), Spanish Ministry of Education
Turkey	Ministry of National Education
UK (England)	Department for Education

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