PEDAGOGICAL CONSIDERATIONS

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Arta Rūdolfa
15.04.2019.

What we have to think about:

- Learning taxonomy
- Steps of pedagogical instructions
- Zone of proximal development
- Motivation
- Classroom managment
- Risks

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Some issues which should be taken into account

Attention span

Capacity of memory

Development of motivation

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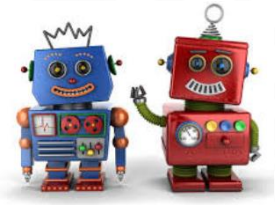

IT IS INTERESTING

Sensory register

Encoding

Perception

Short term memory

Working memory

Learn (save)

Retrieve

Long term memory

Active memories

TEMPORARY STORAGE

PERMANENT STORAGE

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About our memory…

Learning taxonomy by L.Anderson and colleagues

The knowledge dimension	The Cognitive process dimension					
	1. Remember	2.Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual knowledge						
B. Conceptual knowledge						
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D. Meta-cognitive knowledge						

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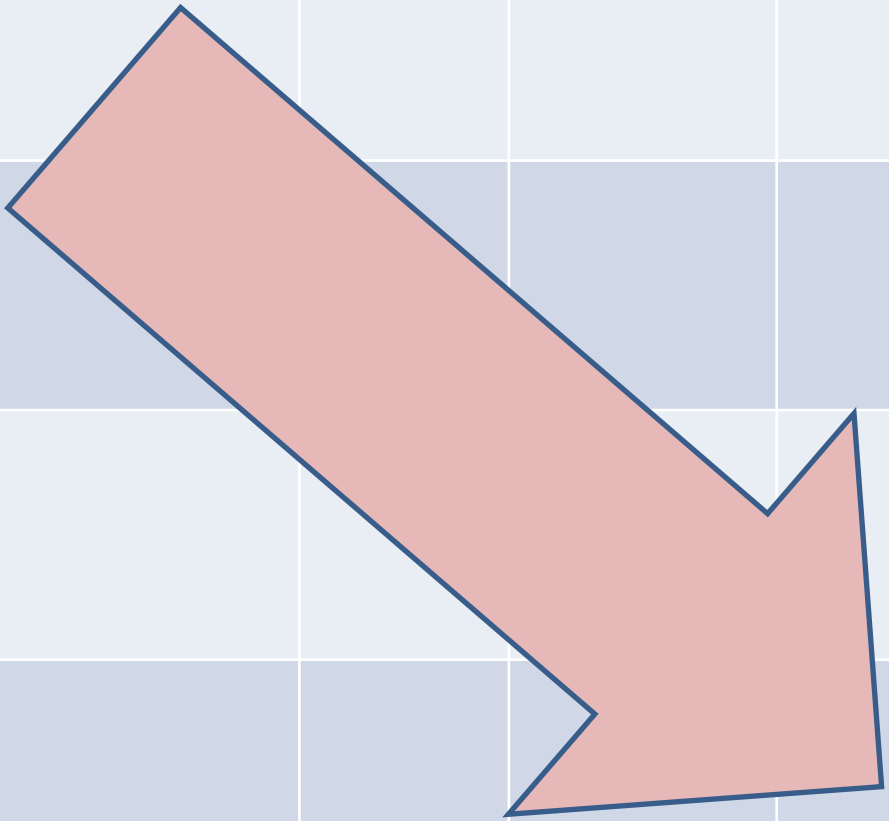

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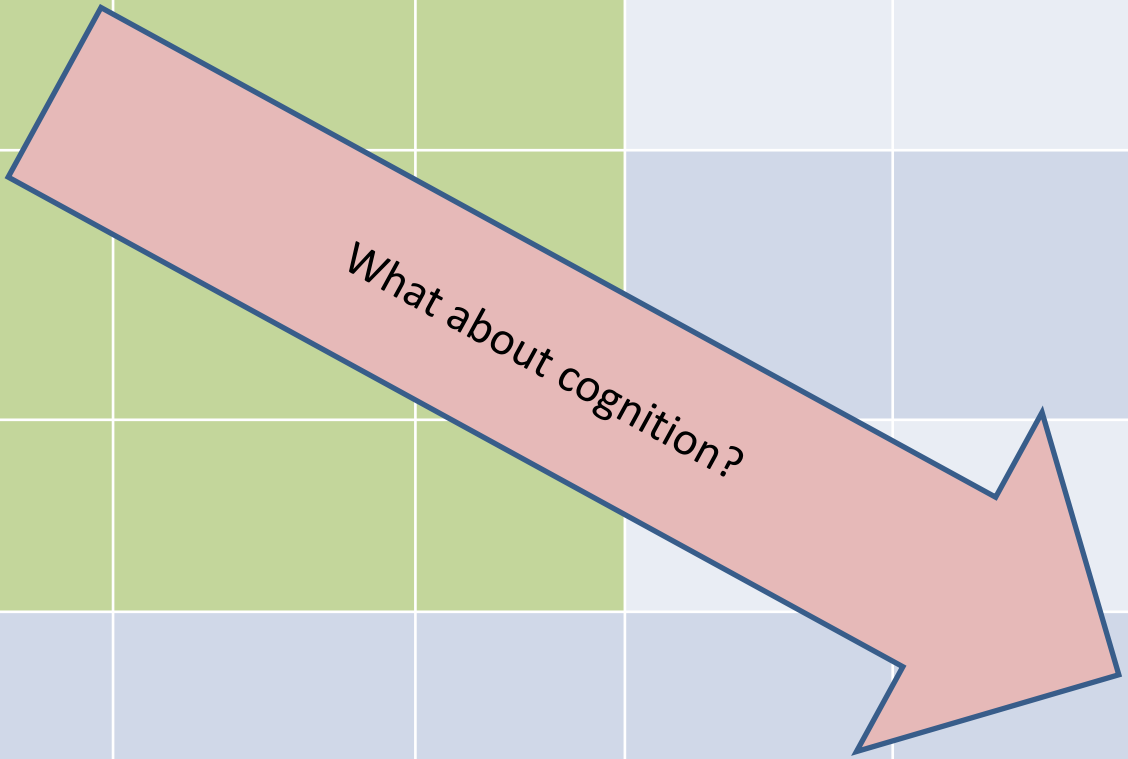
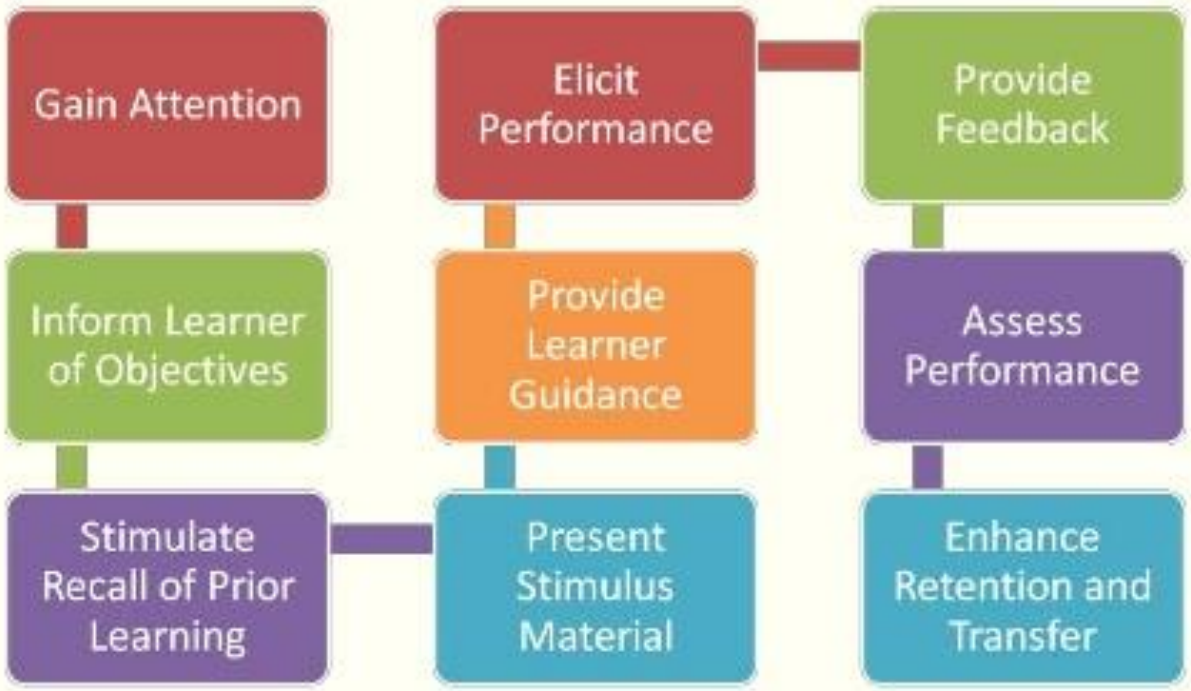


GAGNE'S NINE EVENTS OF INSTRUCTION



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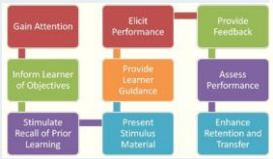
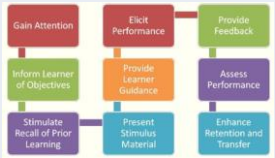
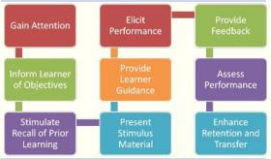
A. Factual knowledge						
B. Conceptual knowledge						
C. Procedural knowledge						
D. Meta-cognitive knowledge						

STEM

- In general, in STEM areas, literacy means more than the ability to read and write in scientific, mathematic, or technologic language. Literacy is a frame to delineate key capabilities that each discipline expects learners to reach.
- While each concept of literacy in the STEM disciplines is unique, the literacy frame describes two key aspects to define each discipline:

1) knowledge and skills (practice) that learners need to learn and be able to use
2) the methods and purposes with which learners are expected to deal with them.

STEM areas such as ***subject-oriented knowledge*** (e.g., knowledge of physics) and ***cognitive skills*** (e.g., analyzing, classification, and prediction)

AND

a consideration of the ***practice domain, problem-solving process, engineering design process, and scientific inquiry skills*** characterized robotics education as a part of STEM

Some experiences from papers on robotics...

the focus is on:

- knowledge of robots (e.g., physical parts of robots, functions of parts of robots) and understanding of systems of robots as components of robotics education
- In terms of application of knowledge, the robotics-intensified knowledge was not merely secondary or background knowledge. Rather, the knowledge domain was closely related to robotics practices (such as designing, constructing, and operating robots)
- An emphasis on programming to the exclusion of other skills.

Computational thinking

- Using abstractions and pattern recognition to represent the problem in new and different ways
- Logically organizing and analyzing data
- Breaking the problem down into smaller parts
- Approaching the problem using programmatic thinking techniques such as iteration, symbolic representation, and logical operations
- Reformulating the problem into a series of ordered steps (algorithmic thinking)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing this problem-solving process to a wide variety of problems

J.Wing, 2006

Computational thinking for scientists, engineers, and other professionals further means being able to:

- Apply new computational methods to their problems,
- Reformulate problems to be amenable to computational strategies,
- Discover new science through analysis of large data,
- Ask new questions that were not thought of or dared to ask because of scale, but which are easily addressed computationally, and
- Explain problems and solutions in computational terms.

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J.Wing, 2006

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Teaching Approaches Applied in Robotics Education

- Narrative (Story)-based approach
- Collaborative approach
- Hands-on approach
- Problem-solving approach
- Trial-and-error method
- Exploratory learning approach
- Inquiry-based approach
- Project-based approach
- Free-play based approach

Technological Features of Robotics Kits

- Types of feedbacks
- Playfulness
- Age-appropriateness

Classroom Conditions

- Formal school setting *vs* laboratory setting
- Flexible time schedules

Risks

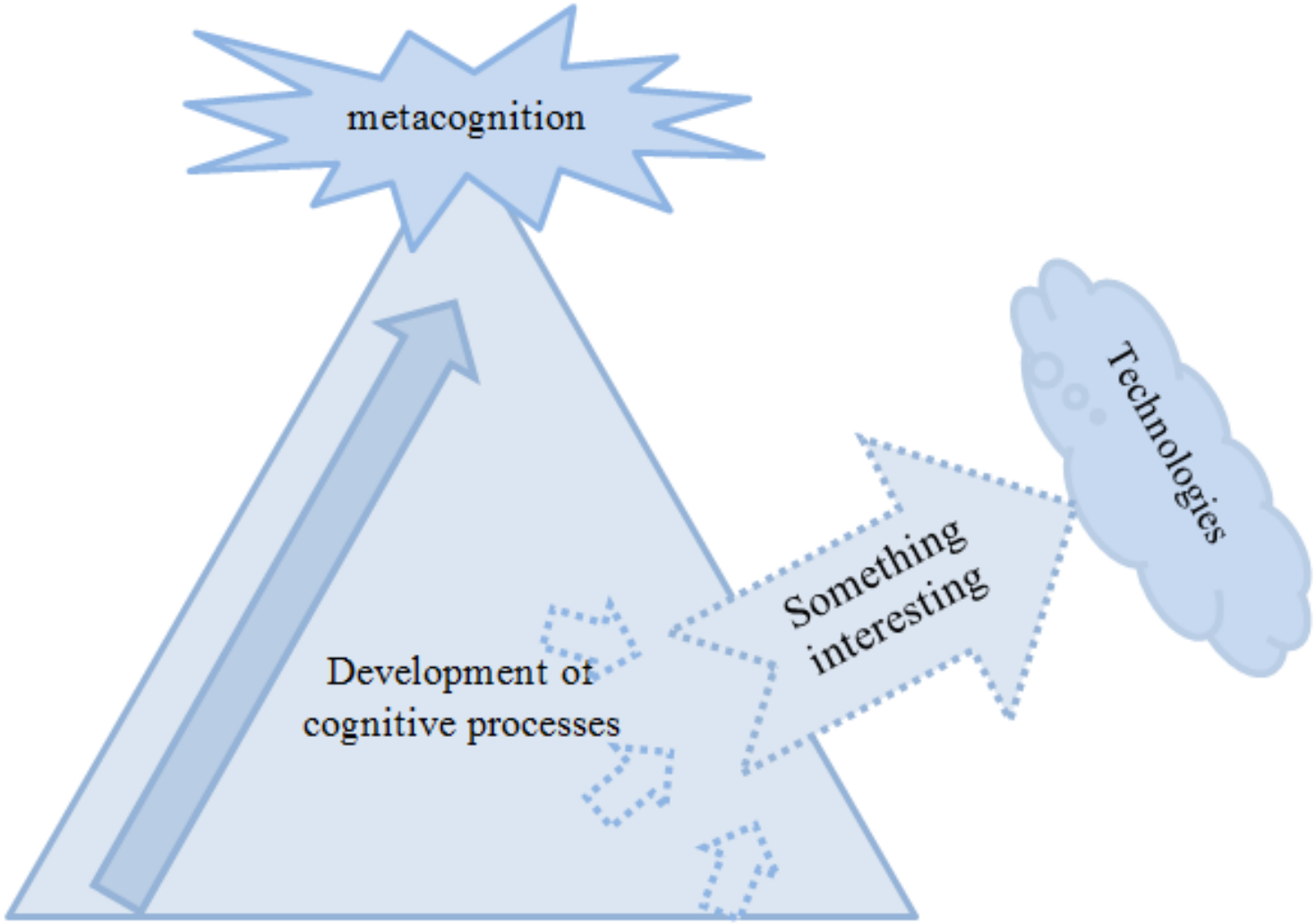
- constructivism and constructionism narrowed down into a technological determinist paradigm
- Easy access to information is not providing the cognitive load and vice versa cognitive load can lead to avoidance motivation
- ‘fascination’ efect without seeing the whole picture
- Diverse special needs
- Classroom managment

Technological determinism

- refers to the claim that “technology itself exercises causal influence on social practice”
- In a teaching and learning context, the determinist paradigm views robotics kits as shaping children’s learning. This paradigm attributed the main cause of learning outcomes to the robotics technologies.

Bimer, B. Karl Marx and the Three Faces of Technological Determinism. Soc. Stud. Sci. **1990**,

- Risk of fascination



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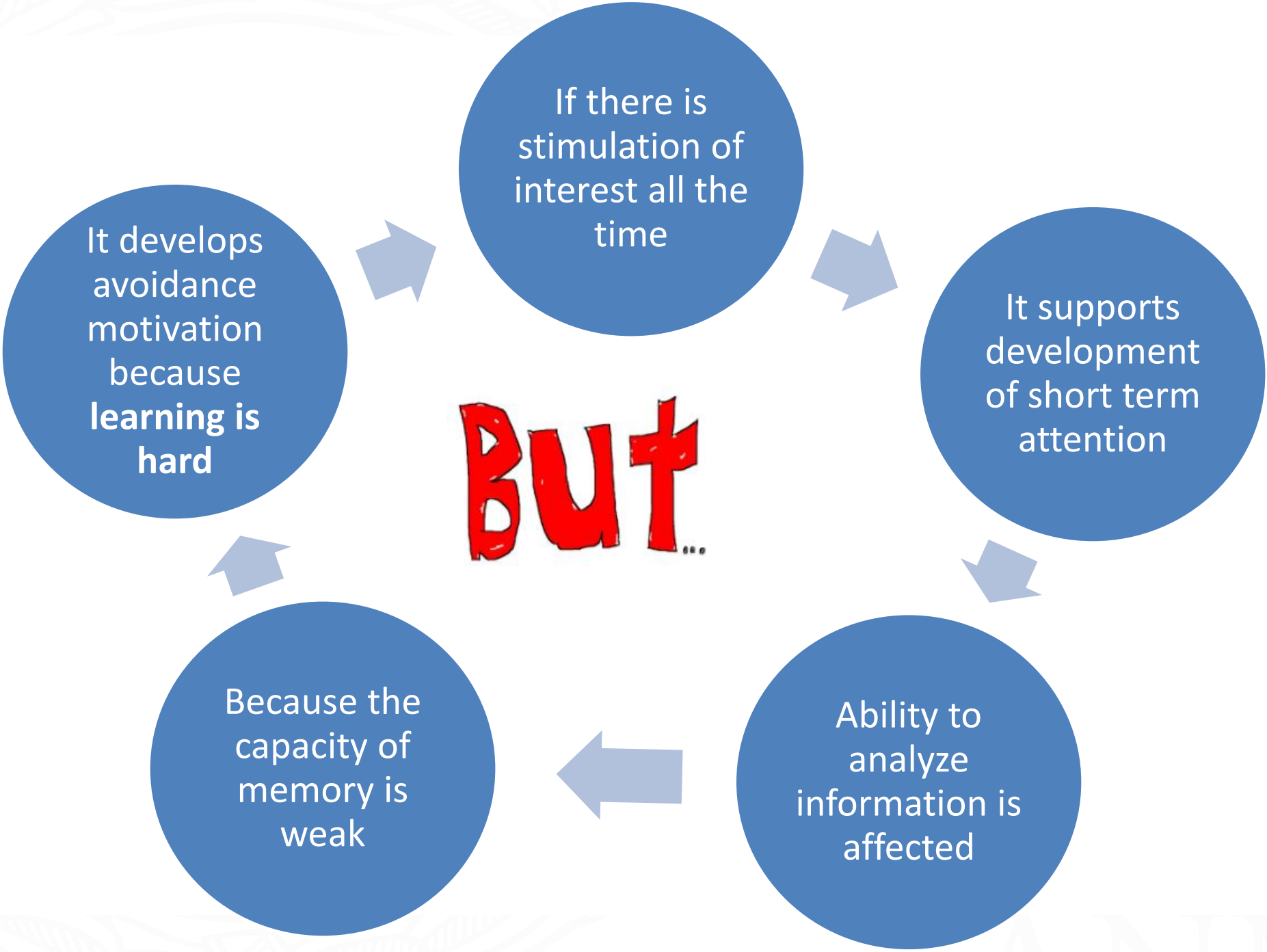
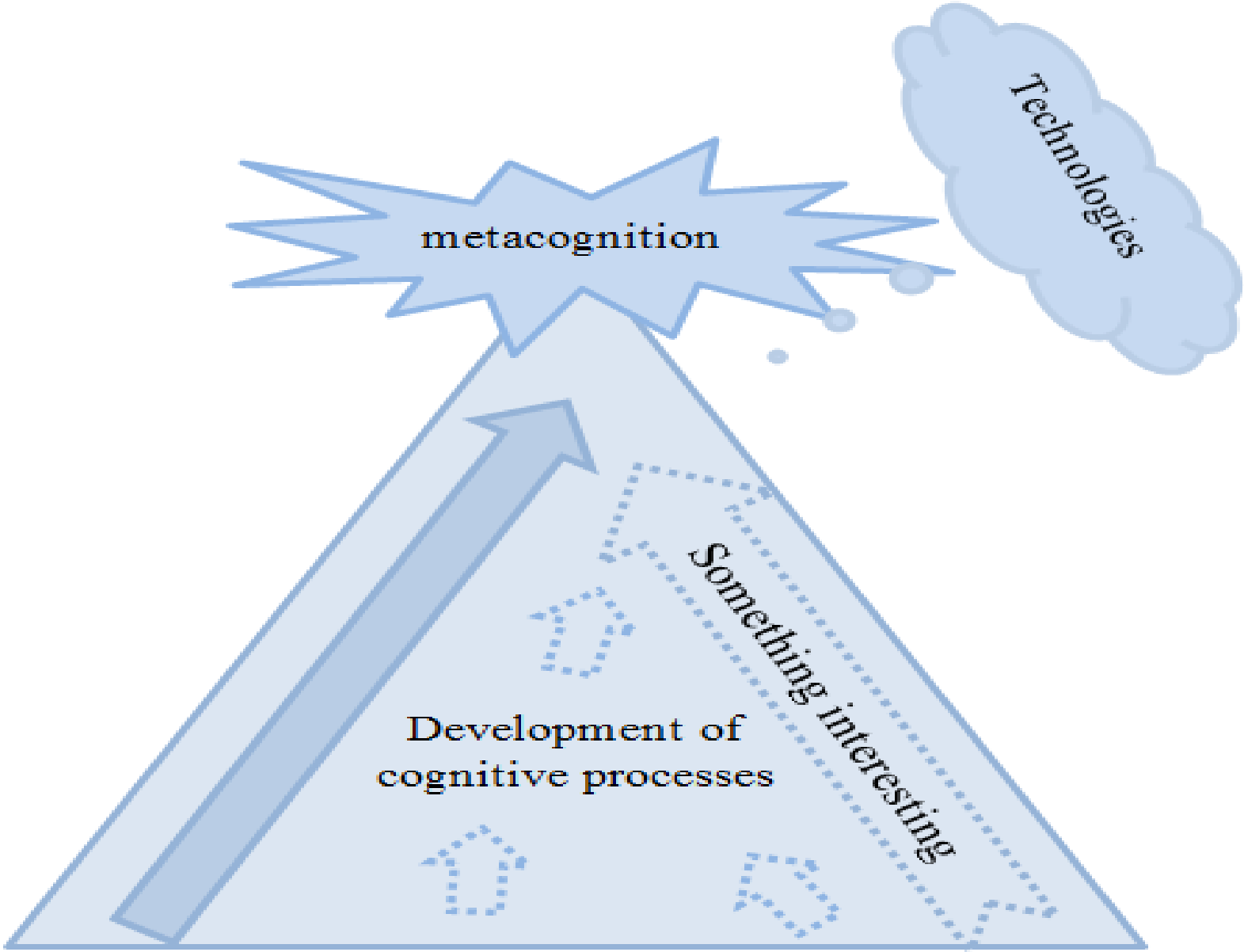

If there is stimulation of interest all the time
It supports development of short term attention
Ability to analyze information is affected
Because the capacity of memory is weak
It develops avoidance motivation because **learning is hard**
But...


Technologies
metacognition
Something interesting
Development of
cognitive processes

We must remember:

- Levels of motivation
- Aims of motivation
- Risks of motivation
- Pedagogical strategies to ensure motivation

Aims of Motivation (Migdley & Urdan 2001)

- To improve skills and knowledge
- To use the acquired skills and knowledge
- **The avoidance**, which is explained as a desire to avoid the use of the knowledge and skills, so that individual does not look more incompetent than others

4 ways in which self-efficacy can develop (Bandura):

1. Experience of success
2. Possibility to observe those who are good performers
3. People who are emotionaly/socialy close convince that child is able to reach the aim
4. Emotional and physiological aspects (people are afraid that they will not be succesfull are in stress and it influences ability to learn)

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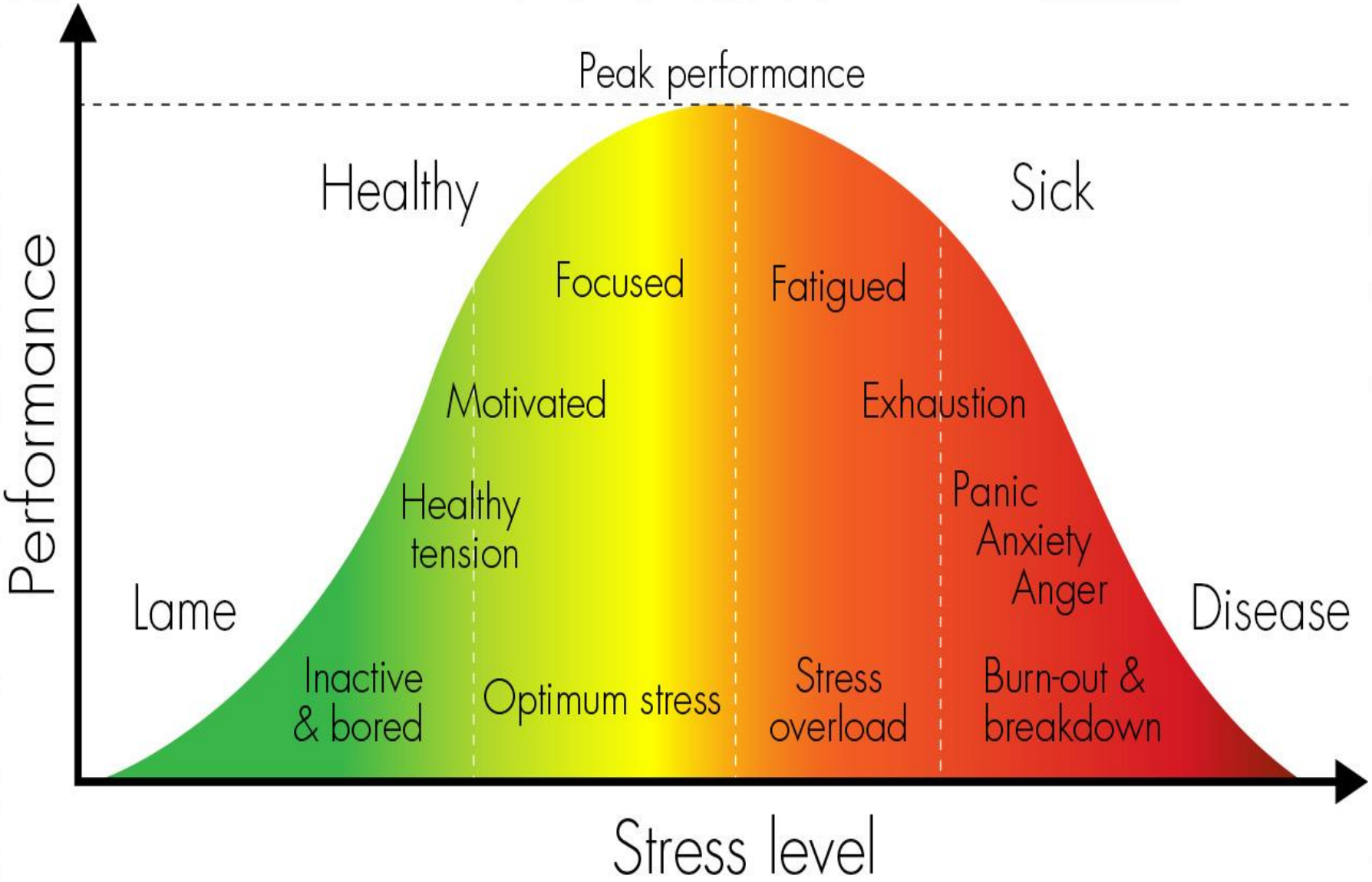
When you're STRESSED, your brain synapses are literally coming unglued

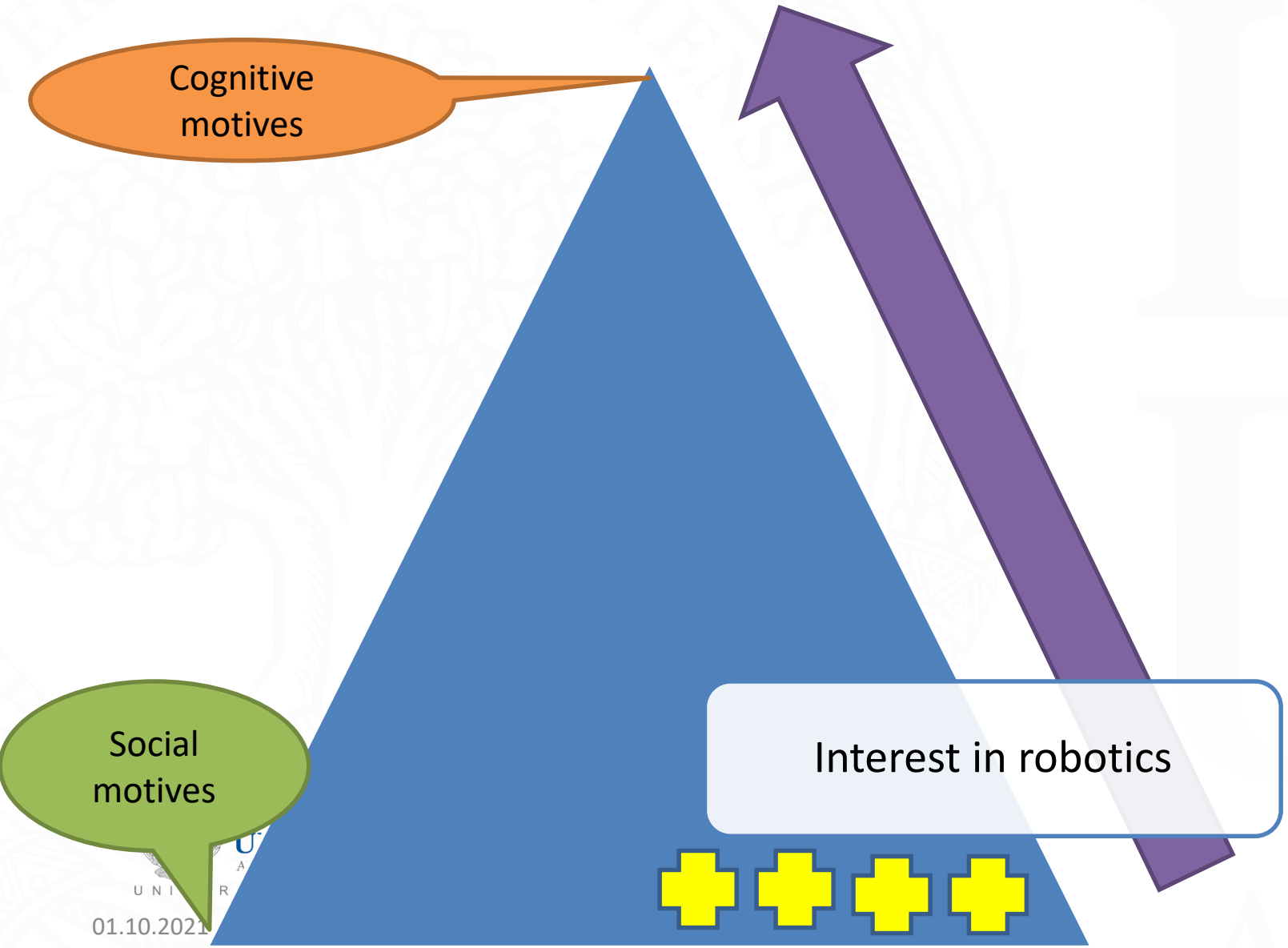
Better Body Chemistry

www.betterbodychemistry.com

Role of the stress in learning process



Development of motivation



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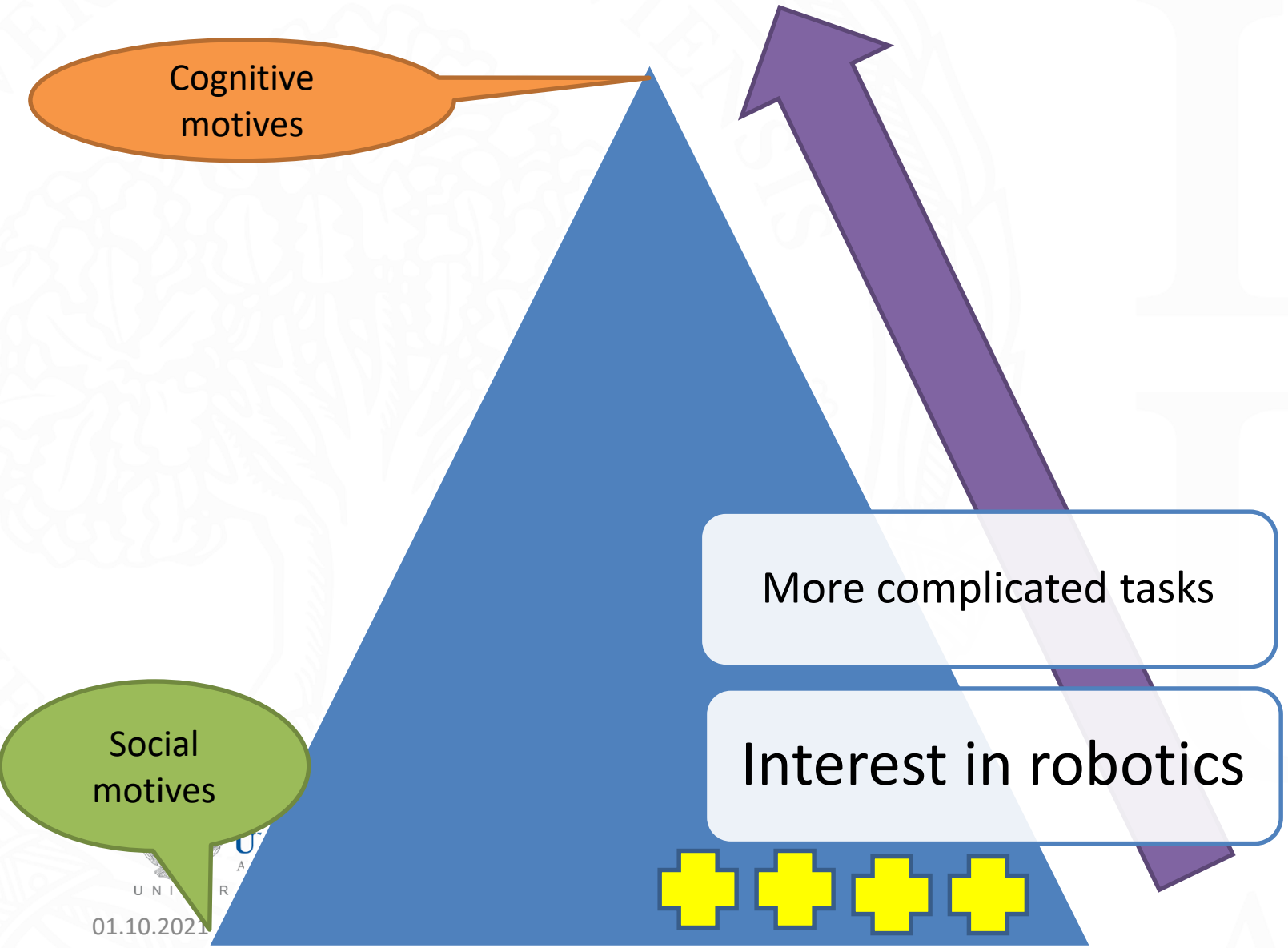

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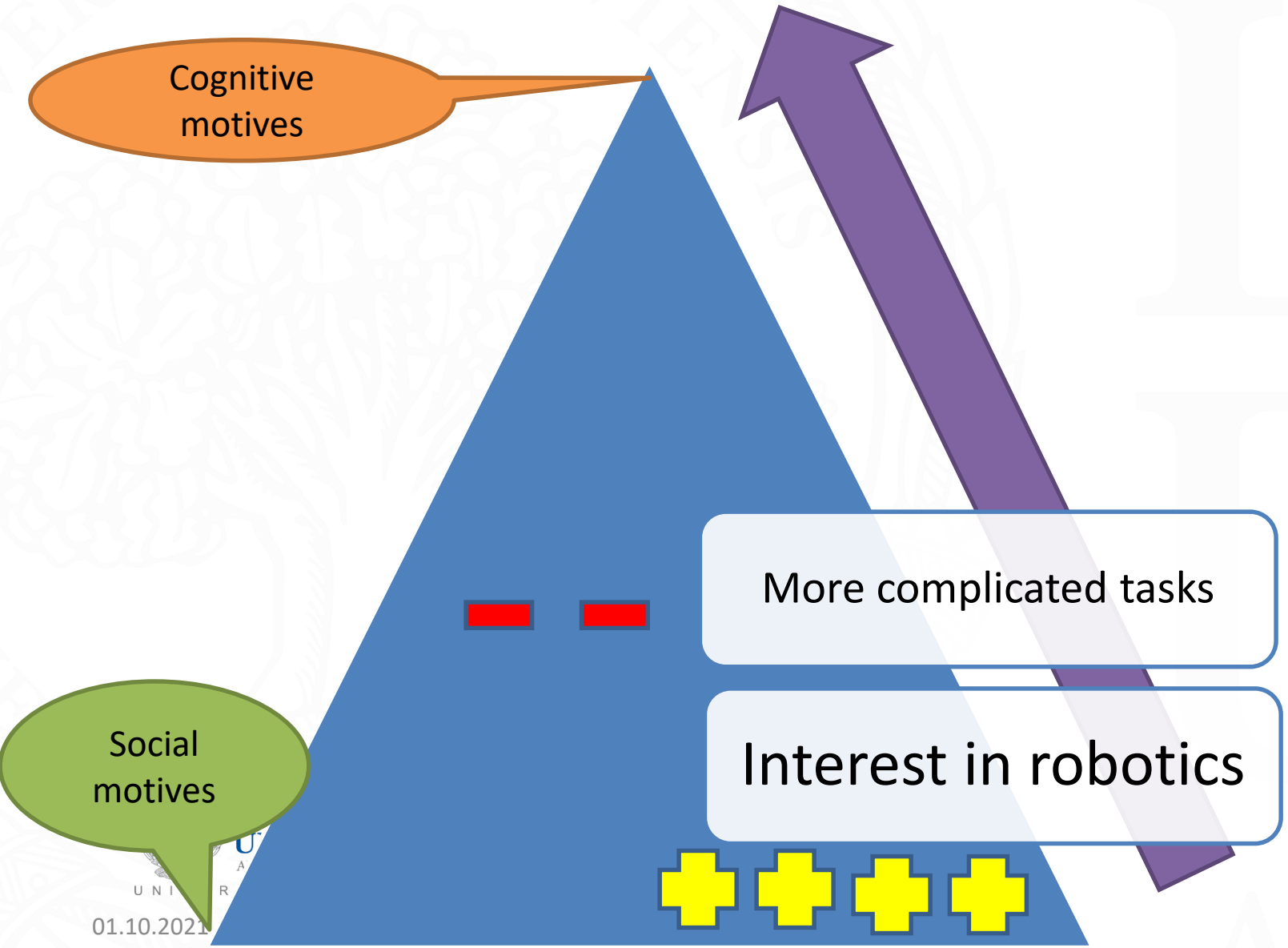
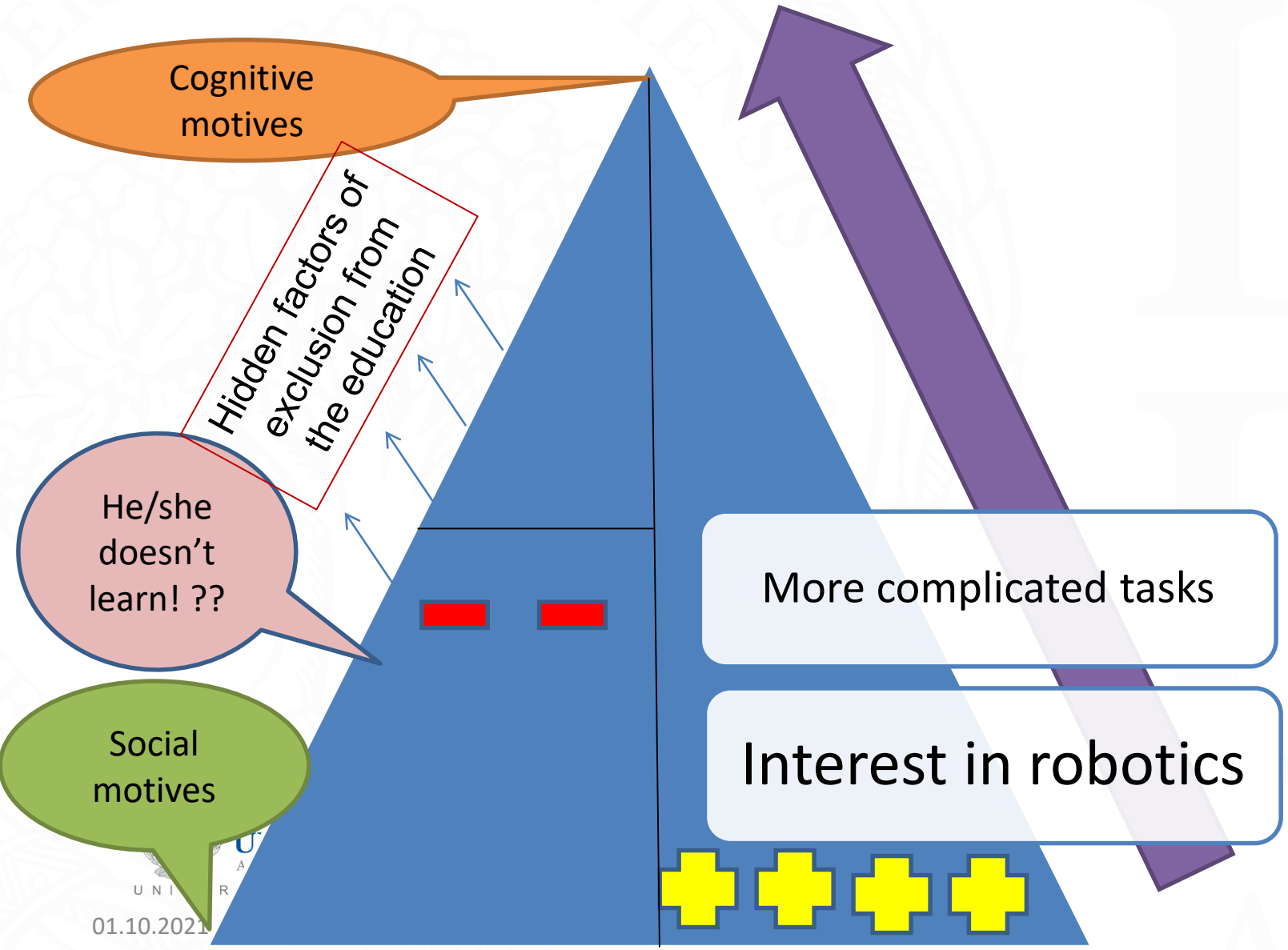
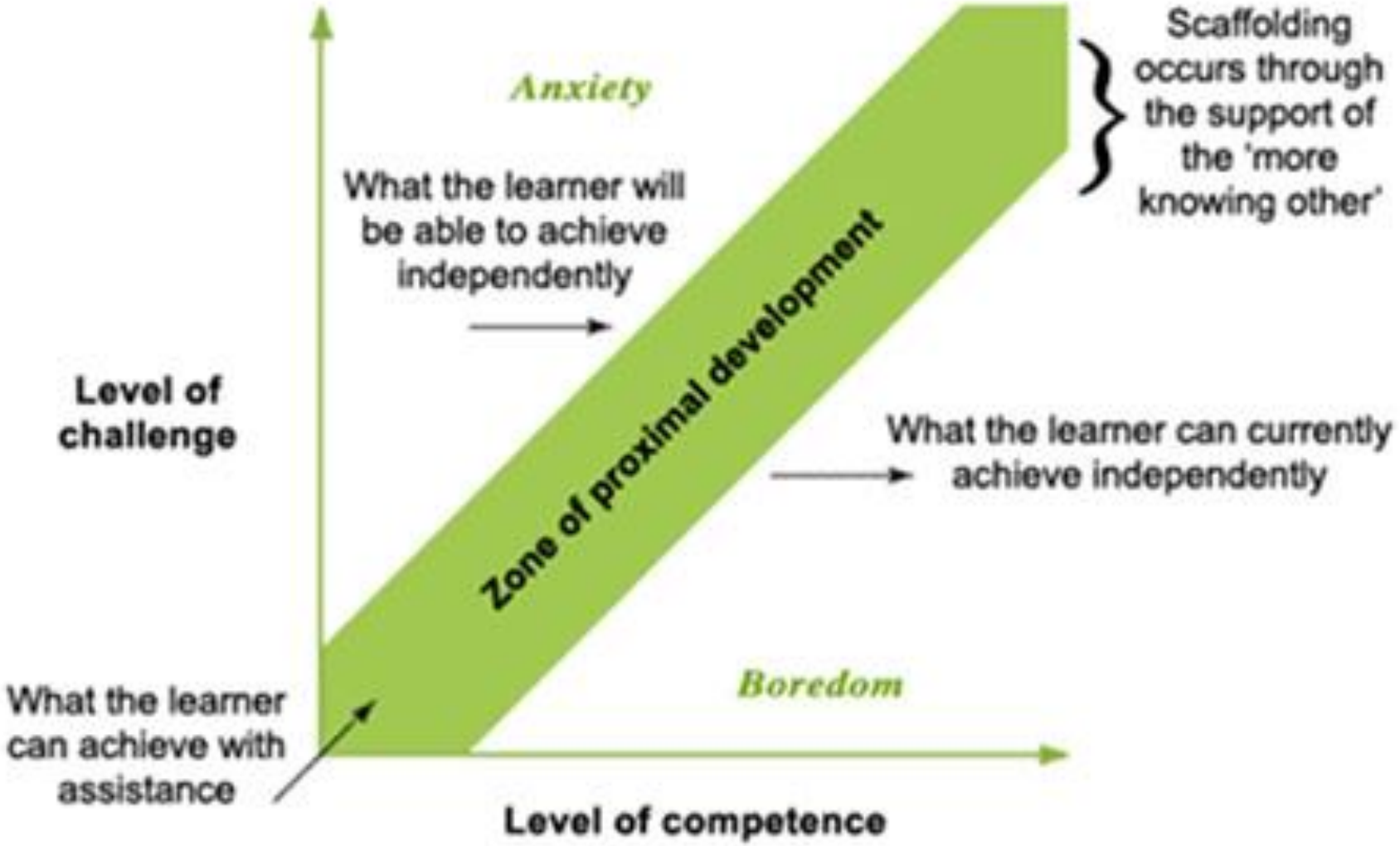


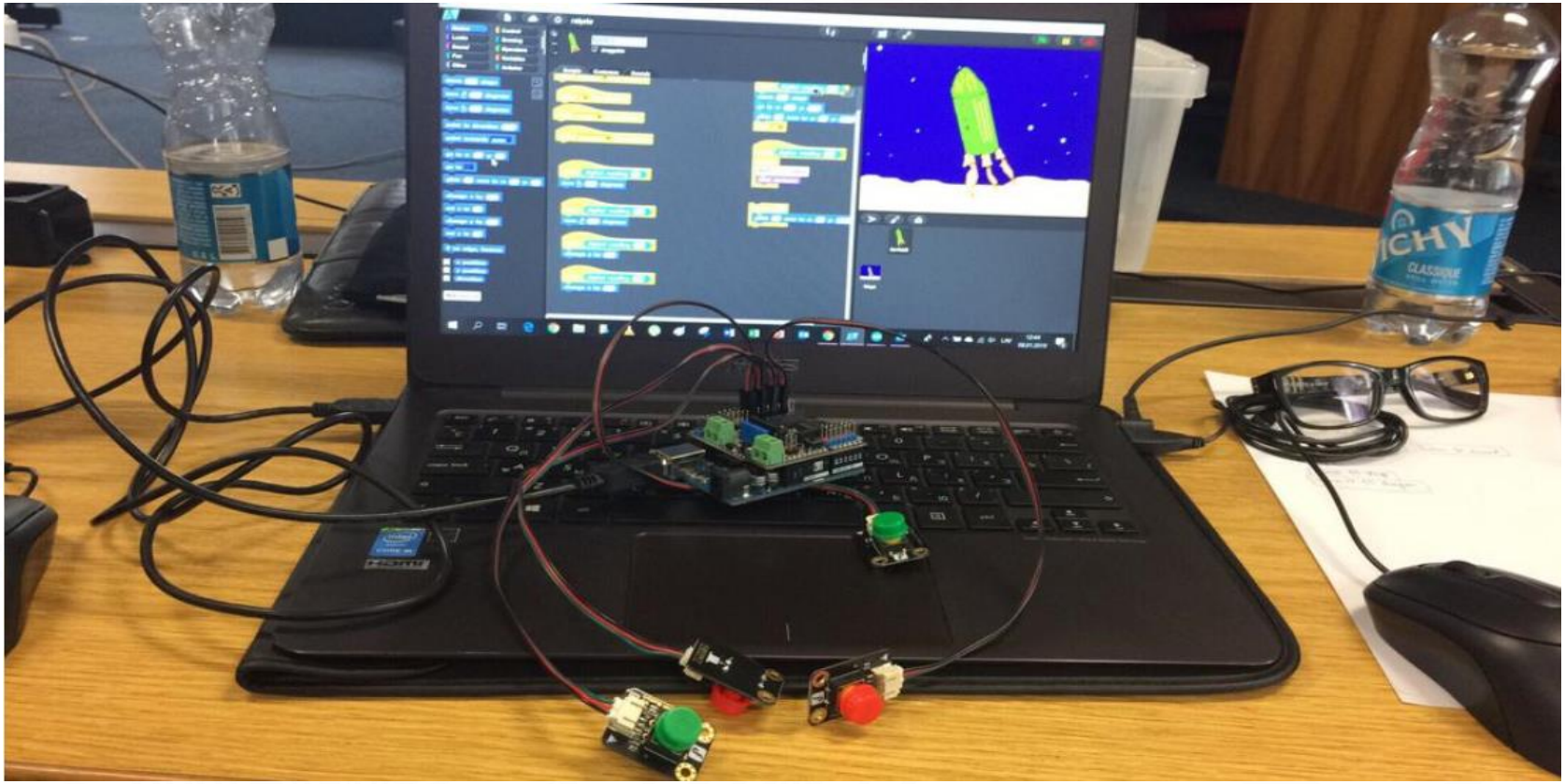
What can happen?



Zone of proximal development
Focused teaching



Classroom manament



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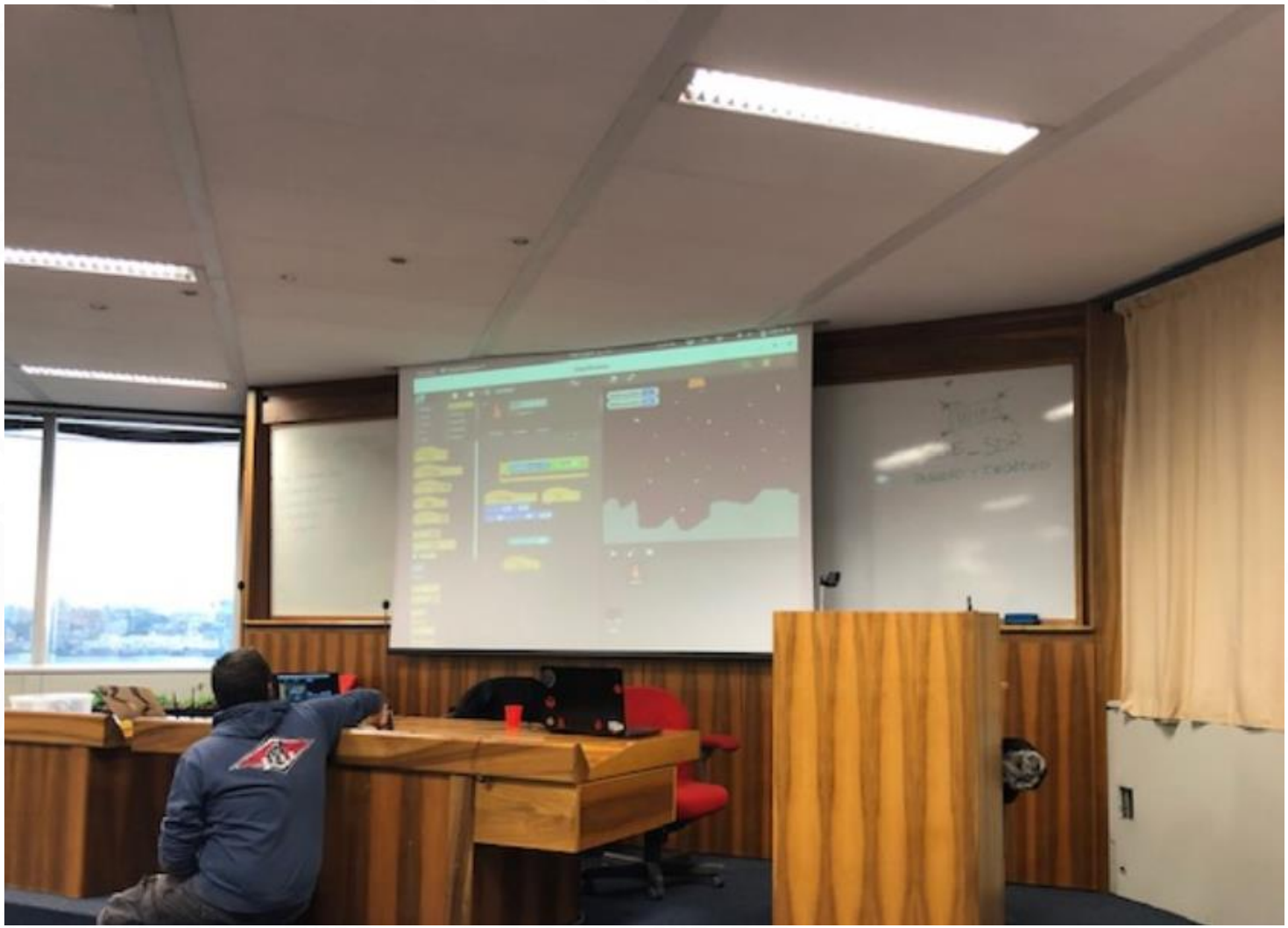

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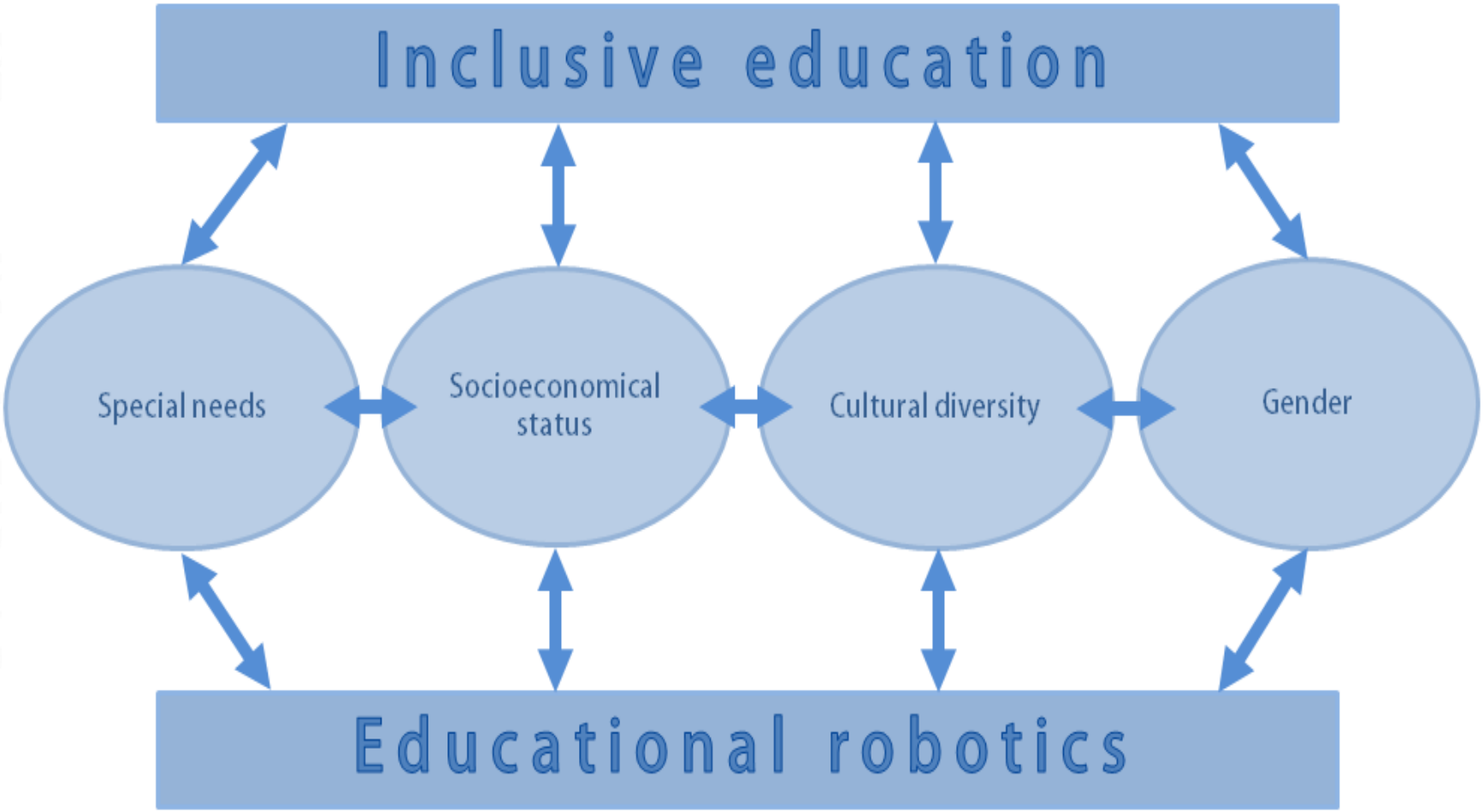

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Special needs

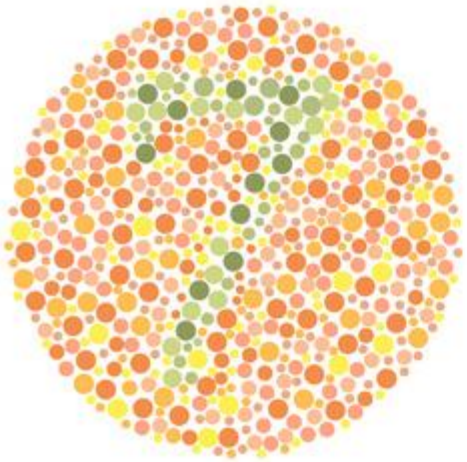
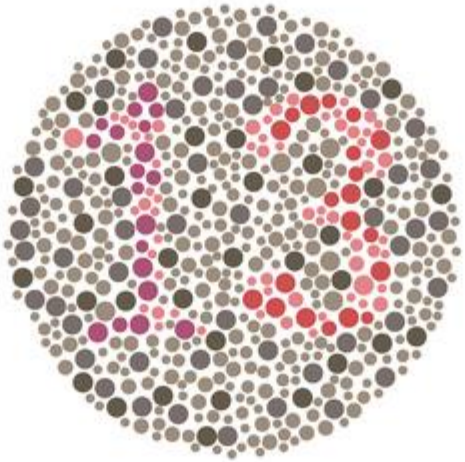
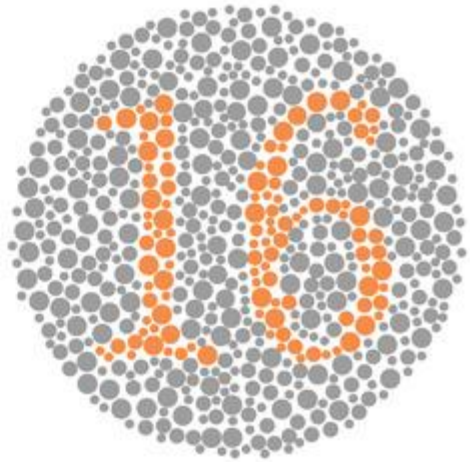
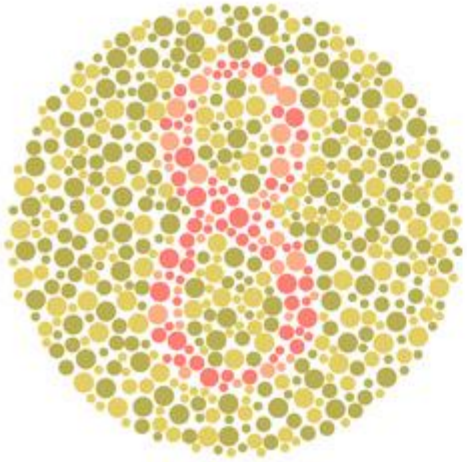
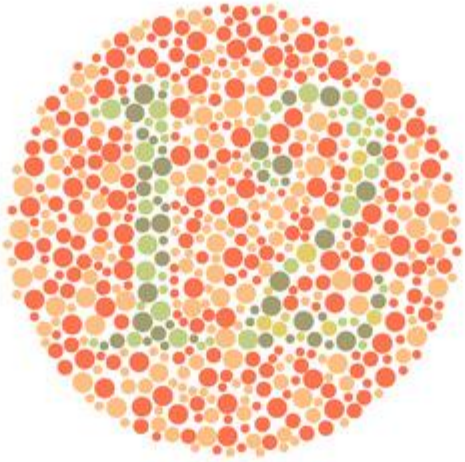
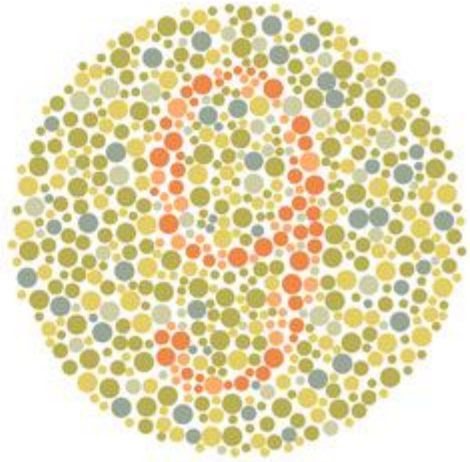
- as one of the major risk factors that can reduce access to education in general and limit access to learning in particular areas. It can be any disability, without going into details of each specific diagnosis, as well as other special needs that may not be so obvious. For example, children who have colour discoloration problems can be confronted with the programming of LEGO robots with a high emphasis on colours; therefore, in the context of inclusive education, not only diagnosed and apparent disabilities but also all special needs that can affect learning should be met.

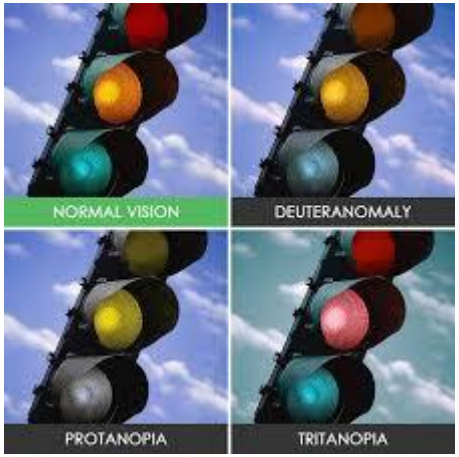
Gender balance

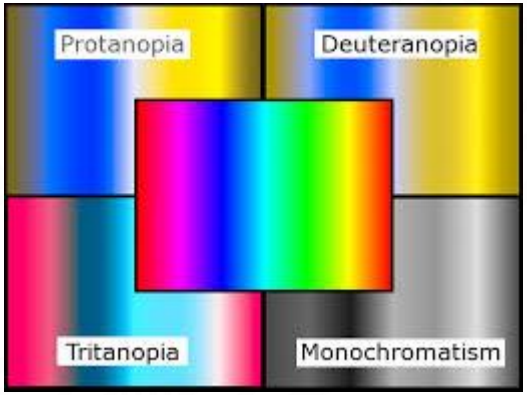
- In some countries research results show that learning outcomes in particular fields are higher for girls than for boys (for example, reading literacy).
- Also, obstacles exist that lead to gender imbalances in different fields, such as where educational sciences become more predominantly female and Information Communication Technologies (ICT) remains predominantly field of male.

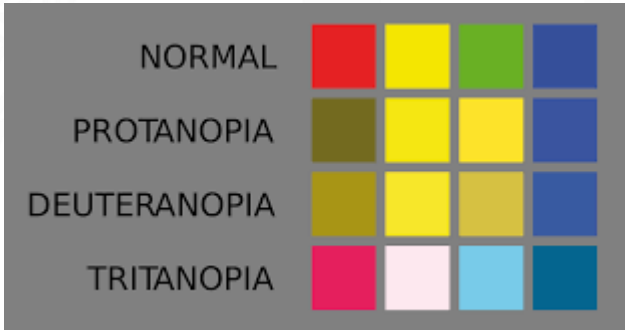
Other issues:

- Color blindness
- Problems of abstract thinking
- Inability to work in groups (introverts)
- Attention span







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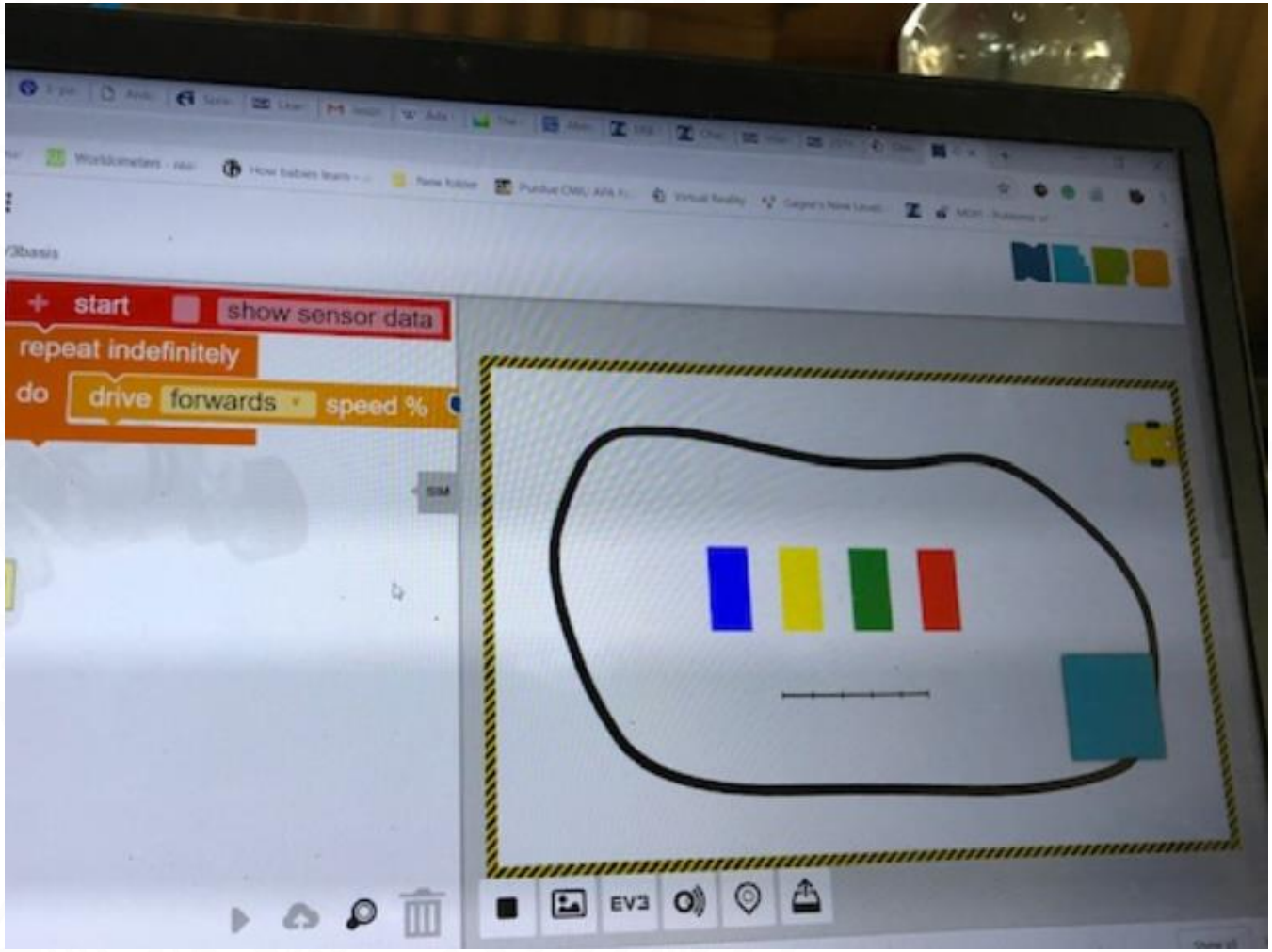

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ROBOSCIENTISTS PROJECT

Motivating secondary school students towards STEM careers through robotic artefact making

Erasmus+ KA2 2018-1PL01-KA201-051129

Creators

Prof. Linda Daniela, Arta Rudolfa (University of Latvia)

Declaration

This report has been prepared in the context of the ROBOSCIENTISTS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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