UNIVERSITY OF CRETE
FACULTY OF EDUCATION
DEPARTMENT OF PRIMARY EDUCATION

“IDENTITIES”

GREECE / UNIVERSITY OF CRETE

KICK OFF MEETING

BOLOGNA, NOVEMBER 2019

Interdisciplinarity

Cognitive-Epistemic approach

Socio-Institutional Approach

(Kahkonen et al. 2016)

Interdisciplinarity

Cognitive – Epistemic approach

- Awareness of disciplinary boundaries and differences of epistemologies
- Understanding of different methodologies in each discipline-grow familiarity with different methodologies
- Disciplinary adequacy in relevant disciplines
- Identifying conflicts between theories and epistemologies
- Create common ground between concepts, grow science argumentation skills

Socio – Institutional approach

- Building networks of people and establishing & keeping relations
- Finding a common place & establishing identity among the team
- Acknowledging value in other disciplines
- Mediating disciplinary perspectives/differences and people - grow leadership of members
- Connect to socioscientific issues

(Kahkonen et al. 2016)

Advanced STEM Topics (O2)

NANOTECHNOLOGY AS INTERDISCIPLINARY FIELD

"The study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale."

(The Royal Society & The Royal Academy of Engineering, 2004)

Advanced STEM Topics (O2)

NANOTECHNOLOGY & INTERDISCIPLINARITY

- Interdisciplinarity gives identity/definition to NST as a distinct domain (Physicists, Chemists, Biochemists, Cell Biologists have been studying phenomena in the nanoscale for centuries)
- Includes complex, authentic problems that relate to students' everyday life that have justification being studied from different disciplines
- Interdisciplinarity in dissemination of work done in NST (journals)
- NST research projects require experts from diverse disciplines
- Contemporary socioscientific issues require that students & citizens have interdisciplinary NST literacy

(Kahkonen et al. 2016)

Advanced STEM Topics (O2)

IRRESISTIBLE PROJECT

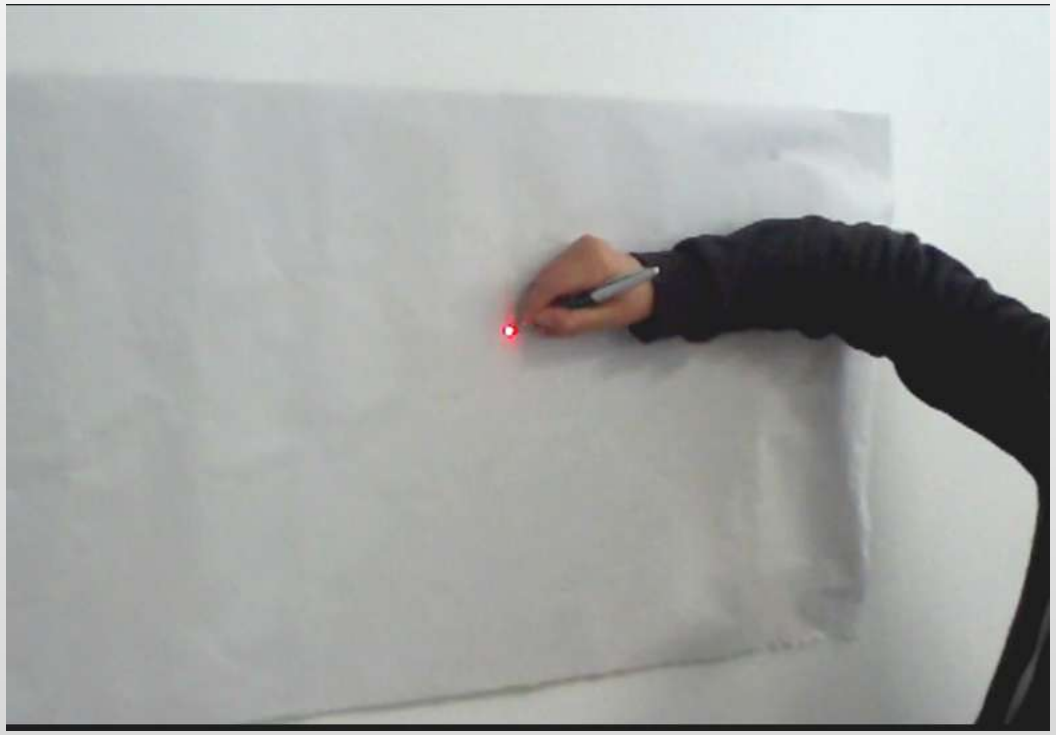
http://www.irresistible-project.eu

Advanced STEM Topics (O2)

EXAMPLES

- Atomic Force Microscope (AFM)
- Self-cleaning materials
- “Smart” house
- Real-time medical care simulation

1. Atomic Force Microscope



1. Atomic Force Microscope

- Problem:

  Build an instrument that allows imaging a surface without visual interaction

- Disciplines:

  S: Forces & interactions, electromagnetic waves

  T: 3D simulations of nanostructures, Coding a robot to navigate a surface with a fixed step, equipped with sensors, wireless data transfer to smart devices

  E: Modelling an AFM, testing efficiency of the model, revising the model.

  M: Graphs

1. Atomic Force Microscope

- Terminology to be shared/agreed:

  e.g. Scanning Probe Microscopy, Atomic Force Microscopy, intermolecular interactions.

- Potential conflicts between insights:

  e.g. model representations

2. Self-cleaning materials

2. Self-cleaning materials

- Problem:

  Common surfaces are not effectively been cleaned

- Disciplines:
  - S: Structure of matter, forces and interactions, stereochemistry
  - T: 3D simulations of molecules
  - E: Constructing a prototype, testing efficiency/durability of the hydrophobic properties of the prototype, revising the prototype, constructing representative models of hydrophobic/hydrophilic surfaces
  - M: Size and scale, geometry of shapes, trigonometry

2. Self – cleaning materials

- Terminology to be shared & agreed:

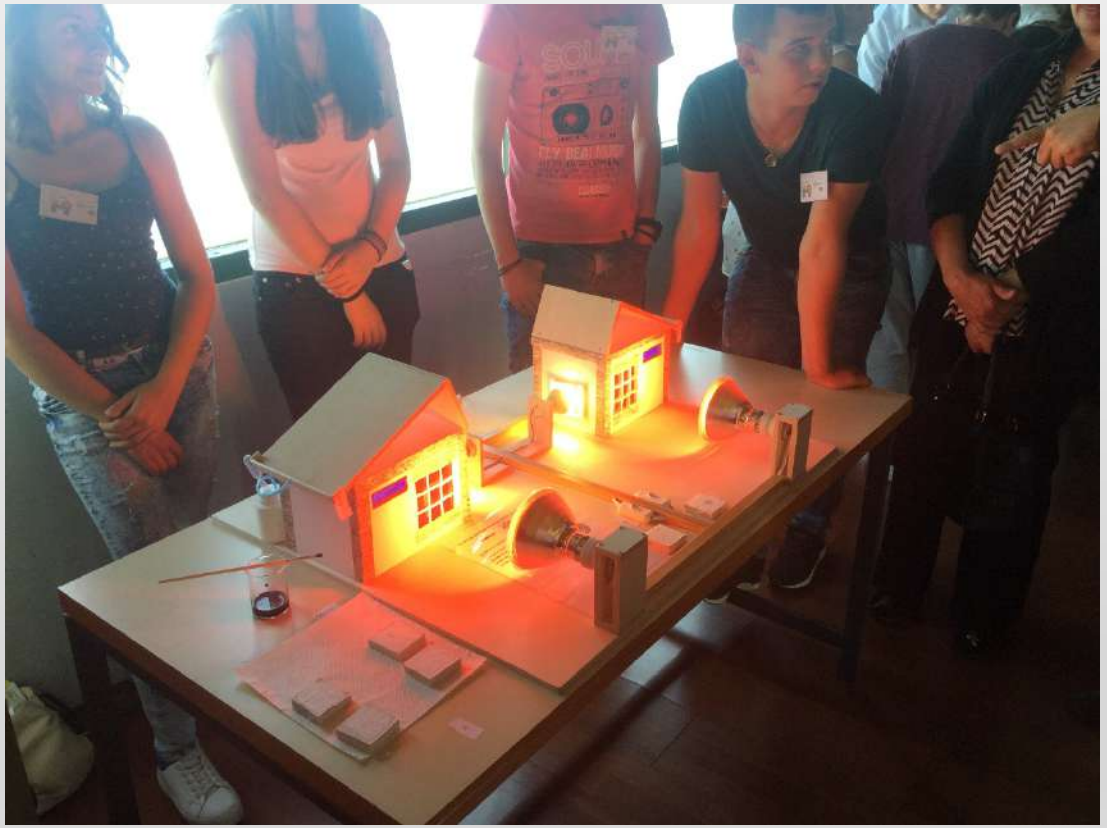
  e.g. self-cleaning, hydrophobic, active surface etc.

- Potential conflicts between insights:

  e.g. model representations & rounding estimations

  different definitions of efficiency (Ph- material efficiency, Ch-efficiency in relation to chemical synthesis, Eng- cost, durability, stability & sustainability).

3. “Smart” house



3. “Smart” house

- Problem:

  Build a smart house with innovative energy-saving & ecological applications

- Disciplines:

  S: Photocatalysis, Hydrophobic/Hydrophilic surfaces, Thermochromic glass

  T: Coding an open source electronic prototyping platform (arduino) to take measurements in the house through electronic sensors

  E: Constructing a house prototype, testing its energy saving efficiency, revising the prototype

  M: Size and scale, geometry of shapes, graphs, percentages

3. “Smart” house

- Terminology to be shared/agreed:

  e.g. Self-cleaning, hydrophobic, active surface, thermochromic glass, heterogeneous photocatalysis, semiconductor TiO_2

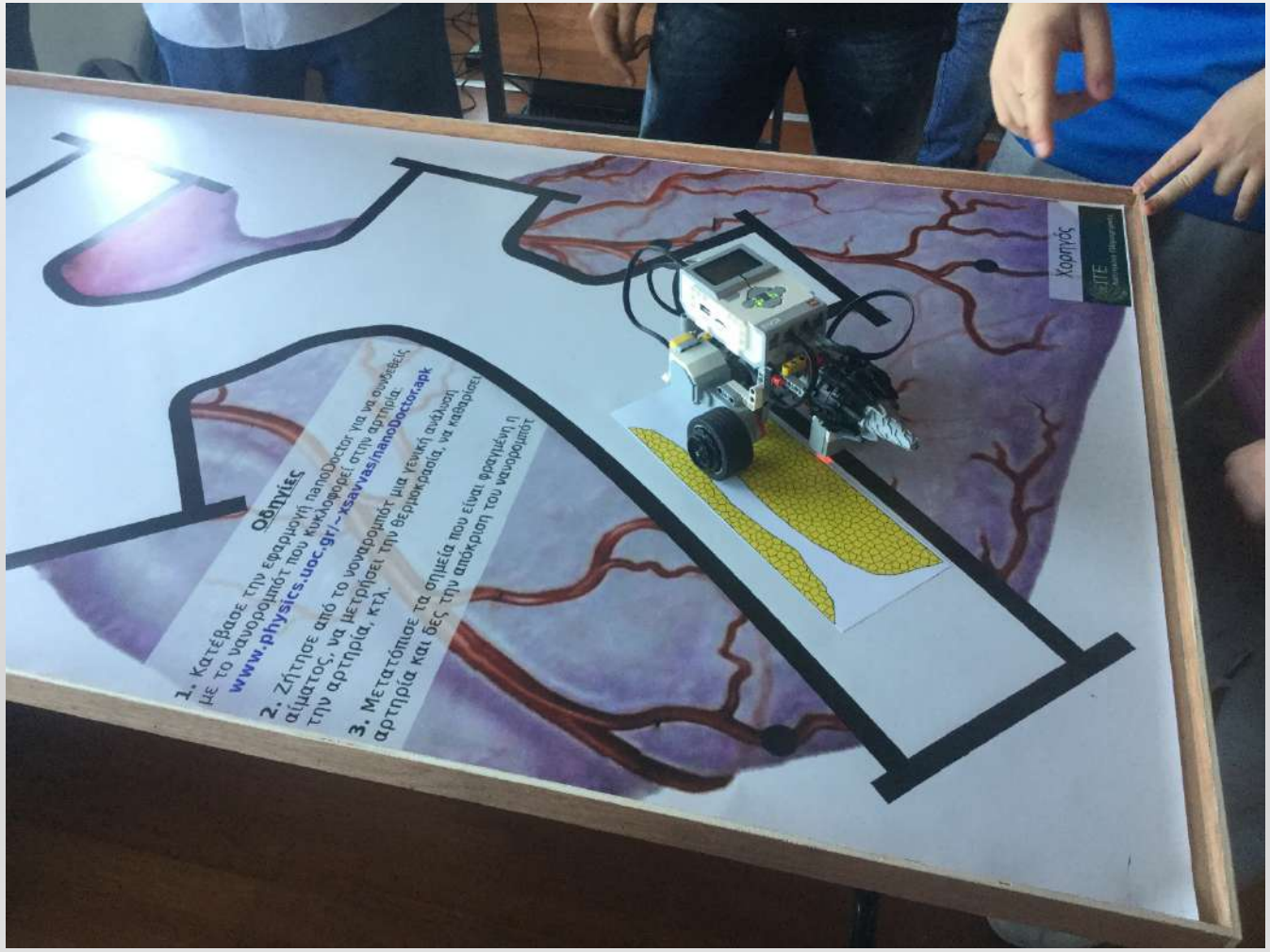
- Potential conflicts between insights:

  e.g. Model representations & rounding estimations

  Organic molecules & semiconductor representations

  Structure orientations (Eng & Math macro level, Chemistry-material level)

4. Real-time medical care simulation



4. Real-time medical care simulation

- Problem:

  Take real-time preventive healthcare measurements of a human body

- Disciplines:

  S: Measures of human body healthcare (blood test metrics, temperature, pressure, concentration of Troponin I), fluid mechanics of blood circulation

  T: Coding a robot to navigate in a blood artery, coding the robot to enact in case of problematic cases (e.g blocked artery), coding the robot to enact in relation to the body organ, wireless data transfer to smart devices

  E: Constructing a robot prototype, testing its navigation ability/efficiency, testing dimensions/weight of the robot in relation to the arteries/structure, revising the prototype

  M: Scales (surfaces & volumes), graphs

4. Real-time medical care simulation

- Terminology to be shared/agreed:

  e.g. types of blood pressure (systolic/diastolic), blood test metrics, blood velocity

- Potential conflicts between insights:

  e.g. Different dimension/shape perspectives (Math & Physics-surfaces, Medicine-surface & flexibility, Chemistry-chemical bondings)

  Blood cell movement/representations

Curricular STEM Topics (O3)

Curricular topics in Greece related to S – T – E – M

Curricular STEM Topics (O3)

EXAMPLES

- Floating water quality investigator
- Windmill
- Solar Cell

1. Floating water quality investigator

1. Floating water quality investigator

- Problem:

  Construct a floating vehicle to investigate the water quality of your domestic marine area

- Disciplines:

  S: Floating principle & buoyancy, density, water quality measures (pH, temperature, dissolved O_2, dissolved CO_2, conductivity)

  T: Digital data collection & analysis (water quality measures), wireless data transfer to smart devices

  E: Constructing a prototype (floating boat), testing flotation/balance/durability/ weight/average density/materials of the prototype, revising the prototype

  M: Descriptive statistics (mean, standard deviation, mean density of a system of objects), Percentages, Beaufort scale estimations

1. Floating water quality investigator

- Terminology to be shared & agreed:

  e.g. buoyant force, balance etc.

- Potential conflicts between insights:

  e.g. Different measures of quality (Ch- concentration of dissolved substances & pH, Eng- macro scale measures/Temperature)

2. Windmill

2. Windmill

- Problem:

  Take advantage of alternative energy sources and improve their efficiency

- Disciplines:

  S: Bernoulli principle, electrical circuits, connecting resistances, angular velocity,
  T: Digital data collection & analysis (voltage/current), wireless data transfer to smart devices

  E: Constructing a prototype, testing efficiency/durability of the prototype (e.g. wing formation, central part, materials, shape, number of wings), revising the prototype

  M: Descriptive statistics (mean, standard deviation), Percentages, Geometry of shapes

2.Windmill

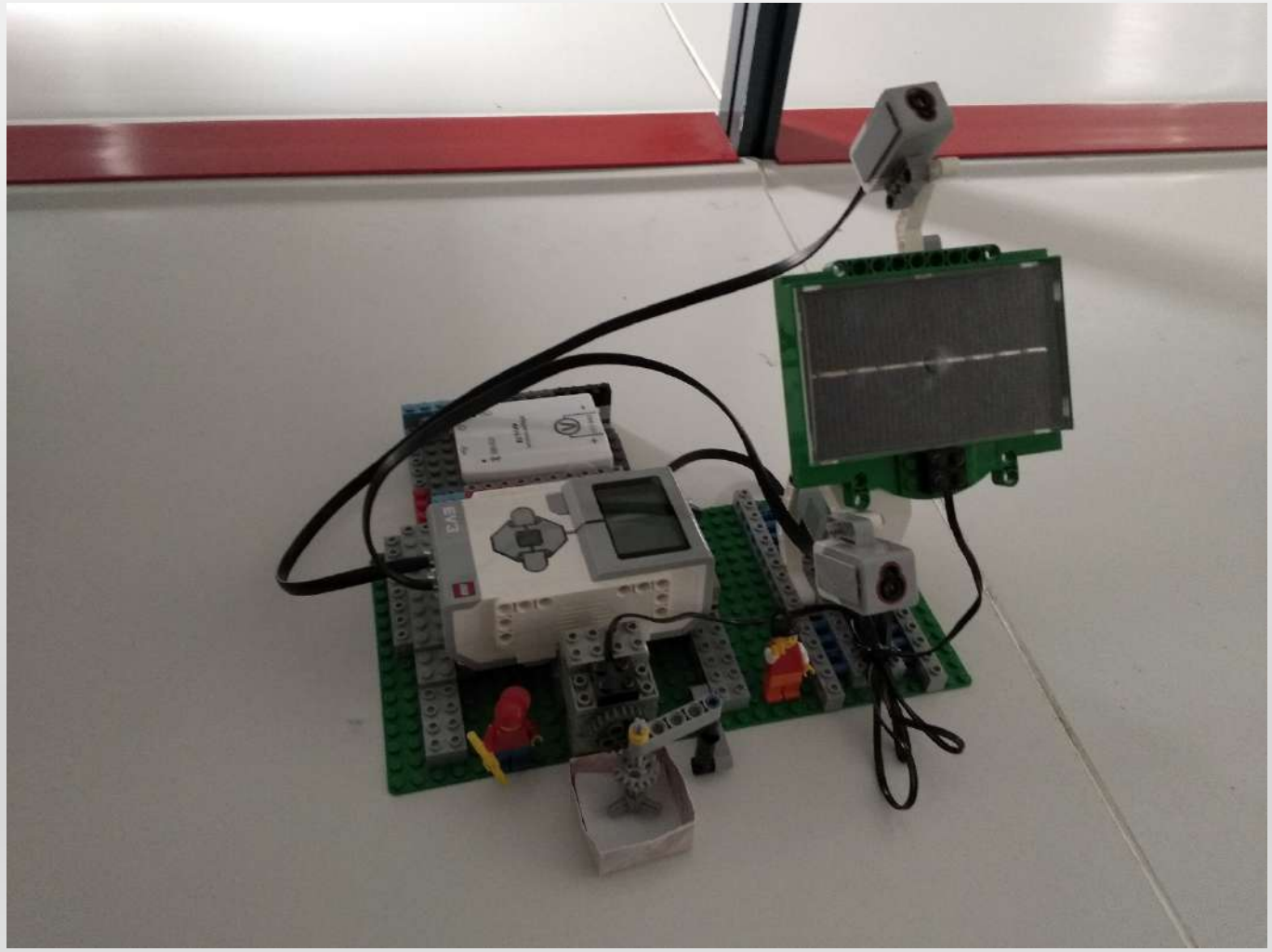
- Terminology to be shared & agreed:

  e.g. efficiency, equivalent resistance, angular velocity etc

- Potential conflicts between insights:

  e.g. Different definitions of efficiency (Ph- material efficiency, Eng- cost, durability, stability & sustainability)

3. Solar Cell



3. Solar Cell

- Problem:

  Take advantage of alternative energy sources and improve their efficiency

- Disciplines:

  S: electrical circuits, connecting resistances, angular velocity

  T: Coding a robot to turn the solar cell panel according to the position/movement of the sun, digital data collection & analysis (voltage/current), wireless data transfer to smart devices

  E: Constructing a prototype, testing efficiency of the prototype (e.g. stability, movement, weight, shape), revising the prototype

  M: Descriptive statistics (mean, standard deviation), Percentages, Trigonometry

3. Solar Cell

- Terminology to be shared & agreed:
  e.g. efficiency, best absorbance angle etc

- Potential conflicts between insights:
  e.g. Different definitions of efficiency (Ph- material efficiency, Eng- cost, durability, stability & sustainability)