

Computational Thinking \neq Programming

The Rise of the Digital Polymath

Prof. Dr. Alexander Repenning

n|w

Hochschule Nordwestschweiz
Technische Hochschule

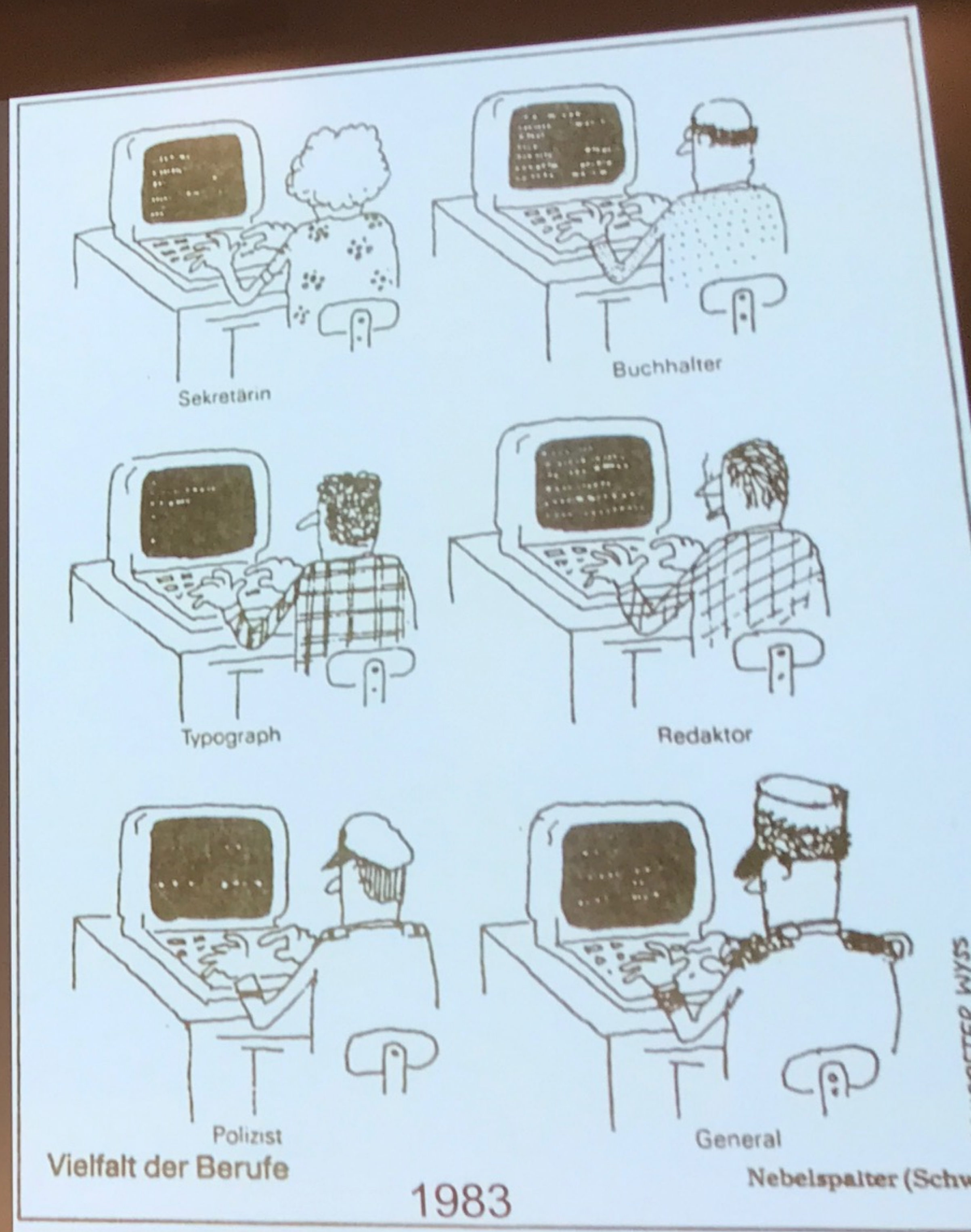


Horror Vision

35 years ago ...

“The variety of jobs”

– Hanspeter Wyss, Nebelspalter





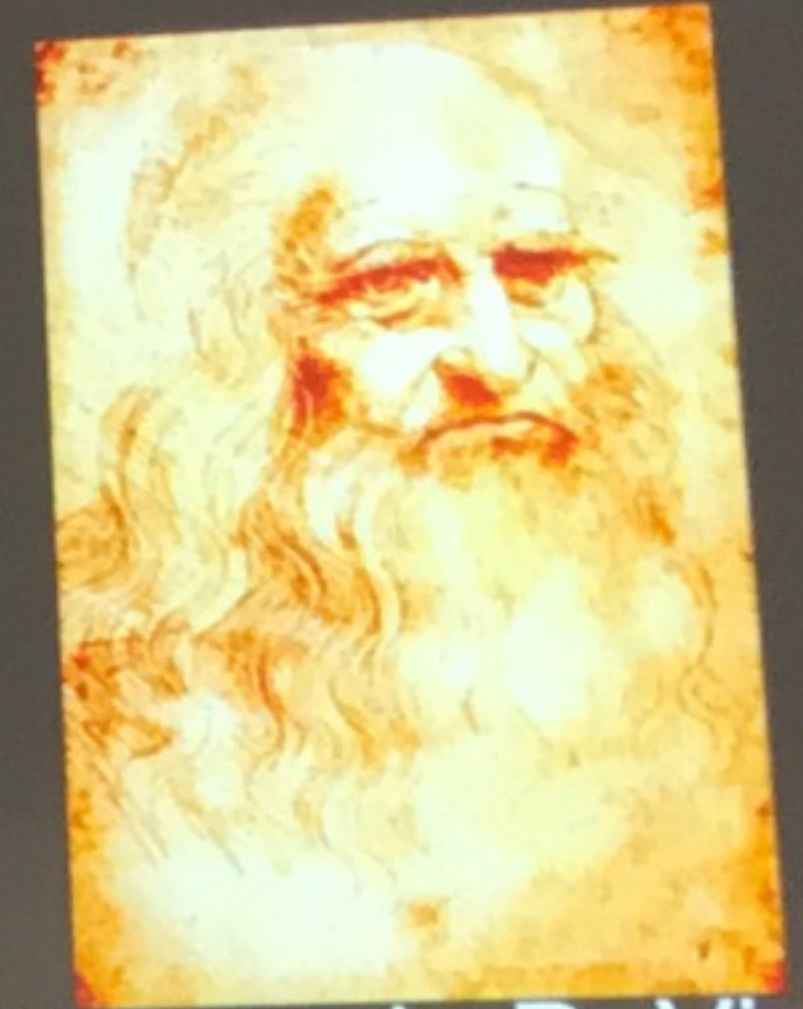
Technology and Education

Time Travel

Renaissance Polymath

Person able to draw on complex bodies of knowledge from different subject areas to solve difficult problems

- Greek: polymathēs, “having learned much”
- Latin: homo universalis
- German: Universalgelehrter



Leonardo DaVinci



Hildegard von Bingen

1760-1820 Industrial Revolution

The Industrial Revolution has launched public education but has popularized ***specialization*** rather than ***discipline integration***



- This concept has remained so until the 21st century
- Students today have great difficulty with independently ...
 - ... connecting knowledge between disciplines
 - ... deepening knowledge within discipline



***The Digital Revolution
eats the grandchildren
of the Industrial
Revolution***

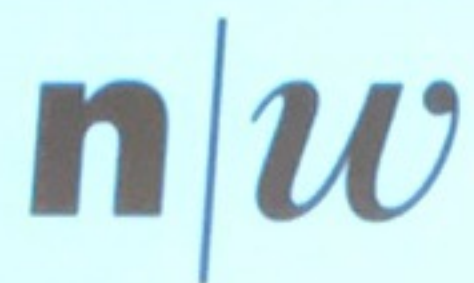


Digital Polymath

	Renaissance Polymath 	Digital Polymath 
Competencies	Has expert-level competencies in many disciplines	Meta-Competence: Has competence to acquire new competencies Peripheral perspectives of many disciplines including the attitude and ability to deepen knowledge—just in time—through the use of digital tools
Problem Solving Skills	Connects knowledge from different disciplines to solve problems	Computational Thinker: can <i>think with a computer</i> combines human skills with computer affordances to connect knowledge from different disciplines.

Computer Science Education

PH FHNW

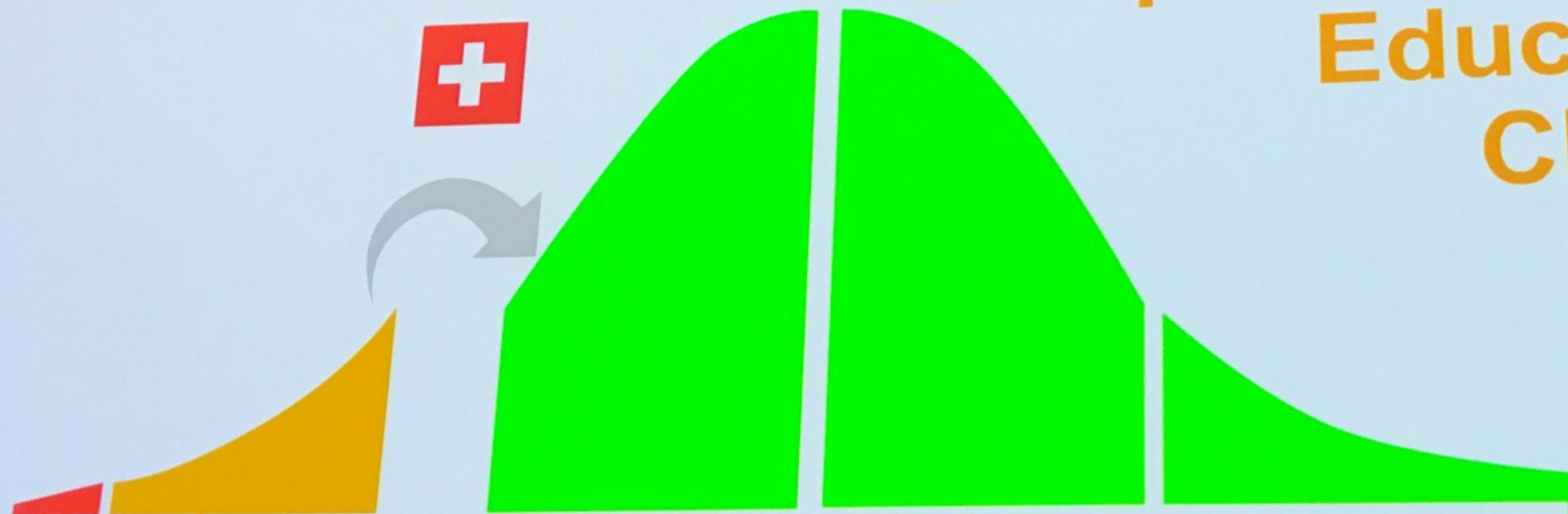


Fachhochschule Nordwestschweiz
Pädagogische Hochschule

Mandatory
Pre-service
Teacher Education



Crossing the Computer Science Education Chasm



Stage I Self-Selected Students / Self-Selected Teachers

Stage II All Students / Self-Selected Teachers

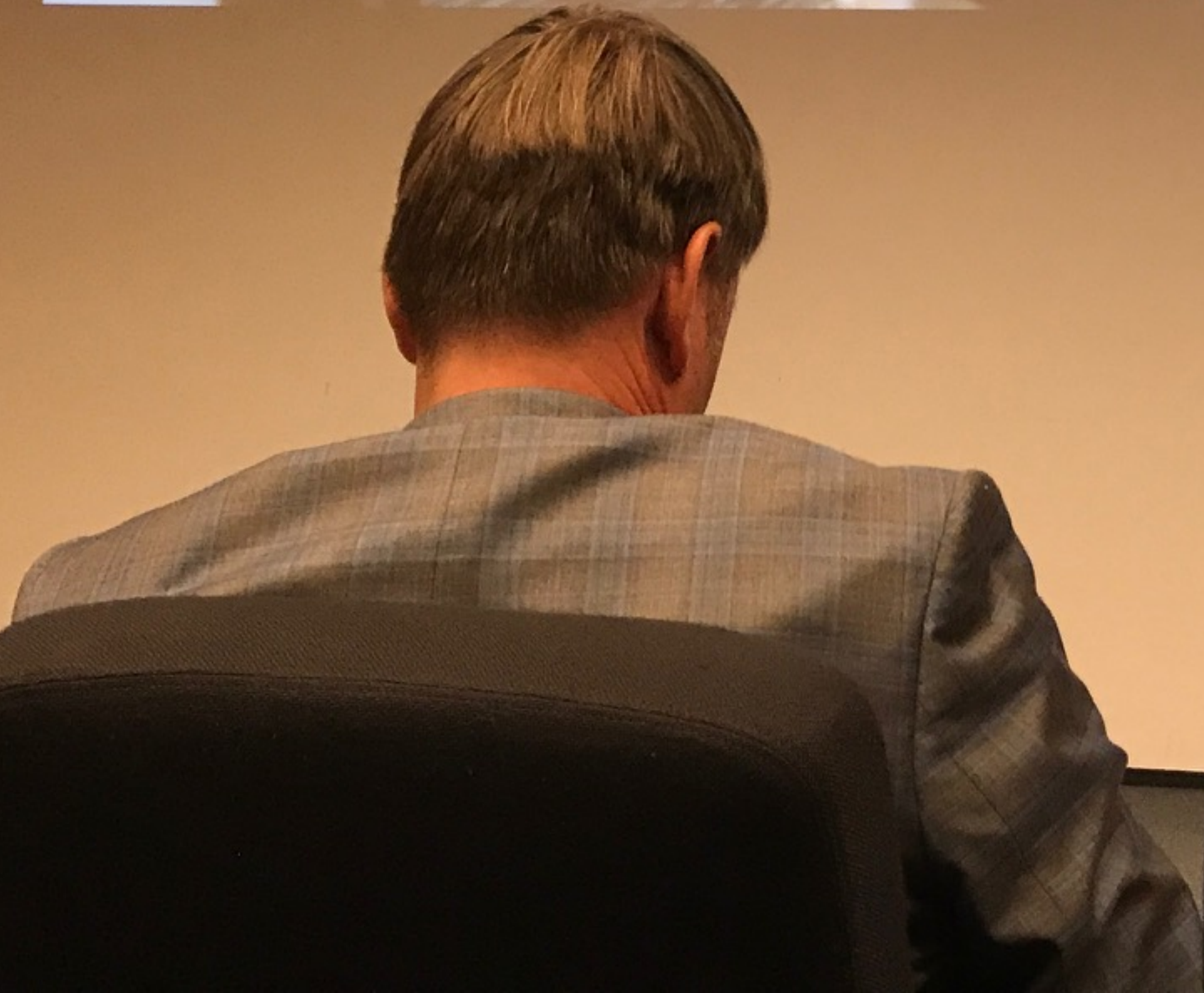
Stage III All Students / All Teachers

Stage I: Self-Selected Students / Self-Selected Teachers

Scalable Game Design



1996



ozeana Do. 11:27

Safari Ablage Bearbeiten Darstellung Verlauf Lesezeichen Entwickler Fenster Hilfe docs.google.com

(E) Rise of the Digital Polymath Datei Bearbeiten Ansicht Einfügen Tools Hilfe

War Kommentierzugriff

tiny.cc/polymath_e

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future challenges

Thinking Tools

cidental complexity

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Folienlayout

test Vorlage ändern

Erscheinungsbild

- Titel
- Text
- Foliennummer

Hintergrund

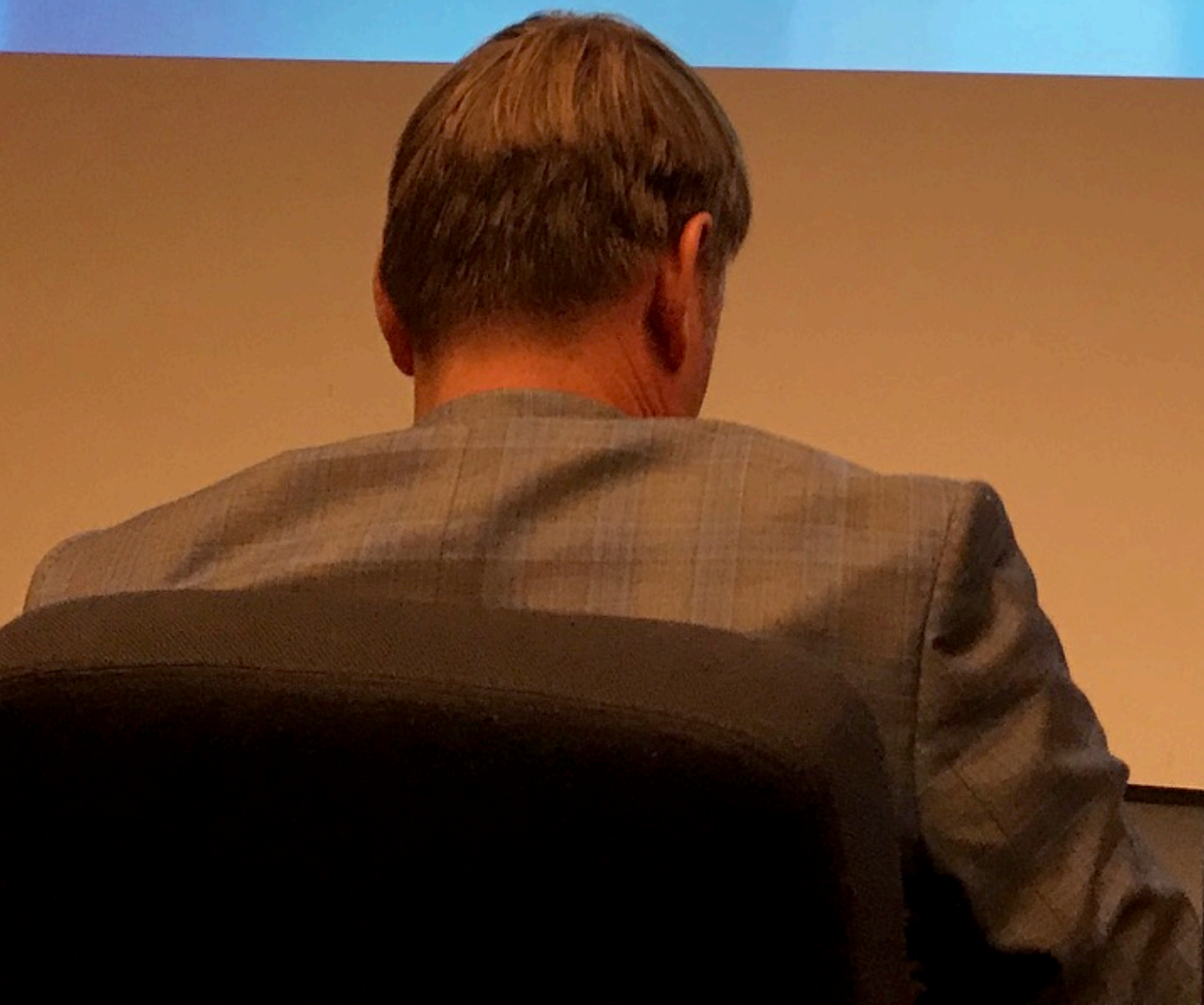
Füllfarbe

Folienvorlage bearbeiten

ozeana HD

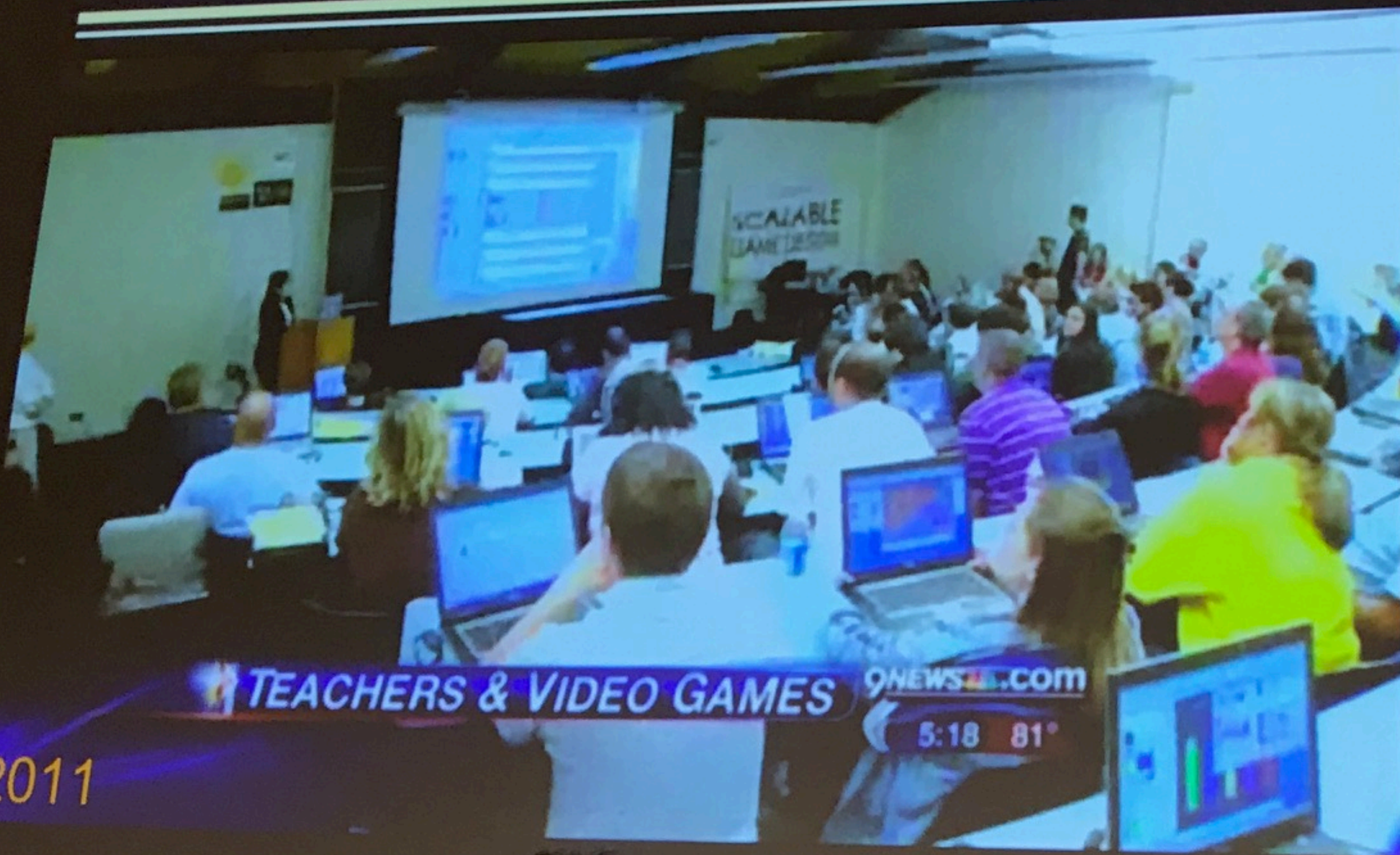
SUSAN





Stage II: All Students / Self-Selected Teachers

9NEWS.com
COLORADO'S NEWS LEADER



SCALABLE
GAME DESIGN
New York

SCALABLE
GAME DESIGN
México

2011

Stage III
All students
All teachers

SCALABLE
GAME DESIGN

Switzerland

- **Mandatory pre-service teacher education:**
Students must pass undergraduate courses to become primary school teachers.
- **2017: 600+ pre-service teachers:** 26 classes x 4 cantons (Aargau, Solothurn, Basel-Land, Basel-Stadt) x 25 students x 2 courses

76%

of the pre-service teachers are women

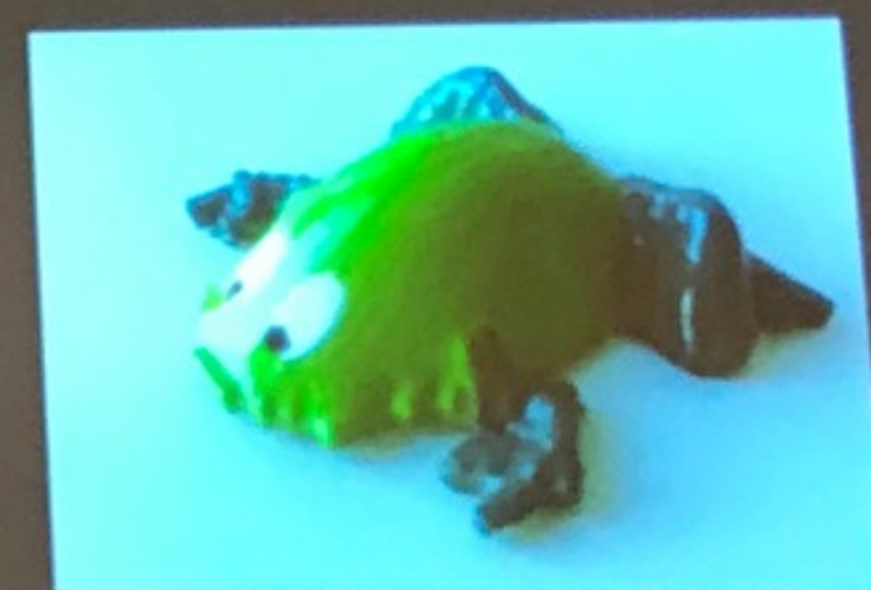


Course Concepts

1. **Motivation:** Game Design

SCALABLE
GAME DESIGN

2. **Tools:** Computational Thinking Tools



3. **Structure:** The 7 BIG Ideas of computer science

CS

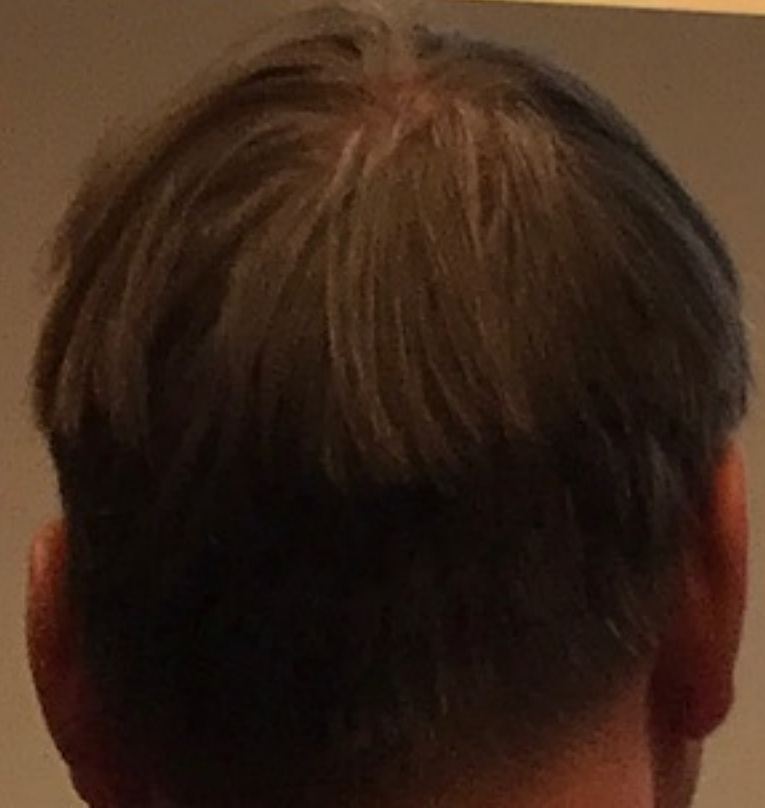
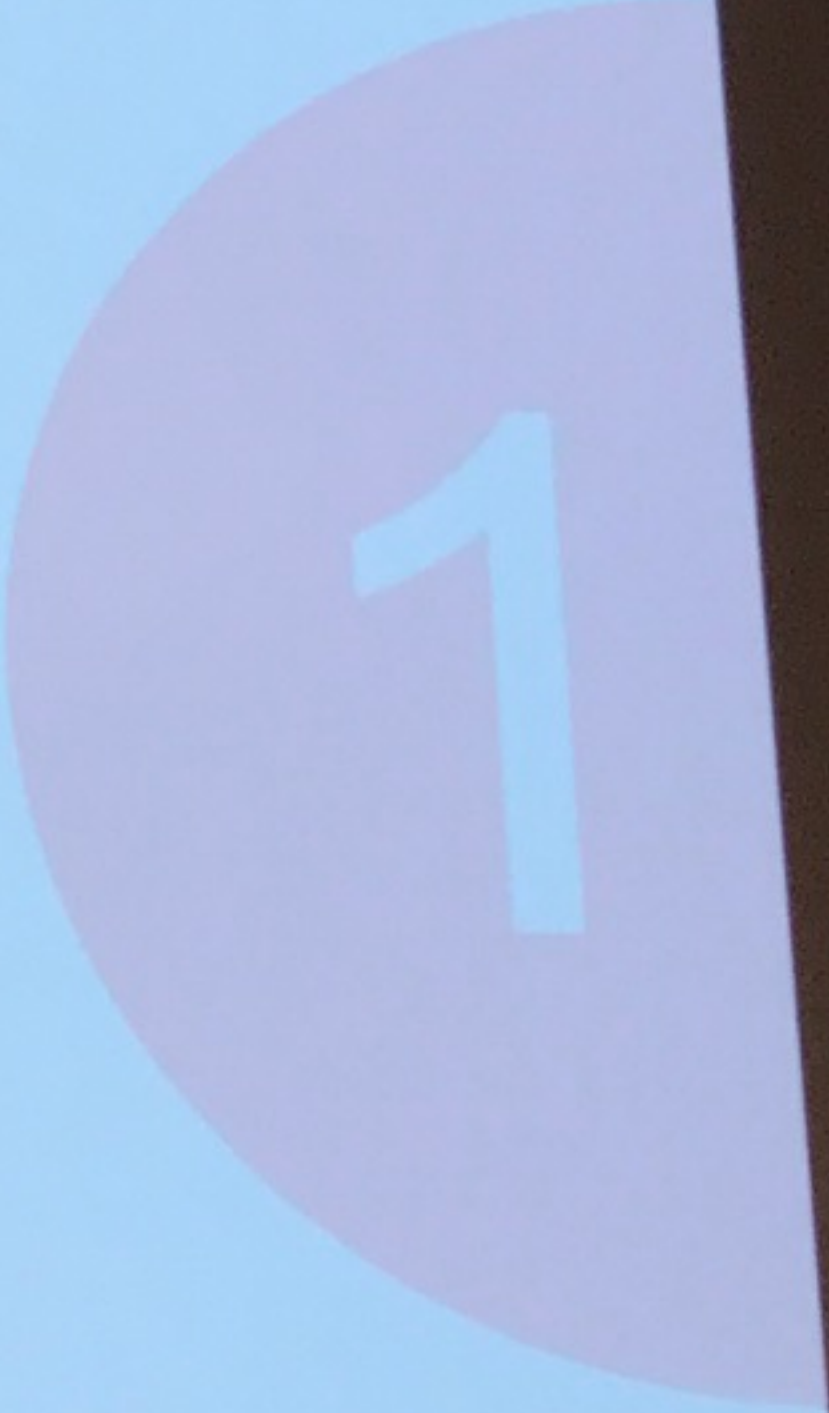
PRINCIPLES

 **KANTON** *solothurn*

Programmieren in der Primarschule – können Kinder das?



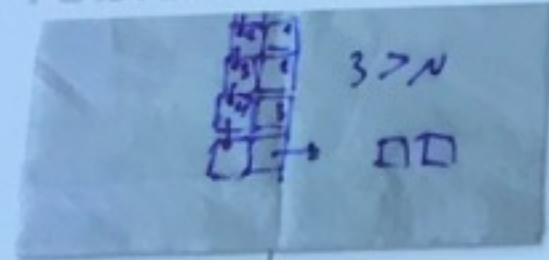
SCALABLE
GAME DESIGN



Computational Thinking

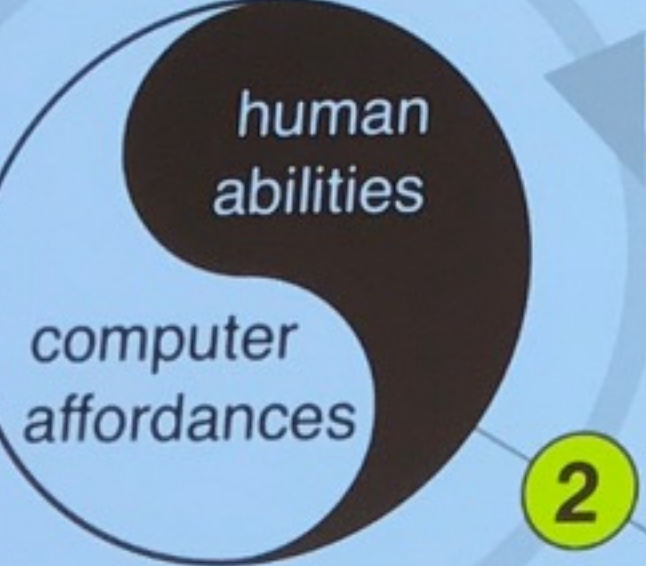
Abstraction

Problem Formulation



"how does a mudslide work?"

1



Analysis

Solution Execution and Evaluation

3

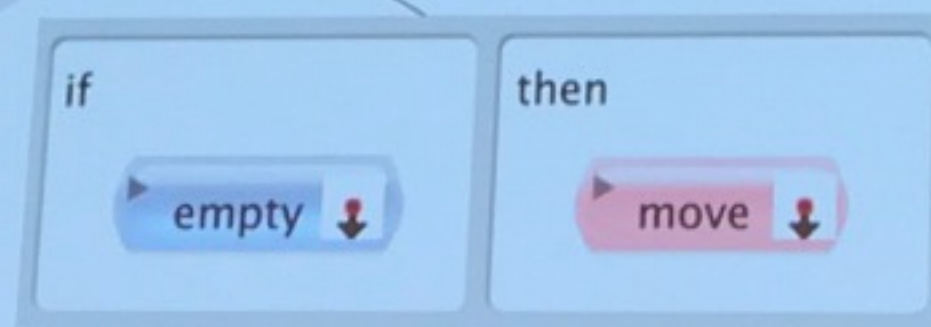


consequence of thinking

Automation

Solution Expression

2



build simple model of gravity

Don't

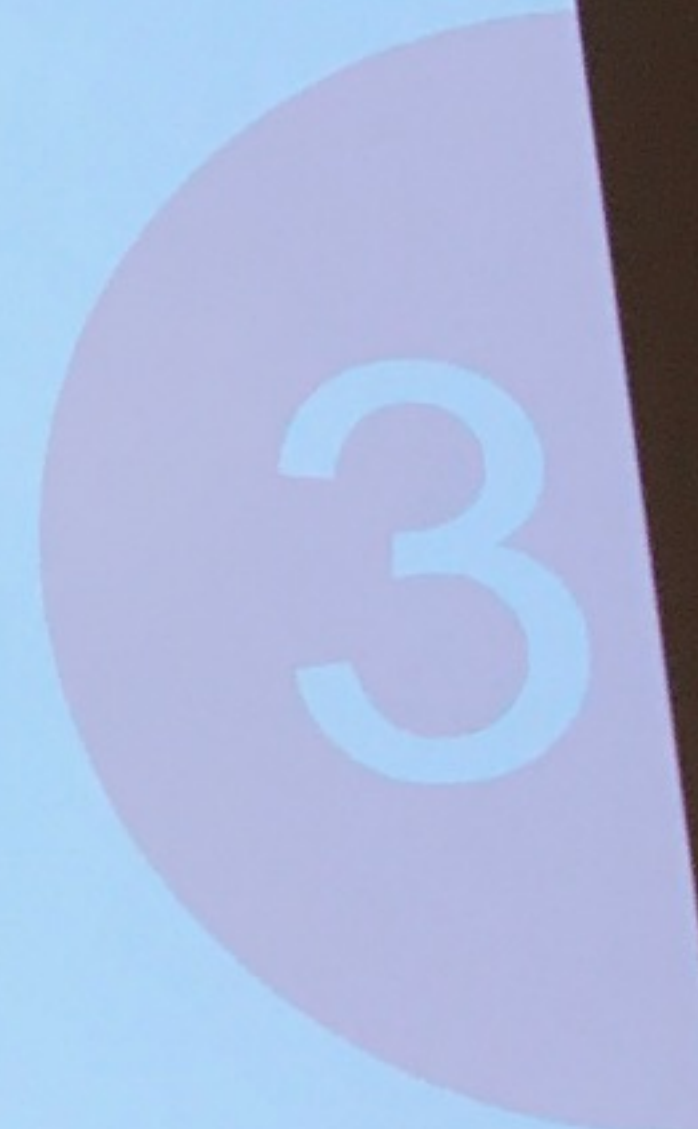
- Think like a computer
- Think about computers

but

- Think **WITH** the computer

2

“7 BIG Ideas”



44%

A single game design activity covers a large percentage of the national curriculum (Lehrplan 21) Computer Science requirements

Lehrplan **21**

Results

In 14 weeks 600+ students:

- Learned to write simple programs
- Learned to build STEM simulations and games
- Became Computational Thinkers



Computational Thinking

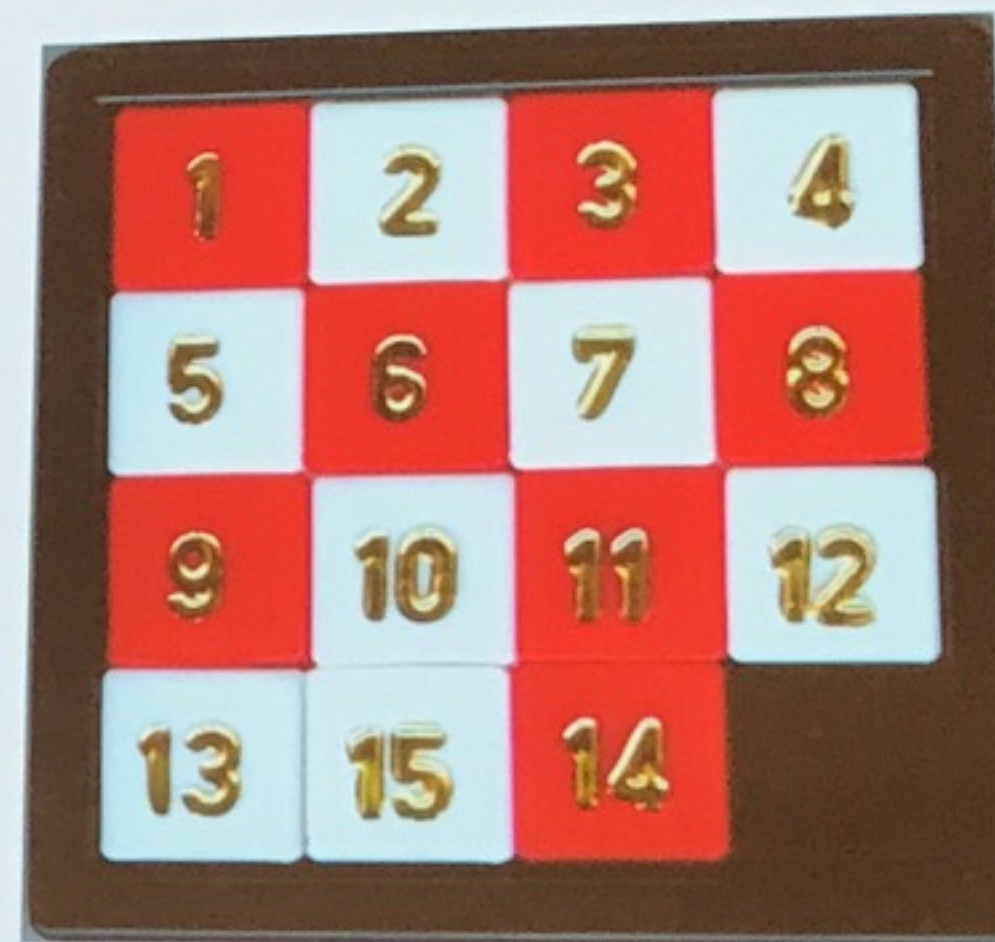
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Programming

Computational Thinking Tools

minimize coding overhead by reducing accidental complexity

- 15 squares puzzle
- **Computational Thinking:**
“Click at a square next to the hole to make the square move into the hole.”



STEM + C

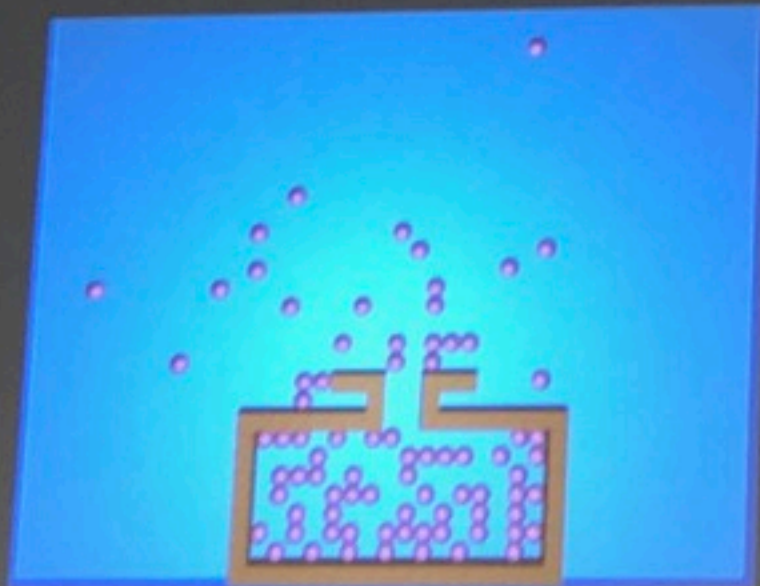
Hourglass

Build an hourglass. Sand should fall from an upper area of the vessel into the lower area and pile up there.



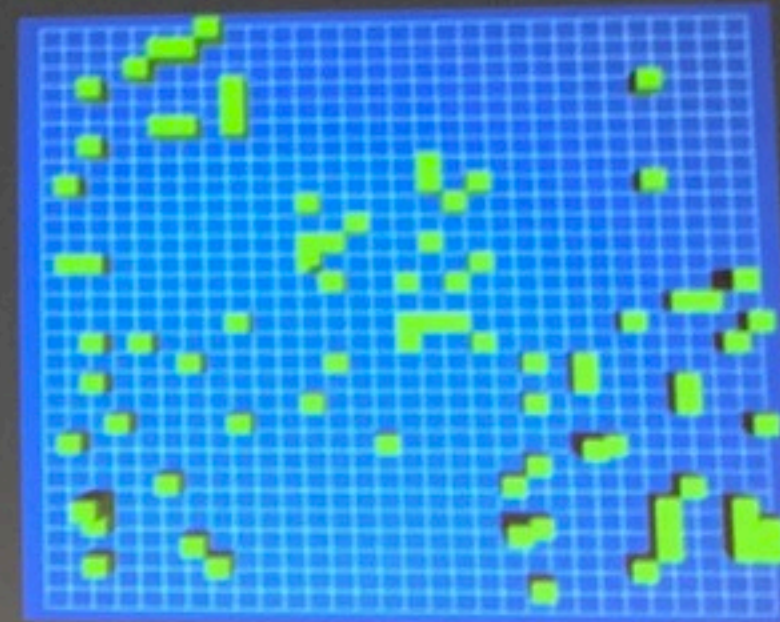
Perfume

Build a perfume bottle. The bottle should contain perfume particles. At the start of the simulation, the particles should escape and spread randomly into the simulation world.



Bacteria

Build a simulation of proliferating bacteria. The simulation should begin with a randomly moving bacterium that divides from time to time.



[AgentCubes](#)

Conclusions

Is Switzerland in the Digital fast lane?

While Switzerland is still in the rear mirror of Digital Thought Leader nations such as the US and the UK in terms of digital education, it is now taking extraordinary measures to accelerate and has set the metaphorical turn signal.

Thank you!

More information

- Schweizer Wissenschaftsrat
 - [Digital Competences](#)
 - [Die Schweiz auf der digitalen Überholspur](#)
- Hasler Stiftung
 - [Computational Thinking](#)

