AN OVERVIEW OF COMPUTING AND INFORMATION TECHNOLOGY CURRICULA IN ROMANIAN HIGH-SCHOOL EDUCATION

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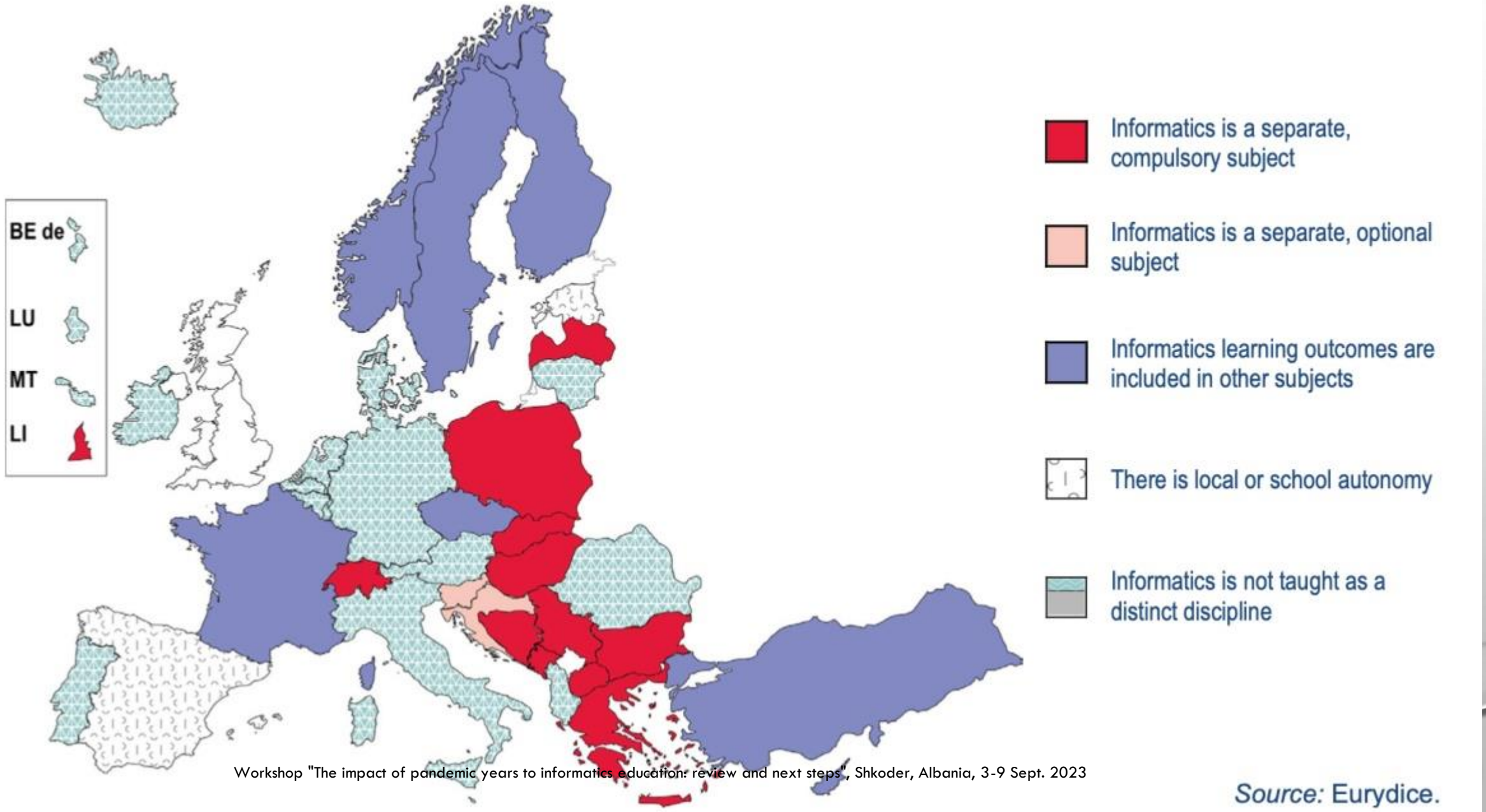
ISSUES

- Different levels of knowledge for university candidates
- No math knowledge (problem solving, abstraction, logic) for human profile candidates (no prerequisites for admission)
- Dislike (repulsion) of computer science for math-info profile candidates
- Boreness and/or superiority of some math-info profile candidates
- Differences in rural/urban teaching in high schools
- Differences in teaching for math-info profile children in same classes – national/international contest preparing versus carelessness for the rest

STATE-OF-THE-ART

- In Romania - intensively taught IT in middle school and high school
- Among the countries with the most hours of teaching IT
- Emphasys on fields gradually losing their importance, without giving any interest of fields considered increasingly relevant and necessary for children (Eurydice European network report)
- Primary school level – not in Romania
- IT - separate compulsory subject, while in many European countries - integration with other subjects

Figure 1.1: Informatics in the curriculum of primary education (ISCED 1), 2020/2021



Source: Eurydice.

SECONDARY SCHOOL

- Romania + a group of predominantly Central and Eastern European countries = informatics taught as a separate compulsory subject

- The vast majority of Western countries = the system of teaching informatics elements within other subjects

HIGH SCHOOL

- Romania + Czech Republic, Greece, Bosnia-Herzegovina and Serbia = the countries with the largest number of hours of IT&C as a separate compulsory subject

- Western countries include this subject mostly as part of other subjects or as optional

FIELDS COVERED

- The Eurydice analysis -10 major IT areas covered in European schools
- Romania - only the basic elements, included in 6 of the 10 fields
- The Eurydice report - over time, elements that were once considered highly relevant to school teaching (i.e. related to networks or operating systems) are now less relevant
- Other more recently developed areas (interaction with IT, safety and security) - much more relevant with the expansion of the Internet and digital technologies
- In Romania, the emphasis - still on the basic elements, with decreasing importance, while the new ones - absent from the curriculum

AREAS COVERED

1. Data and information: in Romania - only in high school, most countries - middle school and high school
2. Algorithms: in Romania - middle school and high school, 9 countries similar, 10 other EU + 6 non-EU - in all cycles
3. Programming: in Romania - middle school and high school, like 10 other countries, 16 - in all cycles
4. Computer systems – in Romania - middle school and high school
5. Networks - in Romania - middle school and high school
6. Safety and security: In Romania - gymnasium and high school (like 9 other European systems), while in 15 European countries - in all cycles.

AREAS NOT COVERED

7. Human-system interfaces – Romania – nothing, 14 European countries - yes, and in Greece, Croatia and Hungary - from primary school
8. Design and development - in Romania no, in 17 European countries yes, in Greece, Poland and Turkey -in primary school classes
9. Models and Simulations - in Romania no, in 18 European countries yes, and in Bulgaria, the Czech Republic, Greece, France and Slovenia - from primary school
10. Awareness of how technology affects the person and society: in Romania no, in the vast majority of European countries yes, in a quarter of them - from primary school

HIGH SCHOOL EDUCATION

- Development and diversification of key skills and on the training of specific skills depending on the field, profile, specialization or qualification.
- It includes the following branches and profiles:
  - **Theoretical stream (humanist and real profiles)**
  - **Technological chain** (technical profiles, services, natural resources and environmental protection)
  - Vocational stream (military, theological, sports, artistic and pedagogical profiles)

Theoretical stream – real profile

	IXth grade	Xth grade	XIth grade	XIIth grade
Mathematics	4	4	4	4
Communication and Information Technology	1	1	0	0
Informatics	2	1	4	4

REAL – NATURAL SCIENCES

	IXth grade	Xth grade	XIth grade	XIIth grade
Mathematics	4	4	3	3
Communication and Information Technology	1	1	2	1
Informatics	2	1	0	0

HUMAN - PHILOLOGY

	IXth grade	Xth grade	XIth grade	XIIth grade
Mathematics	2	2	0	0
Communication and Information Technology	2	1	1	1
Informatics	0	0	0	0

HUMAN – SOCIAL SCIENCES

	IXth grade	Xth grade	XIth grade	XIIth grade
Mathematics	2	2	2	1
Communication and Information Technology	2	1	1	1
Informatics	0	0	0	0

TECHNOLOGICAL

	IXth grade	Xth grade	XIth grade	XIIth grade
Mathematics	2	2	2	2
Communication and Information Technology	1	1	1	1
Informatics	0	0	0	0

REAL – MATH-INFO TOPICS - IXTH GRADE

- Definitions – Informatics, Data, Programming Language, Algorithm, Etc.
- Algorithm Representations
- Elementary Algorithms - Processing Integers (Sum Digits, Testing the Palindrome Property etc), Divisibility Problems, Calculation of Simple Expressions (Sums, Products, etc.), Processing of Sequences of Values (Minimum/Maximum Determination, Checking a Property, Generating Recurring Strings
- Fundamental Algorithms for Array Data Processing - Sequential and Binary Search, Sorting etc.
- Text Files. Definition, Specific Operations. Binary Files
- **C/C++ As Programming Language**

REAL – MATH-INFO TOPICS - XTH GRADE

- Structured Data Types - Character Strings, Structures etc.
- Dynamically Allocated Data Structures (Linked Lists, Doubly Linked Lists, Circular Lists, Stacks, Queues)
- Subroutines - Declaring, Defining and Calling Subprograms, Transfer of Parameters to the Call etc, Recursive Subroutines
- Fundamental Data Processing Algorithms -Processing Strings of Characters, Using Specific Subprograms, Processing a Record/Structure etc.

REAL – MATH-INFO TOPICS - XITH GRADE

- Dynamically Allocated Data Structures - Undirected and Directed Graphs (Special Types of Graphs; Complete Graph, Hamiltonian Graph, Eulerian Graph, Bipartite Graph, Representation of Graphs: Adjacency Matrix, Lists of Adjacency, Edge List, Cost Matrix, Graph Processing Algorithms)
- Tree Data Structures - Rooted Trees - Definition, Properties, Representation, Binary Trees, Special Types of Binary Trees, Heaps
- Programming Methods - Greedy, Backtracking, Divide Et Impera, Dynamic Programming
- Analysis of the Efficiency of an Algorithm
- **Elements Of Object-Oriented Programming**

REAL – MATH-INFO TOPICS - XIITH GRADE

- Databases. Database Management Systems

- Web Programming – HTML, CSS

COMMUNICATION AND INFORMATION TECHNOLOGY SYLLABUS

- Computers – Definitions, Components, Functionning
- Networks
- Operating Systems
- Windows
- Internet
- Word
- Excel
- Powerpoint
- Access

ECDL

HIGH SCHOOL TEACHING

- High Differences in Urban/Rural Teaching – Non-IT Specialists Teaching IT
- Low Motivation for Well Prepared IT Graduates In Accessing a Secondary or High-school Teaching Job (Low Salary, Stress, Poor Working Environment, Political Interference etc)
- Differences in Teaching at the Same Grade – Interest for Students Participating in Contests vs Neglection of the Rest
- In Fact, No Interest in Teaching Math and CIT at Human Profiles

CHALLENGES

- Gather Interest of Highly Prepared Candidates
- Adapt Topics for Average Candidates
- Correct Misunderstood Concepts
- Prevent Abandon in the First University Year
- More Efficient Advertising in High Schools

SOLUTIONS?

- **Ministry of Education**
  - Update and Simplify the Syllabi for Informatics
  - More Informatics for Human and Technological Streams
  - New Methods for Teaching Informatics in High Schools, programs for training teachers
  - Elimination of Bureaucracy and a Different Teacher Evaluation
- **Ministry of Labour**
  - An Appropriate Salary Scale
  - Stimulents for Teachers from the Rural/Small City Area
- **University**
  - Closer Connection with High Schools
  - More Flexibility in Teaching