CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Introduction to Science, Technology, engineering and Mathematics (STEM) disciplines and related methodologies

Alessandra Tedeschi, DBL
February 20, 2023 – CHOICE JSTE, Larissa (GR)

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

What is STEM education?

STEM is a teaching approach combining Science, Technology, Engineering, and Mathematics, and integrates them into a **cohesive learning paradigm based on real-world applications.**

The STEM acronym was introduced in 2001 by US National Science Foundation.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

What is STEM education?

"In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past."

US National Science Foundation

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education?

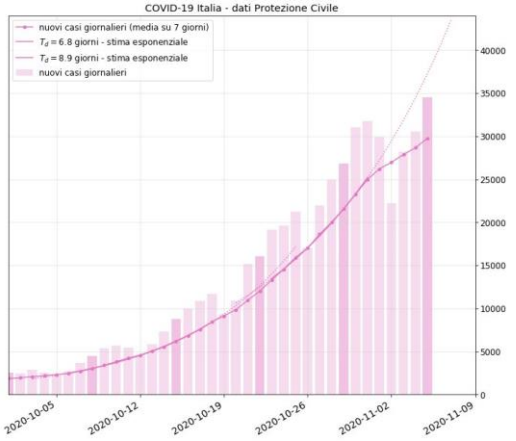
Nowadays, as **innovation** and **technology** go forward side by side, providing students with a strong STEM-oriented education is an ever more **crucial educational priority**.

STEM education not only can help students to be ready and **competitive in the job market**, but also gives them the means to be **more aware citizens**.

Erasmus +

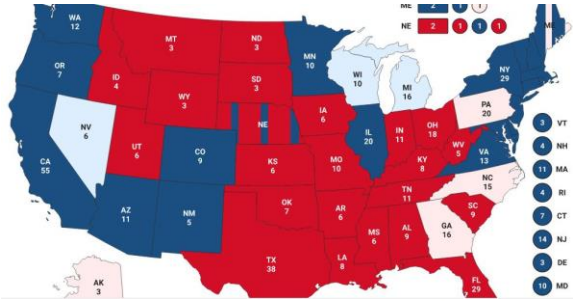
CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education is relevant?



Why is it so important to know an exponential function?

To analyse and forecast the dynamics of an **epidemics**.



What is statistics useful for?

Knowing what «significative sample of a population» means is useful to interpret projections during **elections**.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

What is STEM/STEAM education?

The STEAM approach **adds Arts into the mix**, arguing its role of preparing students for the real world, as it **promotes** not only critical thinking, but also **creativity**.

Integrating arts in traditional STEM makes students **more adaptive** rather than limited by technicalities, teaching them to be more flexible.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education?

STEM education shifts away from the tutor-centered approach into a teaching method that involves **problem solving**, **creative initiative**, research and **hands-on activities**.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education?

Setting students up for future success means exposing them to STEM disciplines holistically in order to **develop** their **critical thinking skills**, teaching them how to think critically, problem solving and use creativity, and preparing them to work in growing fields.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM education and gender an Italian insight

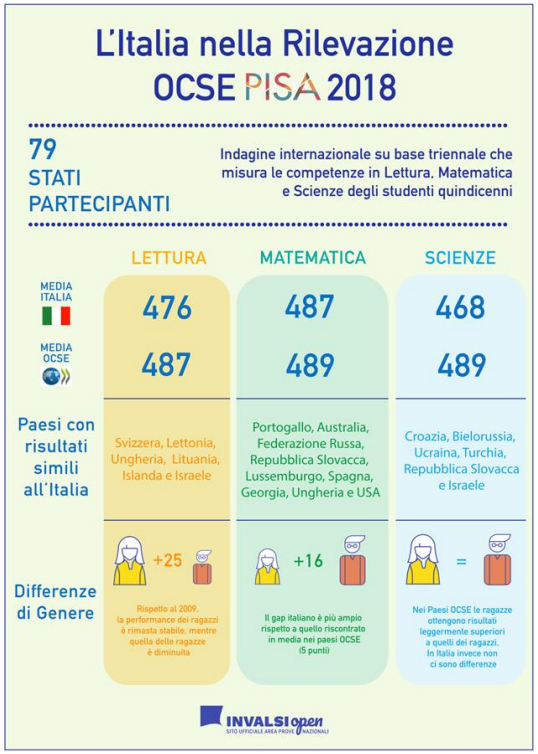
- At higher education levels (University, post-graduate), **only 35% of students are women**. Among scientific researchers, only 28% are women.
- **Gender biases** and **low awareness** of their own attitudes and potential **prevent female students in achieving STEM** subjects in their studies.
- At a young age, **girls and boys show the same interest in STEM**, but strong differences come up in their preadolescence.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education? an Italian insight

- In Italy, high school students' **mathematical** and **scientific** competences are **below average** (OCSE PISA 2018)
- Only **1 out of 4** (27%) University students is studying a **STEM major**
- **Gender bias**: female students math competences is below average



Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education? CHOICE partners countries

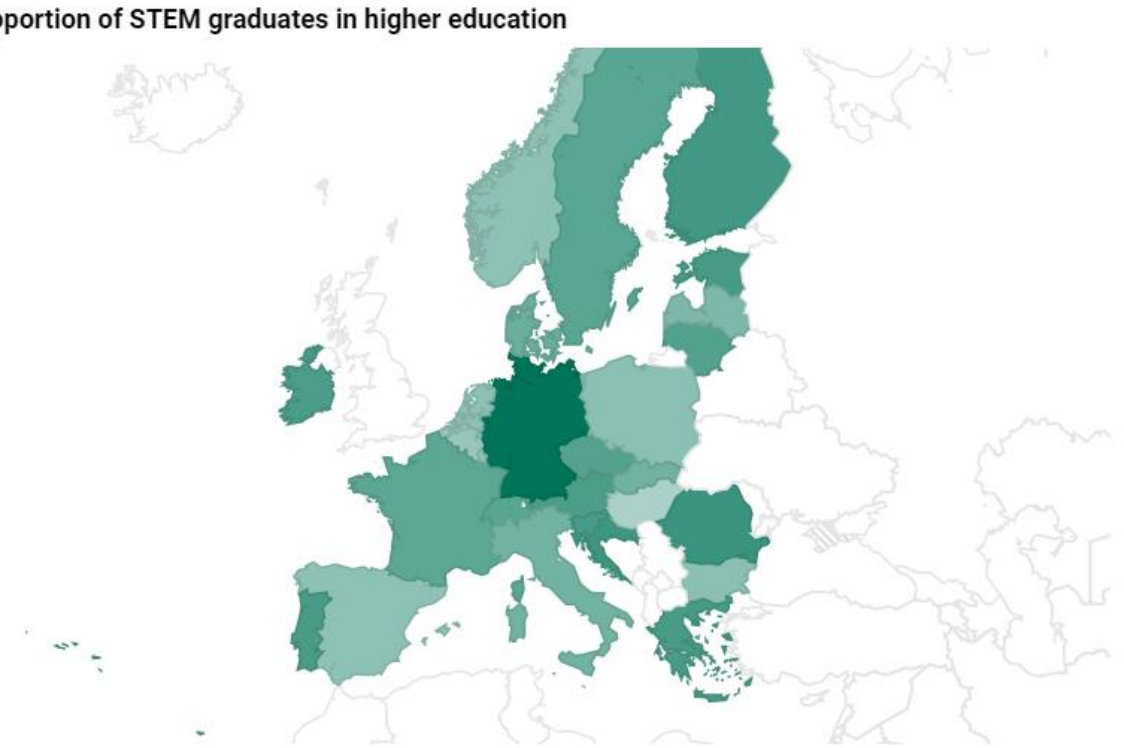
- 25.8% of university graduates graduated in STEM subjects in the EU in 2019 (Eurostat).
- 2.5% (F) vs 13.9%(M) 15yo Romanian students expecting to work in ICT at age 30 (PICS 2018)
- Only 11% of Greek students expect to enroll in STEM majors (PISA 2018)

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education? CHOICE partners countries

- Greece:27.4%
- Italy:22%
- Poland:19.4%
- Romania:29%
- Türkiye: 17%



Source: EU STEM Coalition

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM education and gender how to fill the gap?

New approaches to STEM education could help fix the gap between men and women in STEM, fostering female students' interest.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education?

STEM education fosters crucially important aspects

Teamwork

Children learn to work in teams at a very young age. Communicate, argue, disagree and cooperate are at the basis of group productivity and interpersonal relationships.

Problem solving

The ability of defining and assessing a problem, think of possible solutions/alternatives and test one's hypotheses. STEM education Hands-on activities are directly linked to problem solving.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Why STEM education?

Focus on real-world issues

Thanks to a transversal approach, STEM education focuses on real world problems, pushing students to think “out of the boxes” of subjects and to think holistically.

Systemic Thinking

It is the ability to search for and understand the complexity of underlying connections between the system’s elements and components, so to go beyond the simplistic “cause-effect” thinking.

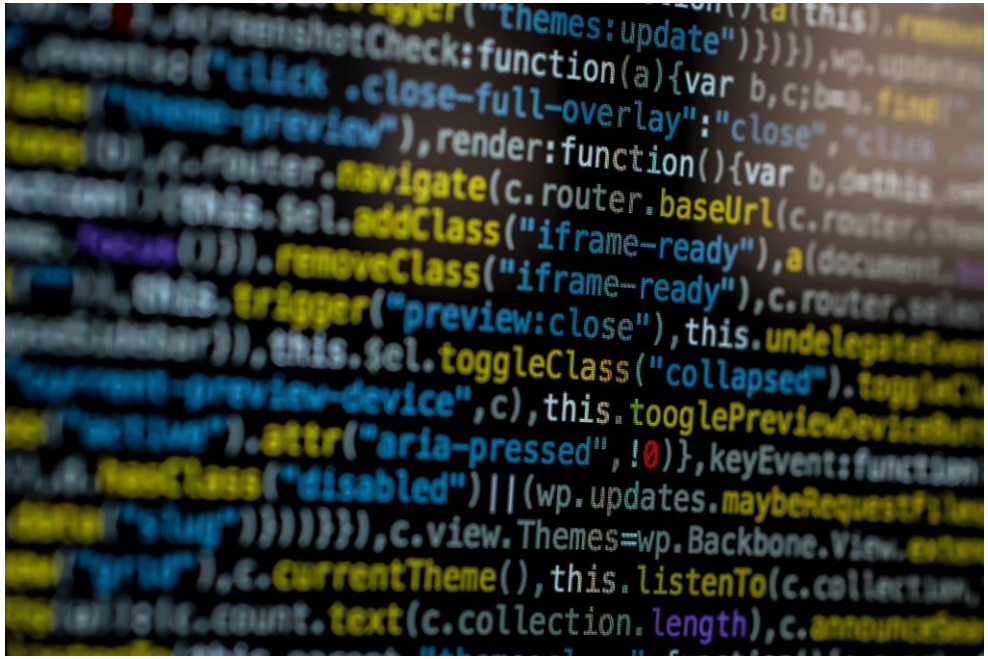
Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Competences

STEM education directly affects students' development of pivotal competences

Digital Literacy: knowledge and familiarisation with new digital technology (e.g. coding).



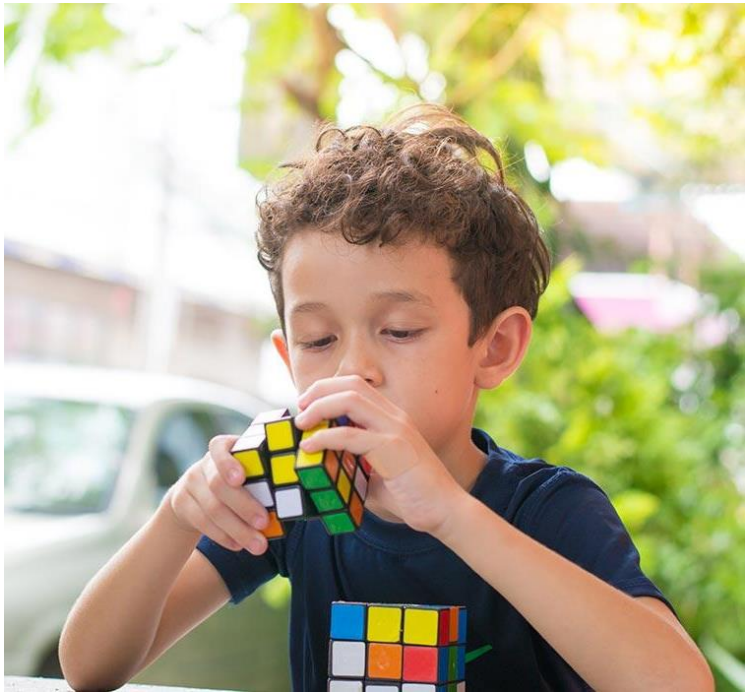
Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Competences

STEM education directly affects students' development of pivotal competences

Ingenuity: fostering creative approaches to conceive new ideas, development of critical thinking, enhancing problem solving ability

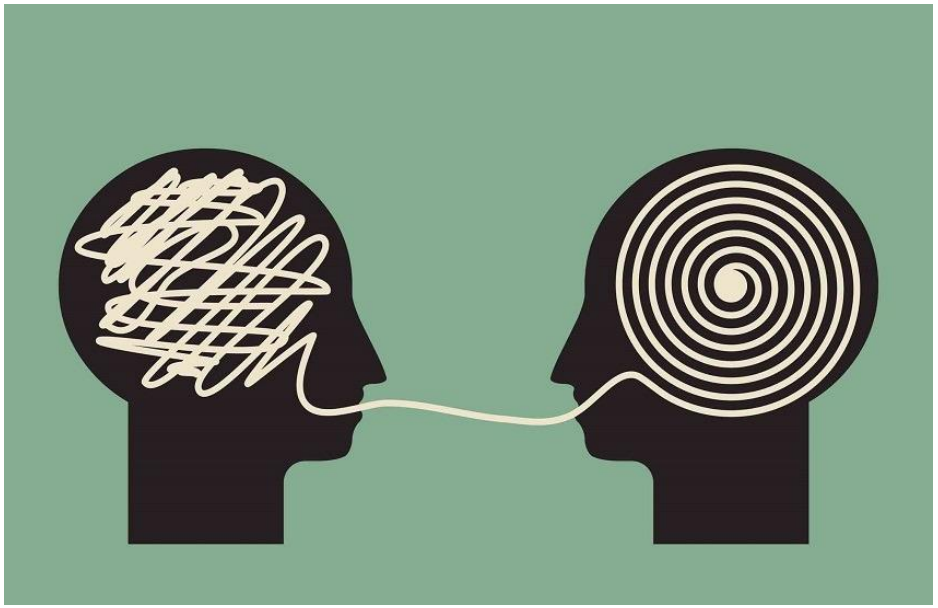


CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Competences

STEM education directly affects students' development of pivotal competences

Effective Communication: developing communicative skills to build social skills and team work attitudes

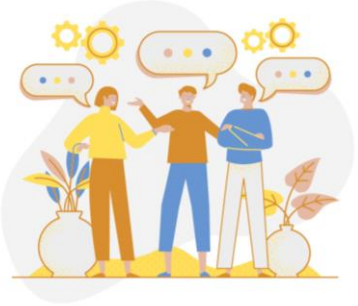


CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Competences

STEM education directly affects students' development of pivotal competences

High Productivity: focus on problem solving and «out of the box» way of thinking

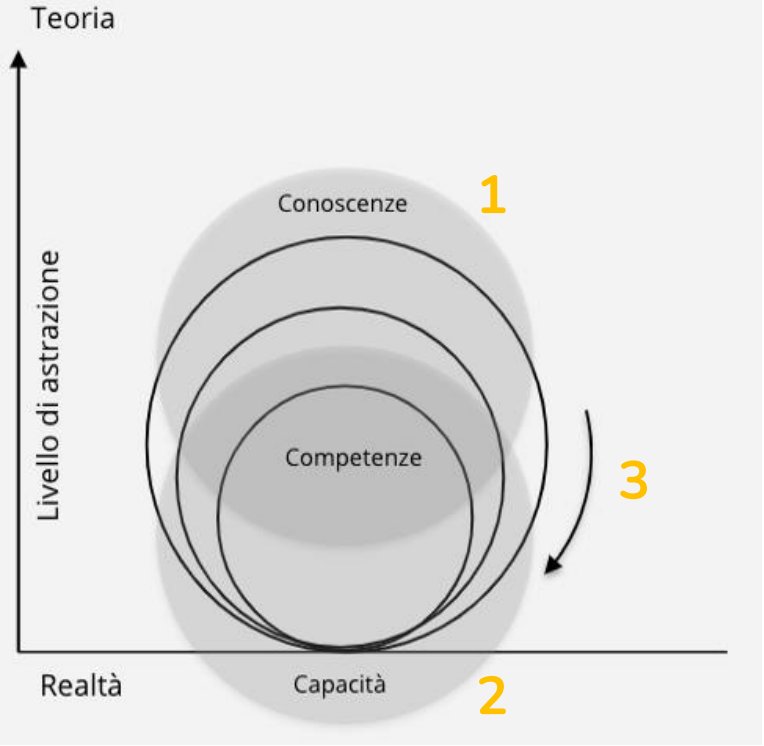


CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

How to develop STEM-related Competences

To be effective, STEM education is based on 3 key principles

1. **Theoretical Knowledge**
2. **Skills/Abilities**
3. **Iteration and Training**



CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

How to develop STEM-related Competences

To be effective, STEM education is based on 3 key principles

Theoretical Knowledge: gained through study of the theory and first-hand experience.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

How to develop STEM-related Competences

To be effective, STEM education is based on 3 key principles

Skills/Abilities: new skills and competences are trained and honed through experience.

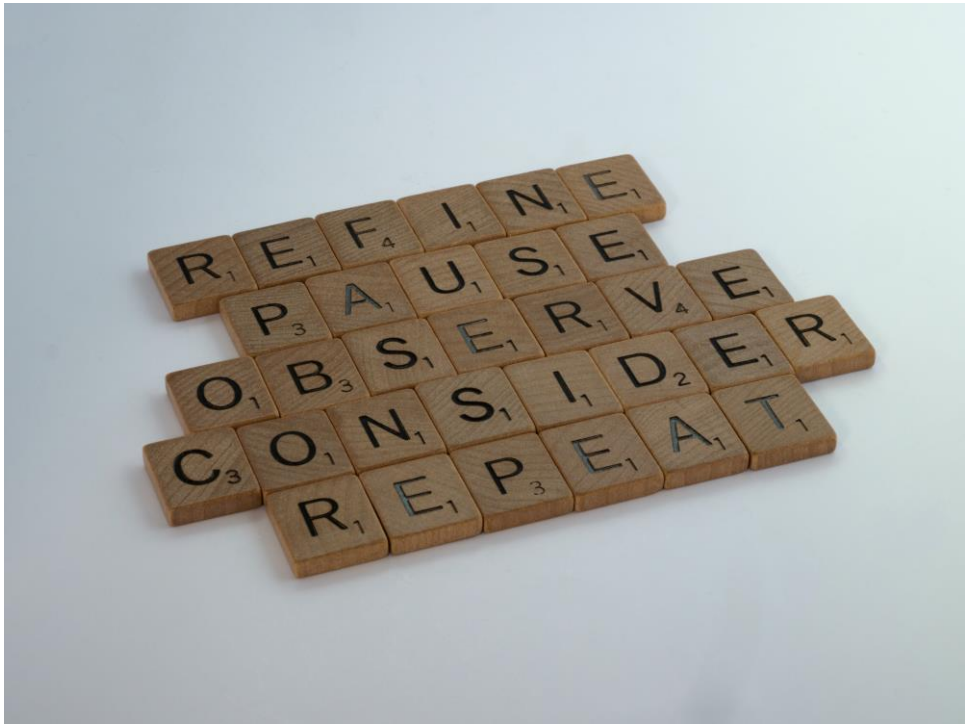
Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

How to develop STEM-related Competences

To be effective, STEM education is based on 3 key principles

Iteration and Training: acquired skills and competences are constantly trained in a continuous cycle of «theory-application».

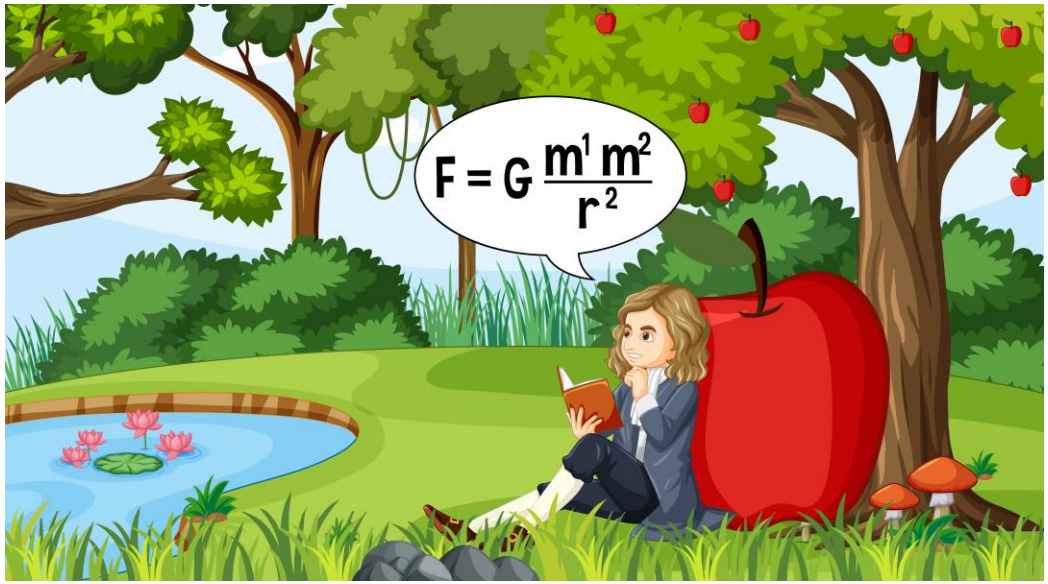


CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Methodologies

STEM education differs from classical frontal class from a strategic and methodological PoV

Knowledge and integrated Application: fosters knowledge acquisition through practical applications.



CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Methodologies

STEM education differs from classical frontal class from a strategic and methodological PoV

Problem-solving: fosters collaborative and constructive problem-solving.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Methodologies

STEM education differs from classical frontal class from a strategic and methodological PoV

Laboratory activities: gives the chance to apply newly acquired knowledge in practical laboratory activities, strengthening connections between theory and practice in the real world.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

STEM-related Methodologies

STEM education differs from classical frontal class from a strategic and methodological PoV

In this way, **new concepts** are **built** from **empirical and actual practices,** and are **instrumental** to achieve **practical goals**, facilitating adaptation and exchange among peers.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

How to develop STEM-related Competences

Some STEM approaches and techniques

- **Story-telling** and Science Theatre
- **Role-playing**
- **Debates**
- **Digital Challenges** in teams
- **Connecting** students **with scientists** and research groups

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

The Mistery Liquid

- The teacher bring a bottle containing a **transparent liquid**.
- What is it? Water, spirit, etc. (students start spontaneusly to formulate **hypotheses**)
- How to understand **what is contained in the bottle**?
- The students have to define an **experimental protocol** to analyse the liquid and verify or discard their hypotheses.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

The Mistery Liquid

- Defined an experiment (or a series of experiments) the needed instruments are identified (a lighter, a scale, etc.)
- The students start to take measures.
- The teacher introduce the concept of **uncertainty** and measurement **error**.
- Repeating the measures and making the **average** of the obtained results reduces the error.

Erasmus +

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

The Mistery Liquid

- The observed phenomenon must be **repeatable**.
- After the experiment we have an answer, we found our **thesis**.
- This is not «the truth» but a conclusion that can be **confirmed or revised** after other experiments.

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

References

- https://www.umultirank.org/blog/In-which-European-countries-are-STEM-graduates-most-highly-recognised/
- https://www.invalsiopen.it/risultati-ocse-pisa-2018/
- https://gpseducation.oecd.org/CountryProfile?primaryCountry=GRC&treshold=10&topic=PI#
- https://gpseducation.oecd.org/CountryProfile?plotter=h5&primaryCountry=ROU&treshold=5&topic=PI
- https://www.stemcoalition.eu/data

CHOICE
CitizensHip cOmpetences to tackle clImate ChangEs

Thank you for your time!

Alessandra Tedeschi
alessandra.tedeschi@dblue.it

Erasmus +