OCCE 2021 DTEL

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Informatics curricula in Nordic and Baltic countries

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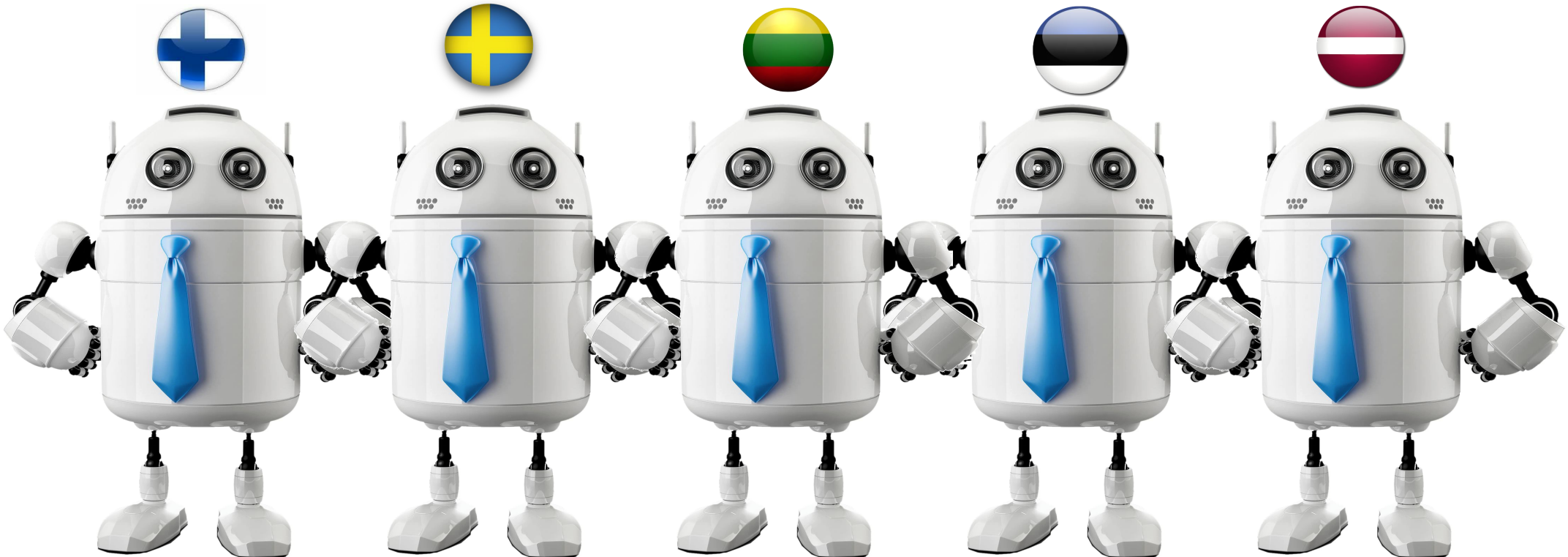
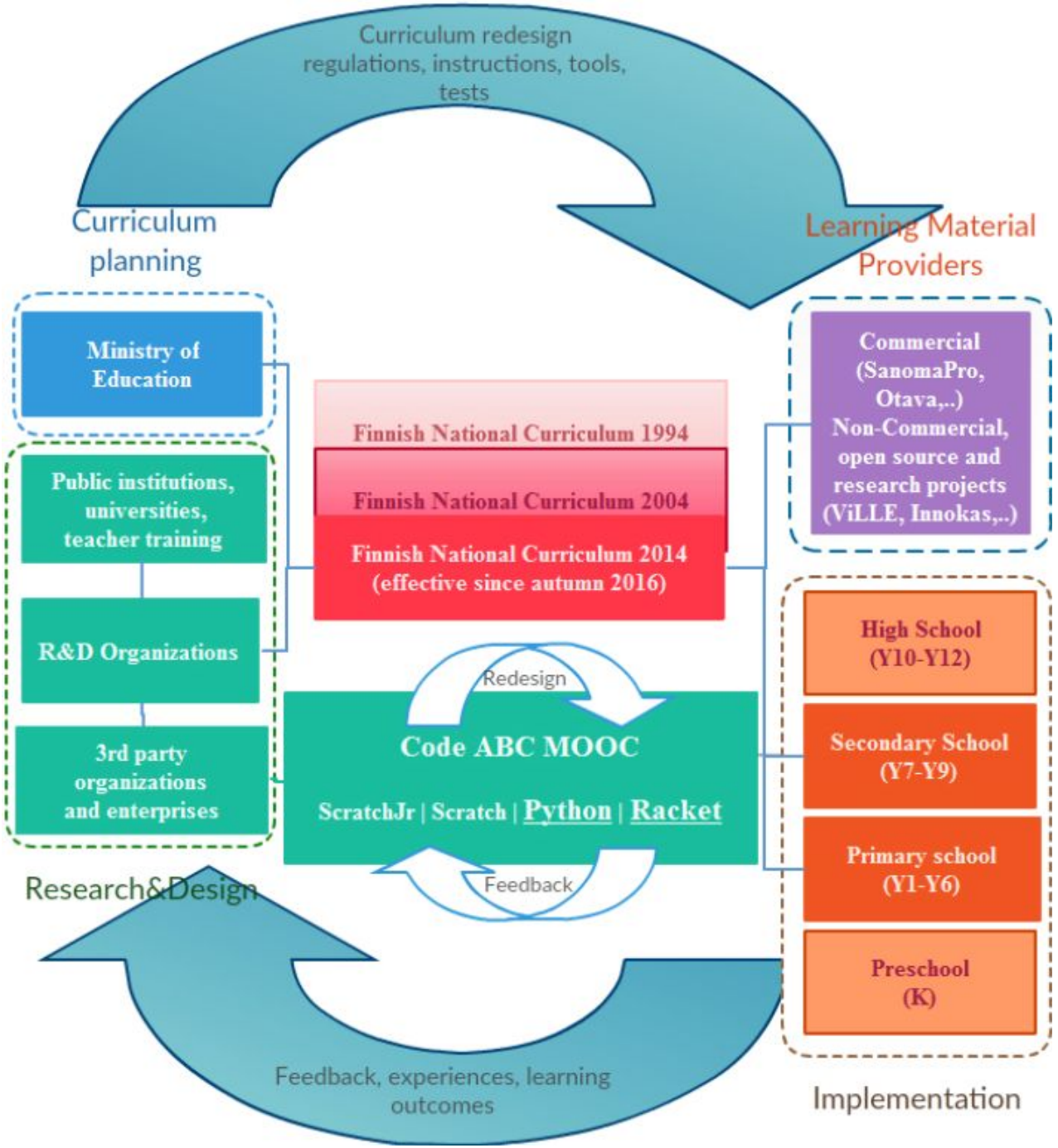


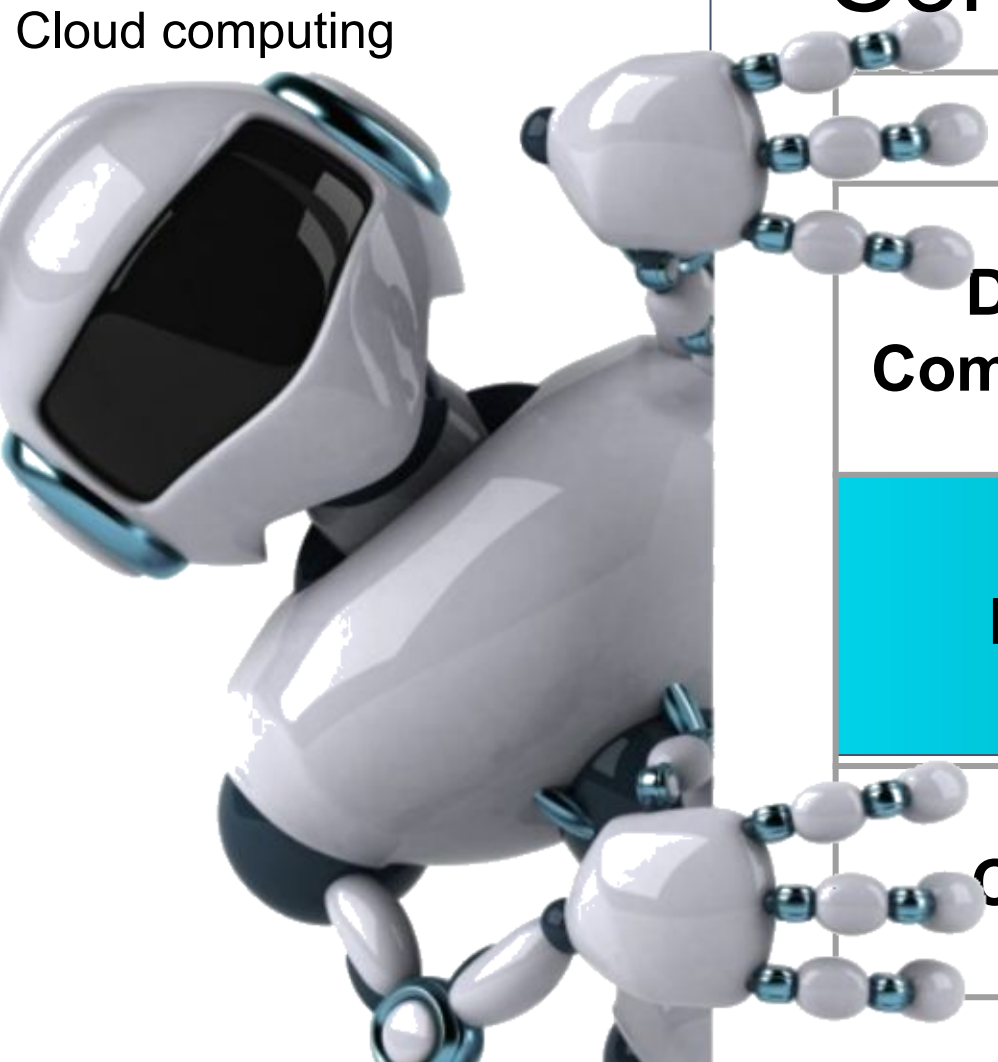
FINLAND

Computational thinking in the Finnish National Curriculum 2014



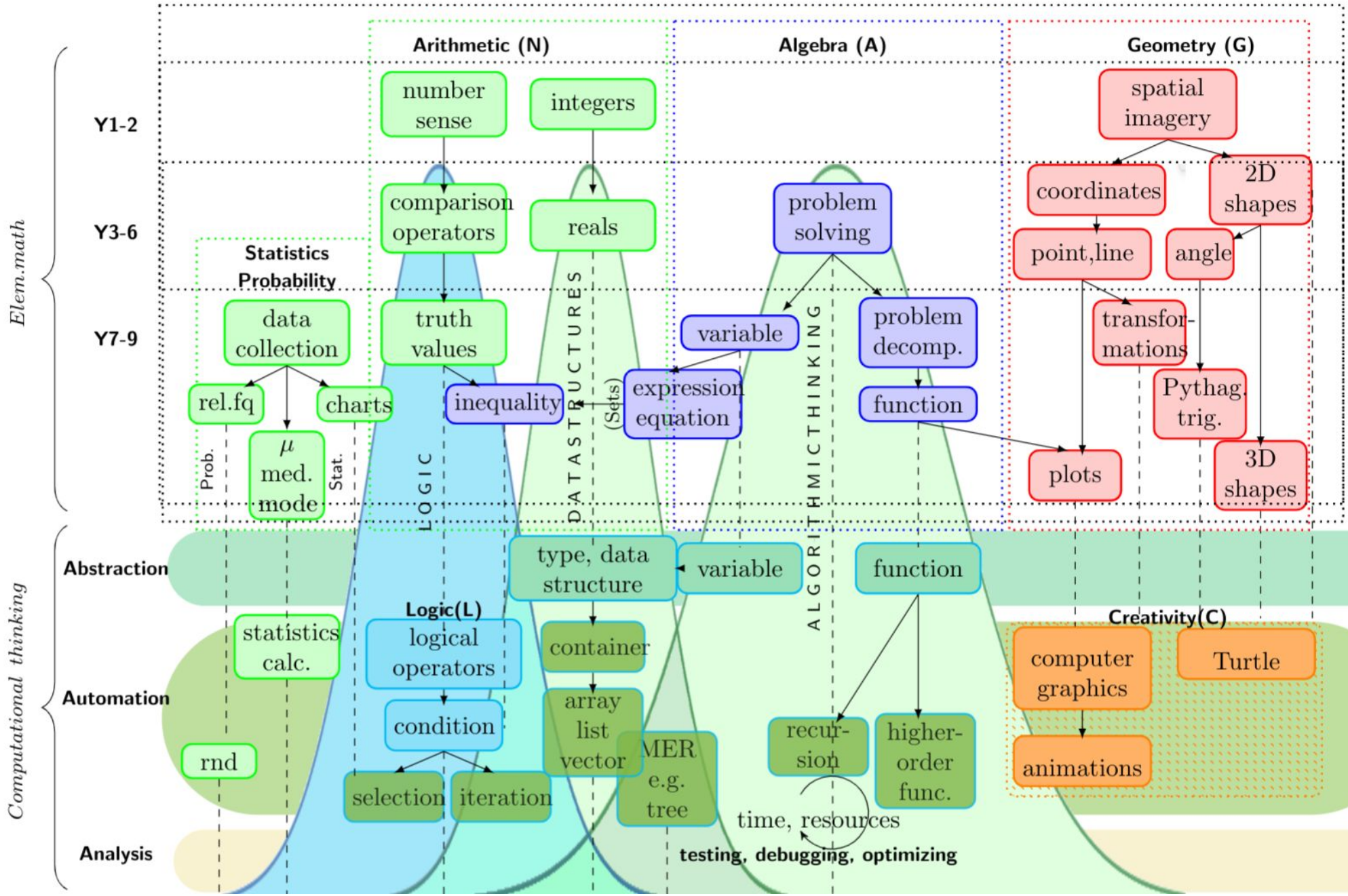
Curriculum development in 10 year cycles 1994-2004-2014

Emerging new technologies, e.g:
Machine learning
Artificial intelligence
Internet of Things
Robotics
Cloud computing



Digital Skills Gap and 2014 Finnish National Curriculum (FNC) with Computational thinking

	Years 1-2	Years 3-6	Years 7-9
Digital Competence	**Using digital media**	**Noticing impacts of computer science**	**Integrating computer science in other subjects**
Math	**Step-by-step instructions**	**Visual programming**	**Logic + algorithms, good programming conventions**
Crafts		**Robots, automation**	**Embedded systems, own artifacts**



2014 FNC Math
and learning trajectories of:

Logic

- Equations, inequalities,
- truth values

Data structures:

- Different kinds of numeric data, such as integers and floats
- Sets and tables

Algorithms

- Problems solving by decomposition
  - functions as
  - building blocks

Niemelä 2018:
From legos, and logos to lambda

Programming in School books

Scratch in primary/Python in secondary

sanoma pro

40-50% of students get their material from SanomaPro
In primary, Kymppi with Scratch
In secondary, Kuutio/Muuttuja with Python

otavamedia

30-40%
In primary, Tuhattaituri and Oivaltaja with Scratch
In secondary, Pii with Excel, HTML, and Geogebra

EDITA

Säde series for secondary math, uses both Scratch and Python

OPPI

Digital material especially for enhancing secondary math with Processing programming https://www.e-oppi.fi/sarja/ohjelmointia-matematiikkaan/

ViLLE

All-contained Learning Management System (LMS) with scaffolded math and programming exercises, Python programming language for 17 weeks to complete (two 45min lessons per week); Computational thinking is a new emerging area

... “Tie koodariksi”, Python courses of LUMATIKKA, MAOL programming materials University of Helsinki Java course for primary school students. Aalto University MOOC course for high school students

Sweden

Computational thinking in the

Swedish National Curriculum, published 2011, revised 2018

The curriculum revision in 2018

- Available since 2017, mandatory since August 2018
- teachers should enable students to
  - make use of digital tools
  - enhance students' knowledge and skills in programming
    - Y1-3, unplugged activities, step-wise instructions, in technology, controlling tangible objects via programming
    - Y4-6, visual programming, e.g., in mathematics
    - Y7-9, different programming environments for algorithms in mathematical problem-solving

A new national strategy and action plan for the digitalisation under construction: the vision for 2022 is that all children will develop adequate digital skills.

Focus of the revised 2018 curriculum

The new curriculum stipulates 4 main goals for students' digital competence:

1. to understand the digital transformation of society and how it affects us
2. to be able to use digital tools and media
3. to be critical and develop a responsible approach to digital technology
4. to learn to put one's own creative ideas into action and learn how to solve problems.

Sex lektioner för Matematik och Teknik årskurs 7-9

Programmera ett övergångsställe

I lektionen programmeras en algoritm för att styra trafikljus i en korsning. Eleverna får skapa en praktisk applikation och lära sig att skapa och modifiera algoritmer.

Av: Måns Jonasson

Åk 7-9 MATEMATIK PROGRAMMERING TEKNIK

Tekniska lösningar inom kommunikations- och informationsteknik för utbyte av information

I lektionen lär sig eleverna om internet och andra tekniska globala kommunikationssystem och verktyg.

Av: Måns Jonasson

Åk 7-9 PROGRAMMERING TEKNIK

Slump och statistik med Scratch

I lektionen simuleras hundratals tärningskast på kort tid. Eleverna får skapa en statistikapplikation och lära sig att skapa och modifiera algoritmer.

Av: Måns Jonasson

Åk 7-9 MATEMATIK PROGRAMMERING

Programmera ett dörrlarm

Lektionen handlar om att låta eleverna programmera algoritmer för att de ska lära sig styra tekniska system och öva på programmering i teknik.

Av: Måns Jonasson

Åk 7-9 PROGRAMMERING TEKNIK

Programmera ett kärnkraftverk

I lektionen programmeras en algoritm för att styra processen i en reaktor i ett kärnkraftverk. Eleverna får skapa en praktisk applikation och lära sig att skapa och modifiera algoritmer.

Av: Måns Jonasson

Åk 7-9 MATEMATIK PROGRAMMERING TEKNIK

Algoritmer för geometriska uträkningar och mönster

Lektionen ska ge eleverna ökad förståelse för algoritmiska mönster och geometri inom matematiken genom att öva på programmering.

Av: Måns Jonasson

Åk 7-9 MATEMATIK PROGRAMMERING

Digital competence includes also

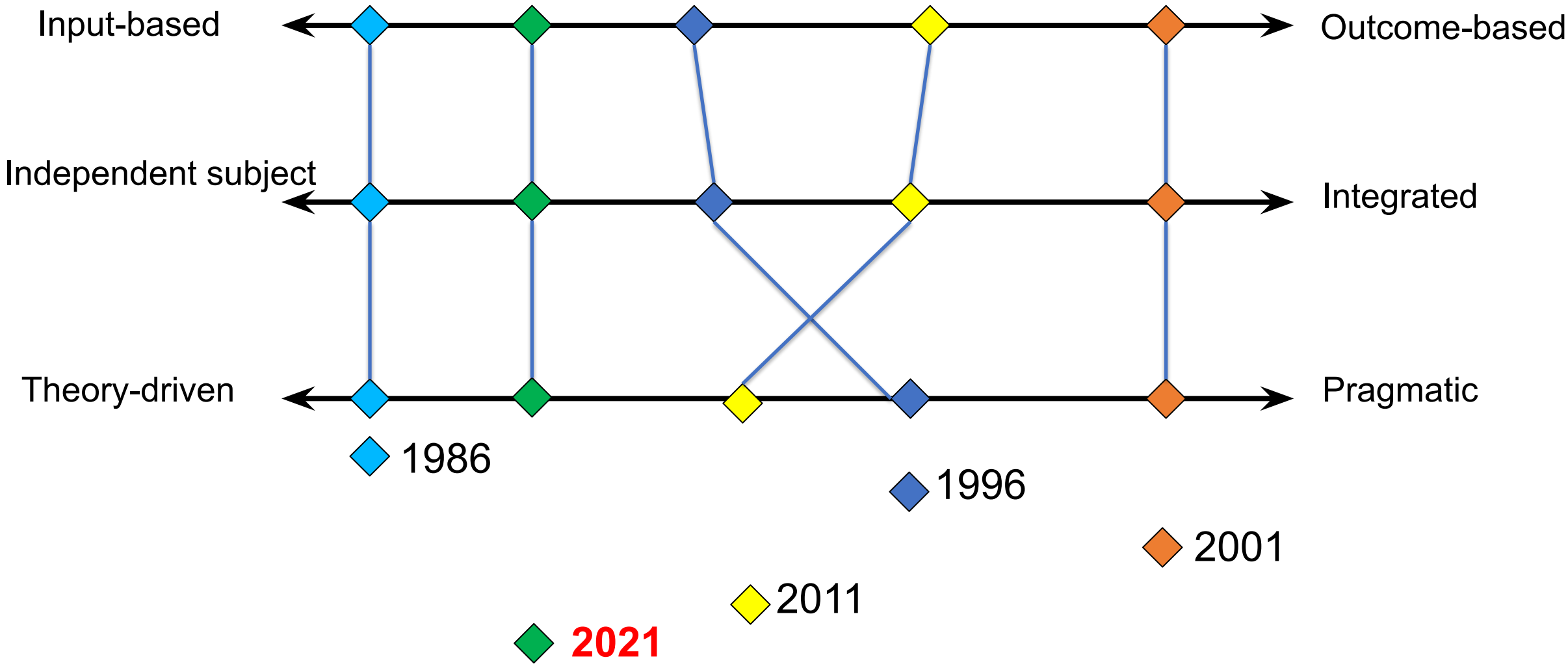
- Aspects of digital literacy,
  - such as the importance of
  - source criticism (käll kritik) and fact checking
- Safe use of Internet
  - By being aware of security threats as well as the attempts of manipulation and propaganda
- Technological fluency
  - With digital devices and applications

@After school: https://www.youtube.com/watch?v=09maaUaRT4M

Baltic countries

- All three countries started to reform Informatics education
  - shift from IT to Informatics

Informatics curriculum change dimensions: the pendulum



Informatics Education in Lithuania

Reformed Informatics curriculum in schools in Lithuania:

- Integrated in grades 1-4
- Mandatory in grades 5-10 (approx. 1 h per week)
- Selected in grades 11-12

Six areas of Informatics achievements (aligned to DigComp)

Informatics Education in Lithuania

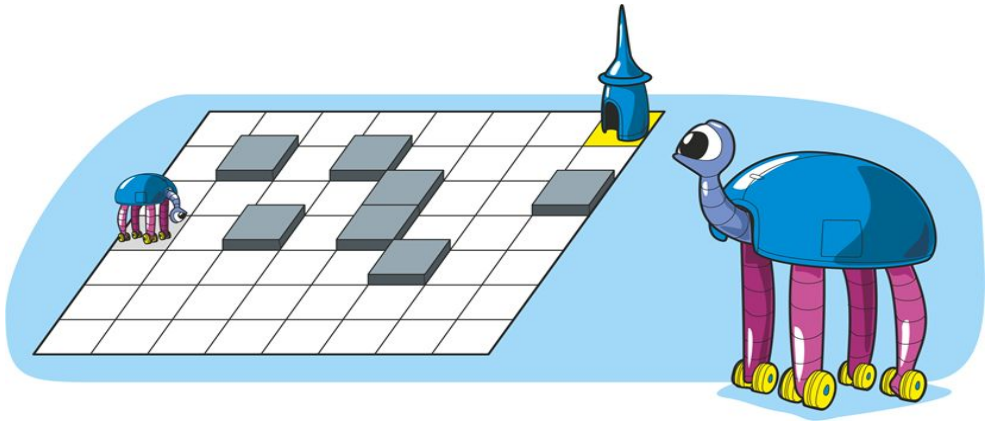
Algorithms & programming	• Understand the benefits of an algorithm, a program, recognize and use informatics concepts • Apply programming commands, logical operations and call programming interfaces (APIs) • Create (code) and execute programs • Detect bugs, test and improve programs. Use IDEs
Data mining & information	• Understand the importance of data and information, make data analyses • Perform various actions with data: collect, store, group, search, visualize • Evaluate relevance and reliability of information
Digital content creation	• Know various digital content for learning, recognize concepts • Create various digital content: draw, write, compose, record, film, create mind maps, tables, diagrams • Evaluate and improve, shares digital content

Informatics Education in Lithuania

Technical problem solving	• Investigate hardware, see problems arising from the use of digital technologies, use properly technical concepts • Select and combine various digital technologies • Self-educate and self-evaluate own digital skills
Virtual communication & collaboration	• Collaborate, share experiences and resources, communicate using digital technologies • Assess the dangers of virtual communication, protects software and hardware
Safety	• Protect health and environment • Behave safely in virtual space

Informatics Education in Lithuania

Robot should reach the Tower by walking from square to square.



The programmer has made a program out of movement direction commands marked by arrows:

→ ↓ → → → ↓ → → ↑ ↑ ↑ ← ↑ ↓ → →

However, he made a mistake. The program can be corrected by rotating one of the arrows. Fix it.

V. Dagienė. THINK and CREATE

Pilot "Informatics in primary schools"
(2017-2022)

- 1-4 grades
- Integrated source
- Piloting in 100 schools (out of 400)
- Many schools have implemented

Educational statistics of Estonia

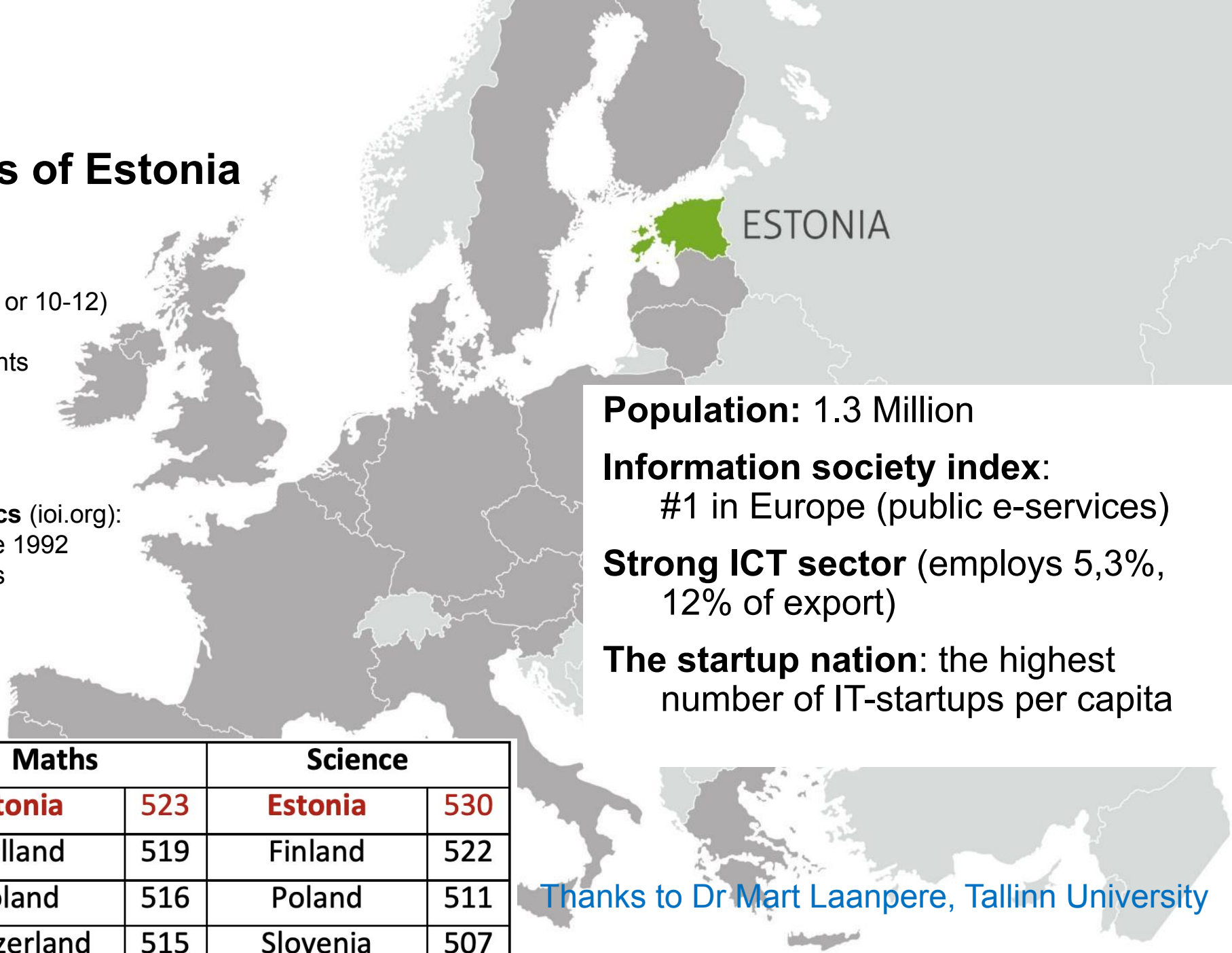
Number of schools: 530, including:

- 351 basic schools (grades 1-9)
- 143+21 high schools (grades 1-12 or 10-12)

50% of high schools have <100 students

Number of students (K-12): 143 713
Number of teachers (K-12): 14 581

International Olympiad of Informatics (ioi.org):
- Estonia participated 26 times since 1992
- 5 gold, 19 silver, 32 bronze medals



Population: 1.3 Million

Information society index:
#1 in Europe (public e-services)

Strong ICT sector (employs 5,3%, 12% of export)

The startup nation: the highest number of IT-startups per capita

OECD PISA 2018: #1 in Europe

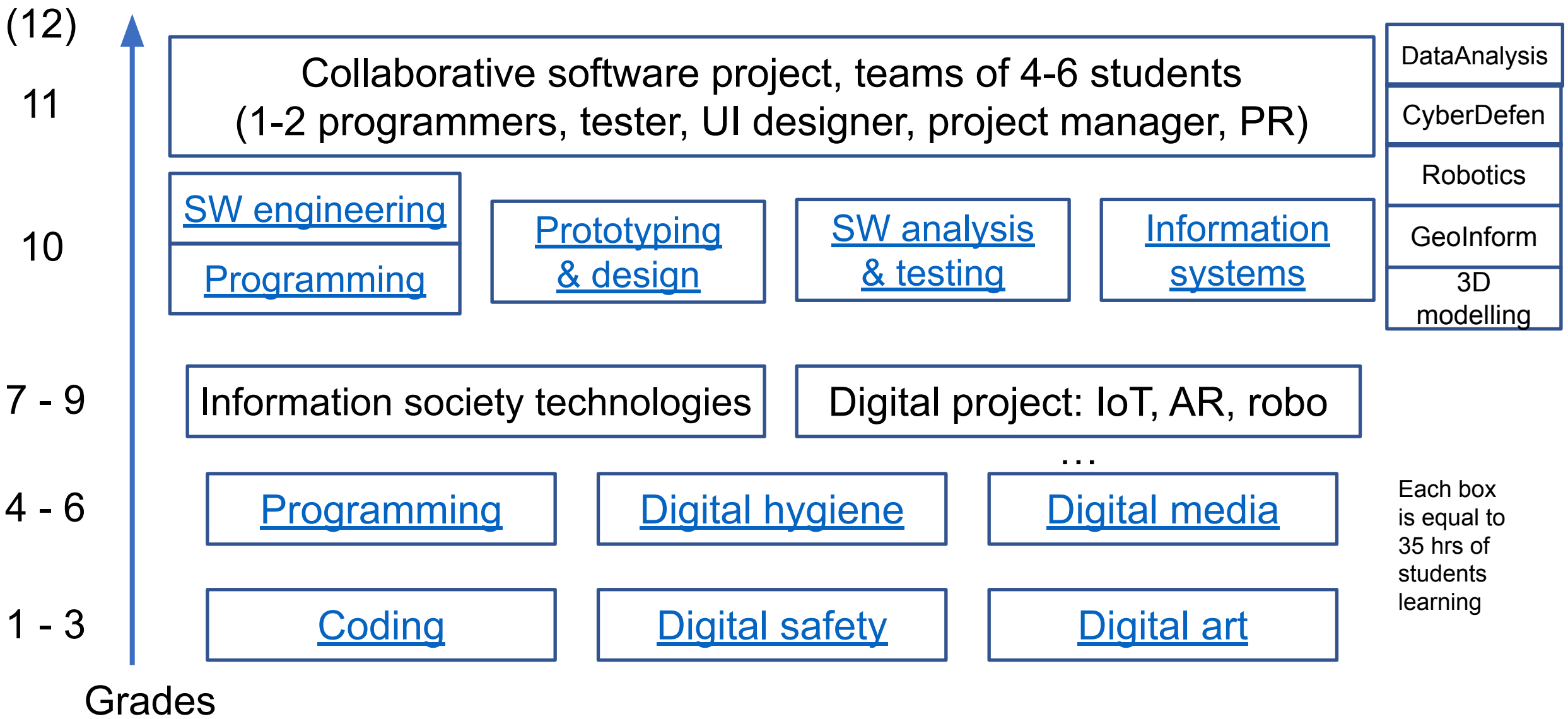
	Reading		Maths		Science	
1	**Estonia**	**523**	**Estonia**	523	**Estonia**	530
2	Finland	520	Holland	519	Finland	522
3	Ireland	518	Poland	516	Poland	511
4	Poland	512	Switzerland	515	Slovenia	507

Thanks to Dr Mart Laanpere, Tallinn University

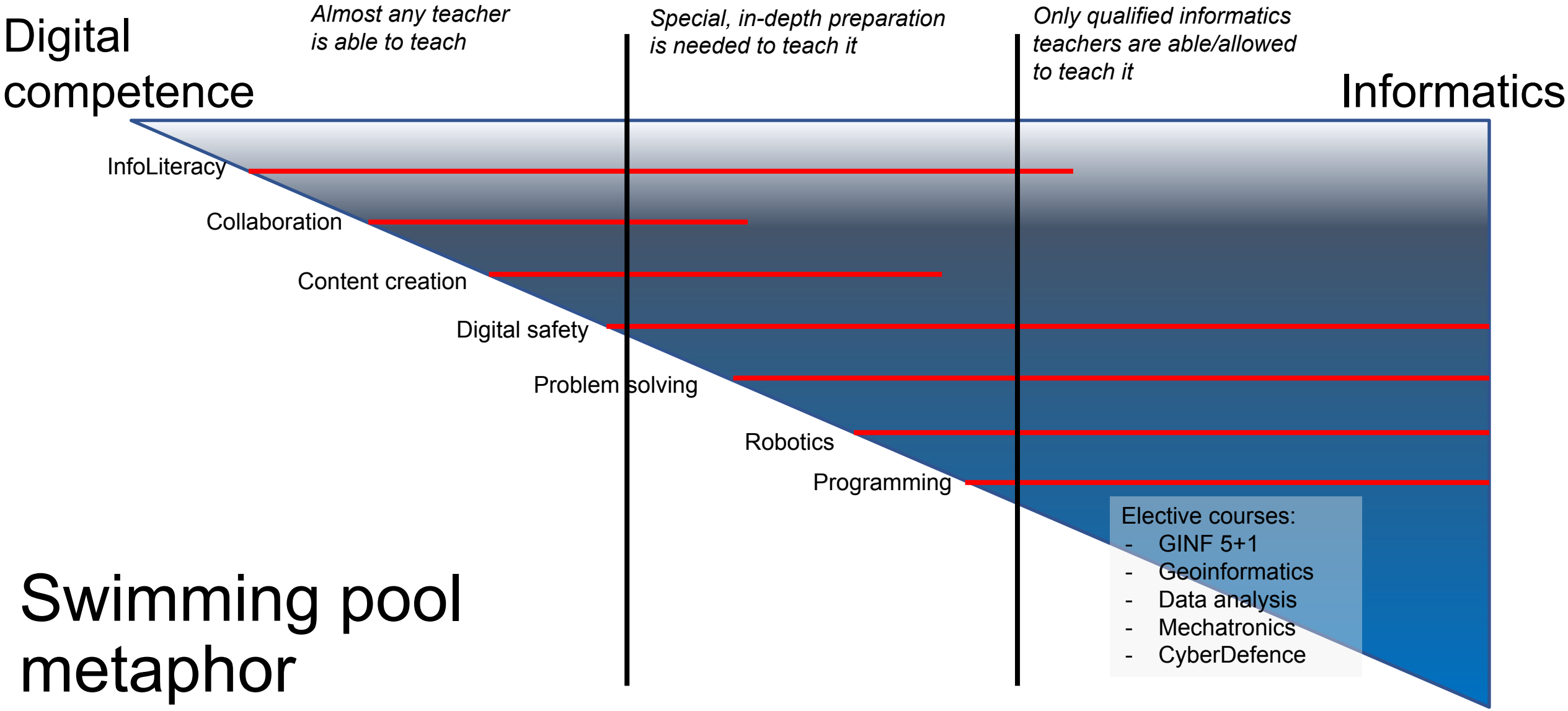
School informatics in the independent Estonia

- **1991-1996**: no curriculum, complete freedom, many schools continued to teach programming, some tried new ideas (web, multimedia)
- **National curriculum 1996**: informatics as an optional subject in grades 10-11, 4 courses (text, spreadsheet, database, internet); IT as cross-curricular theme
- **National curriculum 2001**: no separate subject of informatics, IT and media as cross-curricular theme, national test on ICT skills in Grade 9
- **National curriculum 2011**:
  - 2 **optional** informatics courses (35h) with standardised curriculum in grades 5 and 8;
  - 5 **optional** courses in grades 10-12 (data analysis, coding, robotics, geoinformatics, 3D)
  - cross-curricular themes “Technology & Innovation” and “Knowledge environment”
- **Proposed changes in 2023**: turn towards computer science
  - Coding, robotics, digital safety, digital media topics in Grades 1 - 6
  - Software project in Grade 11, preceded in Grade 10 by 1-2 optional courses (Coding 1&2, Software analysis and testing, Prototyping and design, Information systems)

The new informatics curriculum for K-12 (2020)



Swimming pool metaphor



Seven new e-textbooks in G10-11 informatics

- University of Tartu:
  - Programming: web.htk.tlu.ee/digitaru/programmeerimine/
  - Software development: web.htk.tlu.ee/digitaru/tarkvara/
- Tallinn University:
  - User-centric design and prototyping: web.htk.tlu.ee/digitaru/disain/
  - Software analysis and testing: web.htk.tlu.ee/digitaru/testimine/
  - Digital Hive (software project): web.htk.tlu.ee/digitaru/digitaru/
- TalTech:
  - Information systems: web.htk.tlu.ee/digitaru/digiteenused/
  - Cyber defence: web.htk.tlu.ee/digitaru/kyberkaitse/

Platform: Wordpress + Pressbooks plugin + H5P interactive exercises

Latvia: Informatics Education

From 2020, schools in Latvia gradually started introducing curricula based on the new standards of primary and secondary education

The most significant changes in **basic education**:

- a new subject - Technology field, which includes the following subjects:
  - Design and Technology (in grades 1-9);
  - Computer Science (in grades 1-9, including integrated Informatics in 1-3 grades);
  - Engineering (in 7th grade).

At **upper-secondary level** is an opportunity to take courses as

- Computer Science,
- Design and Technology I (basic course) and II (advanced level),
- Programming I and II.

Thanks to Viesturs Vezis, Latvia University

Informatics is under Technology subject

Grades 1-3 - formally integrated, but in fact depends on choice and facilities of schools

Grades 4-6 separate subject *Informatics* (total – 105 hours)

Grades 7-9 separate subject *Informatics* (total – 175 hours)

Grades 10-12 *Informatics* (total – 70 hours) or school may offer:

- *Programming I* incorporating the content of the object of the item (total 210 hours)
- Design and *technology I* include the content of the object of the item (total – 210 hours), but the acquisition of the Computer content might be dicutable

In addition for grades 10-12 schools may offer:

- *Programming II* (total 210 hours)
- Robotics (total — 140 hours)
- Digital design (total — 140 hours)

Thank you!