Algorithmic ● Programming ● Didactics

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Recommendations

for policy makers regarding the implementation of algorithms and programming in education

1 The importance of programming

> Programming is the competence of the future. It is understood as much more than just writing a program in a programming language, it is a process: from specification of the problem, through finding and developing a solution, to programming and testing the correctness or possible improvement using a properly selected application or programming language.

Today's life is inseparable from computers. Telephones, television, home automation, smart cities - all of them involve the use of computers. The huge technological progress has forced the situation in which Information Technologies, and in particular, programming become the key competence of the 21st century. Today, digitization and technology development make programming language a language of communication. We must be aware that children who are currently enrolled in school will in future perform professions that do not yet exist, and the only thing we can say about these jobs is that they will be technology based.

In order to achieve competitiveness and tangible growth, it is necessary to educate people in the most demanding sector of the future - information technology. All of the industries we know will gradually become involved in the use of software. The person of the future without appropriate knowledge in this field will depend on those who will have this knowledge. Especially for teachers the implementation will be a benefit: a basic literacy in a digital age must include an understanding of coding and the development of crucial competences to computational thinking, such as problem solving, collaboration and analytical skills.

Algorithmic and programming can enrich not only the education of digital competences, but also improve mental dispositions such as: imagination, creativity, and critical thinking. They are also an important way to teach teamwork and to build students' conviction of personal control over their own learning. As a result programming could be a link in the organization of integrated teaching - subject and cross-curricular, and an important tool for students that gives a personal sense to their learning in school.

Programming ability is recognised by the European authorities. Development of this skill is one of requirements in terms of development of key competencies. The development of Information and Communication Technologies is vital for Europe's competitiveness in today's increasingly digital global economy. Improving access, use and quality of ICTs is one of the 11 thematic objectives for Cohesion Policy in 2014-2020. European funds are to not only be seen as financial support, but also as a policy tool to support the public authorities in defining their strategy and planning their administrative and investment effort. In order to make sure that EU investments achieve maximum impact, Member States and regions that wish to use funding for ICT-related projects are required to put in place a strategic policy framework for digital growth and a next generation network plan.

2   Partner countries examples

> The situation in partners' countries varies but in each, the national authorities in the field of education understand that ICT competence has interdisciplinary status, what means that there is a need to implement it cross the curricula.

In Poland, developing digital competences of students and teachers is one of the main directions for the implementation of the national educational policy (besides safe and responsible use of resources available on the network). According to the new core curriculum, from 1 September 2017 programming is a permanent element of education since the first grade of primary school. Both the Education Law Act and the core curriculum of the subject of computer science provide for school activities to develop students' skills in using information and communication technologies efficiently.

In addition, there are many initiatives that take place in the country. One of them is the "New Year with programming" competition. It is initiative of the Ministry of Digitization that promotes learning of programing. As it is important that not only big cities are included, the Ministry has launched 16 Young Programmer Clubs in places where the offer of this type of classes is not as rich as in big cities. Young Programmer's Clubs are workshop points where free programming classes are organised. An interesting initiative is the FRSE Mobile Education Center (MCE) - a modern educational truck and teaching space for teachers who

are invited to the world of virtual learning. Among others, MCE helps in learning the basics of programming.

In Italy the Ministry of Education have been supporting projects for the introduction of technology in the classroom and their integration with traditional resources (the National Plan for the dissemination of multimedia interactive whiteboards – LIM-Cl@ssi project 2.0, iTEC path ...). The objectives are to disseminate knowledge about new models of learning and training, to equip the school guidelines for entering, at the base of teaching methods, new technologies, and to win the widespread resistance to their use, promoting interactivity between teachers and students and among students themselves.

An example of the good practice in Italy is October 2018 CODE WEEK 4 ALL – with more than 20,000 events organised (more than in any other European country) + *codenanoMOOC* released by the University of Urbino 'Carlo Bo', located in Emilia Romagna region.

In Latvia, in 2015, in order to develop pupils' ICT skills, a new subject "Computer Science" was introduced and a pilot project on Computer skills was launched, involving more than 150 schools. Digital competence is one of the foundations of the new content of competence training. Teaching of computer skills in schools began to be taught from grade 1 (7-year-olds). Its content is in line with the development trends of the computer industry, which promotes the development of the learner's knowledge and the development of practical skills (competencies) in computer science, which are needed in diverse life situations for obtaining, processing, analysing and developing information, as well as for efficient use of information and communication technology in the learning process. From the age of 7, pupils learn algorithms, solve tasks based on logical thinking. At primary school, students learn the Scratch visual programming environment and textual programming languages. In the last years of primary school, 50% of computer content is algorithm tasks and programming.

Teacher survey data show that more than 4/5 teachers rated the pilot project positively. It is especially important that teachers see the great benefit of computer science in the acquisition of other subjects - more than half believe that computer science helps pupils to learn other subjects more successfully.

Examples of experience include Computers Pilot Project in years 2015 – 2018 which involved 150 schools, European programming week in October 2018, Participation of Latvian

students in European and World Informatics (Programming) Olympiads where 3 Bronze Medals in 2018 were awarded to Latvian students.

For Romania, year 2000 was the year in which the Romanian Ministry of Education had the first strategy to develop the initial and continuing training system for teachers and managers in pre-university education. The continuous training of the teaching staff is a right that is achieved mainly through professional development and conversion. The continuing education programs, including ICT, of the teaching staff are organized modularly. Continuous training ensures the updating and development of teachers' competences, including the acquisition of new competencies, in line with developments in the educational needs and educational curriculum as well as the requirements for adapting the teaching staff competences to the changes in the structures / processes of education.

One of the example initiative in Romania is Hour of Code, which is possible thanks to ADFABER, the only Romanian NGO that promotes community development and social change through technology. Hour of Code represents an introduction to technology and programming. Beneficiaries are students and anyone can be a supporter. Everyone, even a beginner, can learn the basics of programming.

3   Recommendations for policy makers

> Two years' work within CodeIT project shows that currently one of the most important challenges of today's schools is introducing the basics of programming from the beginning of school education and what comes with that, teacher education and training.

The following activities in the area of competence development of teachers and students are recommended:

- treating algorithmic and programming as the fourth competence of modern man, next to reading, writing and calculating
- adopting a definition of programming understandable for teachers and students of early school education thanks to which the developed methodology for implementing programming science in schools for teachers and students would divide the education process into basic and substantively justified pedagogical stages
- using of reference standards for equipping classrooms with computer equipment:

- o reference applications (off-line and on-line)
- o reference teacher training courses
- o reference tasks / scenarios

- developing digital competences and the appropriate education of teachers and students understood as actions leading to specific educational goals, and at the same time as states being the result of all student activities both at school and outside of school

- developing digital competences and training through action, including collaboration in a group - with particular emphasis on manual and motor activities, including programming learning

- including sensory-motor classes using appropriately selected sets to learn the basics of programming

- experiencing and experimenting with the use of teaching aids for various subjects, including music, nature and languages

- developing digital competences and problem education by solving theoretical (child-like) and practical problems using the basics of mathematics and algorithms based on the child's critical thinking

- assuring usage of digital contents, learning objectives, serious games, alternate reality games, digital platforms for sharing practices of edutainment

- assuring that the above mentioned tools are instruments of systematic and non-episodic experiences