FEDORA

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ESERA 2023 Cappadocia

Educational Reconstruction to Promote (Physics Epistemic) Identity

Cappadocia, August 31st

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Backgrounds

- Science (**as a school subject**) is often seen as not **relevant** by students: no space for reflection, arguments and personal views (Sjoberg, 2001; Levrini, 2014)

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Vocational Relevance

- Career paths

Societal Relevance

- Responsible participation within society

Personal Relevance

- Interest, curiosity, intellectual development

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"A key aspect in the lives of young is the search for meaning and relevance. They like areas where their voice is taken seriously, where their views count. Science and mathematics have an image of authority, at least as school subjects. Answers are either right or wrong. There is no place for arguments and personal views" (Sjoberg, 2001)

Vocational Relevance

- Career paths

Societal Relevance

- Responsible participation within society

Personal Relevance

- Interest, curiosity, intellectual development

(Stuckey et al., 2013)

Backgrounds

- Objective: work for a (science) education which could be considered not only VOCATIONALLY but also

SOCIALLY AND PERSONALLY RELEVANT

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SOCIALLY AND PERSONALLY RELEVANT

"A Bildung-oriented education […] is aimed at making the student capable for **a self-determined life** in his/her socio-cultural environment, for participation in a democratic society, and for empathy and solidarity with others (Sjöström and Eilks, 2018)

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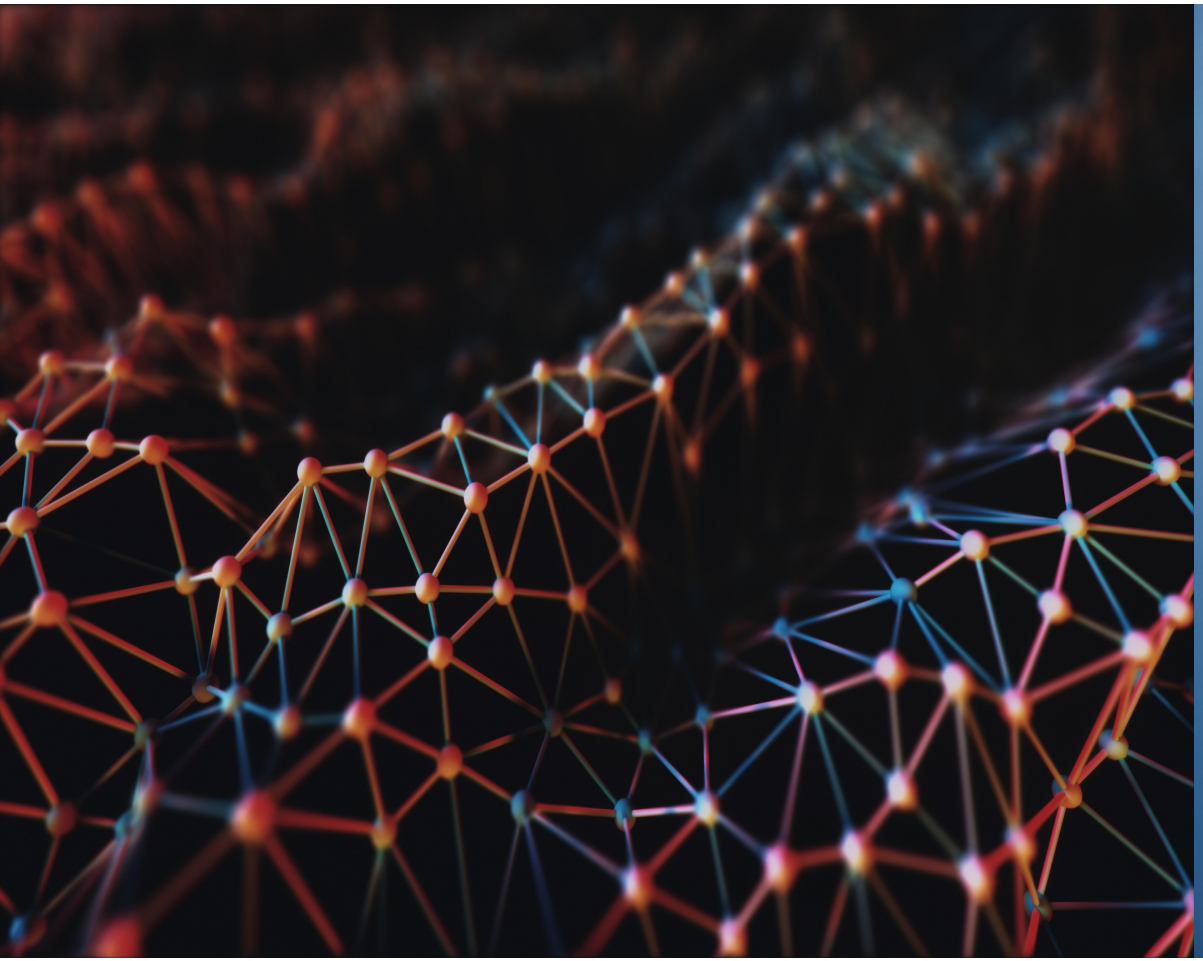
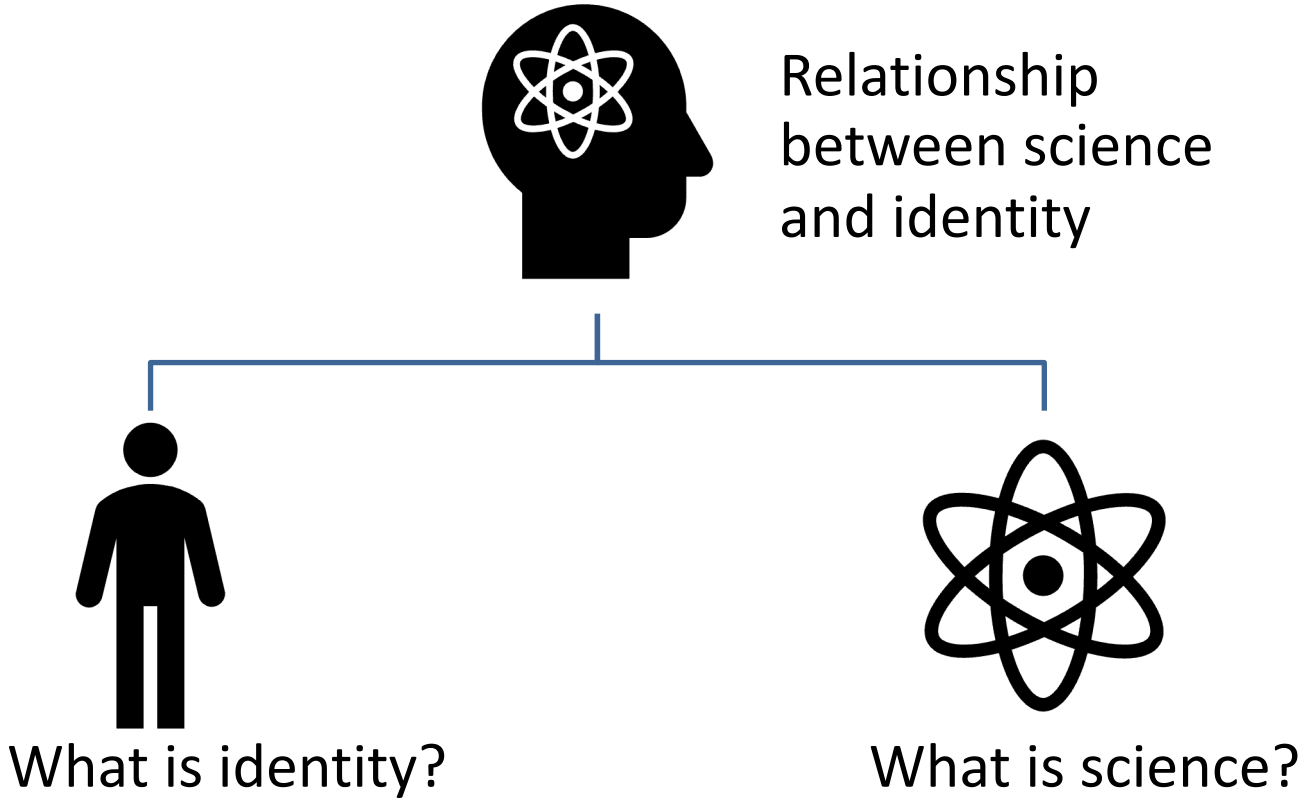
→ "Form the self" → "identity development"

Research objective



What is the relationship between students' identity development, and the science learning experience?

Roadmap discussion



What is identity?

"The debate on the definitions of identity in science and mathematics education is controversial since each definition is an expression of a research approach, a way of looking at science or mathematics, education and, more broadly, a "worldview" […] each definition is ***consistent with a research model that has different epistemic aims, ideals and processes****"*

(Levin, Levrini and Greeno, 2018)

Approaches to identity

"The debate on the definitions of identity in science and mathematics education is controversial since each definition is an expression of a research approach, a way of looking at science or mathematics, education and, more broadly, a "worldview" […] each definition is ***consistent with a research model that has different epistemic aims, ideals and processes****"*

(Levin, Levrini and Greeno, 2018)

Approaches to identity

Discursive approach (Gee, 2000):

A source of power defines an identity, then **interiorized through a discourse with others**.

TABLE 1 Four Ways to View Identity

Process		Power	Source of power
1. Nature-identity: a state	developed from	forces	in nature
2. Institution-identity: a position	authorized by	authorities	within institutions
3. Discourse-identity: an individual trait	recognized in	the discourse/ dialogue	of/with “rational” individuals
4. Affinity-identity: experiences	shared in	the practice	of “affinity groups”

Approaches to identity

Narrative approach (Sfard and Prusak, 2005):

“we suggest that identities may be defined as collections of stories about persons […] as ***those narratives about individuals that are reifying, endorsable and significant****.”*
(Sfard and Prusak, 2005)

- **identity ontology within the words** and discourses.

Approaches to identity

Knowledge-based approach (diSessa, 2018):

Identity as a characterization, based on the knowledge acquisition and utilization.

Characterization is built up by:

- Using a **descriptive vocabulary**
- Adopting a **specific perspective**
- Making an **inferential backdrop**

- **MANAGED** identity
- **PROJECTED** identity
- **PERSONAL** identity

Approaches to identity

Practice-based approach (Nasir and Hand, 2008):

Identity existing *within and in relation* to a practice:

“practice-linked identities are the identities that people come to take on, construct, and embrace that are linked to participation in particular social and cultural practices”. (Nasir and Hand, 2008; p.147)

Approaches to identity

Operational-analytical approach (Carlone and Johnson, 2007):

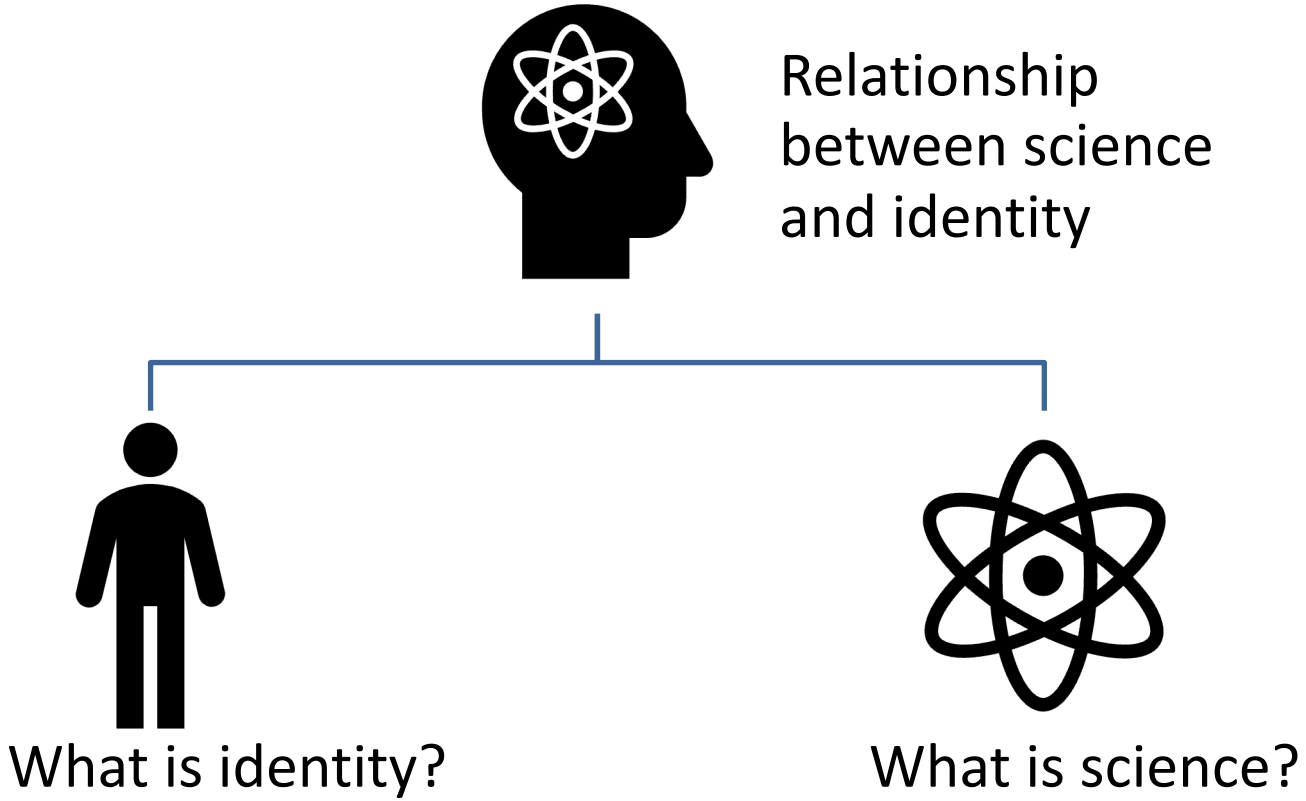
- Identity as an **operational lens,** unpacked into markers:

- Competence
- Performance
- Recognition

Approaches to identity

- Identities as trajectories
- Trajectories directioned by people, contexts, experiences…

Roadmap discussion

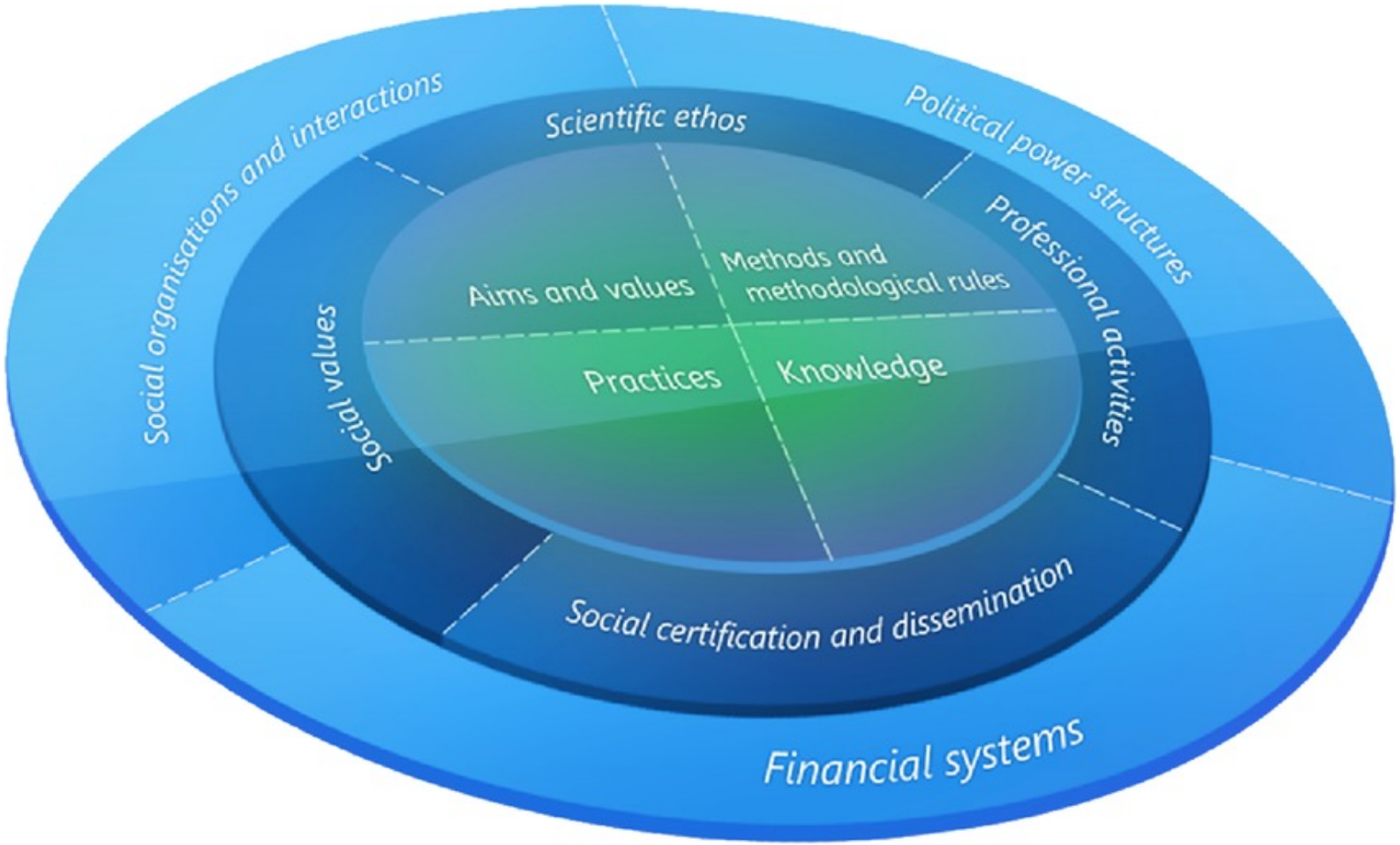


What is science?

FRA to NOS Reconceptualization
(Erduran and Dagher, 2014):

- the nature of STEM disciplines is defined through resemblance

- scientific disciplines as composed of two main blocks (interacting):
  - *cognitive-epistemic*
  - *social-institutional*

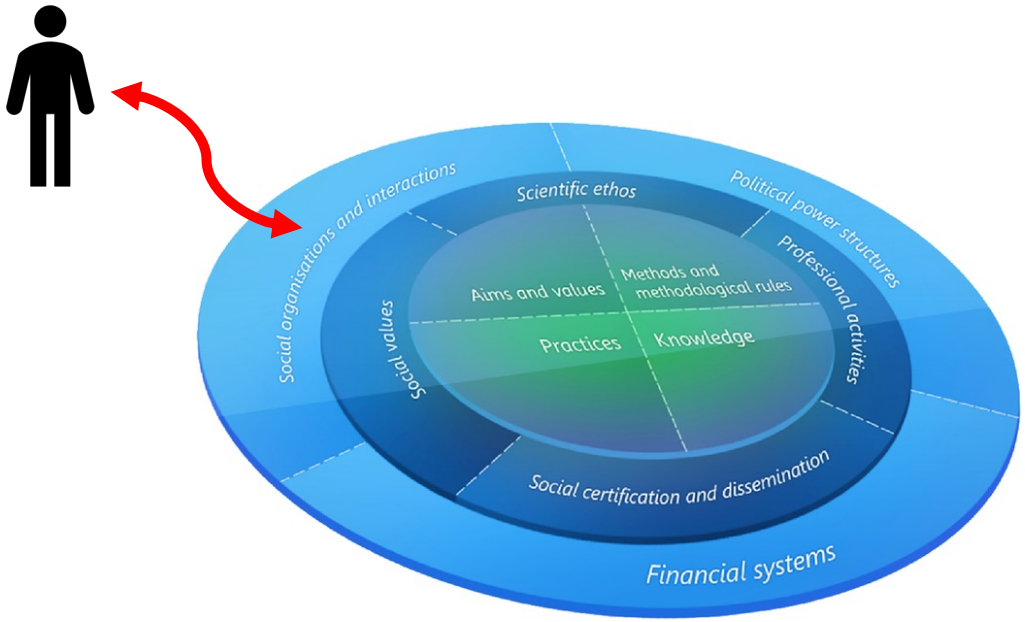


Research choice

Inquire the relationship between identity and the social-institutional nuances of science.

Hence, for commensurability, a **socio-constructivist approach to identity.**

→ **Identity as sense of belonging**



Research choice

Inquire the relationship between the individual and the social-institutional nuances of science.

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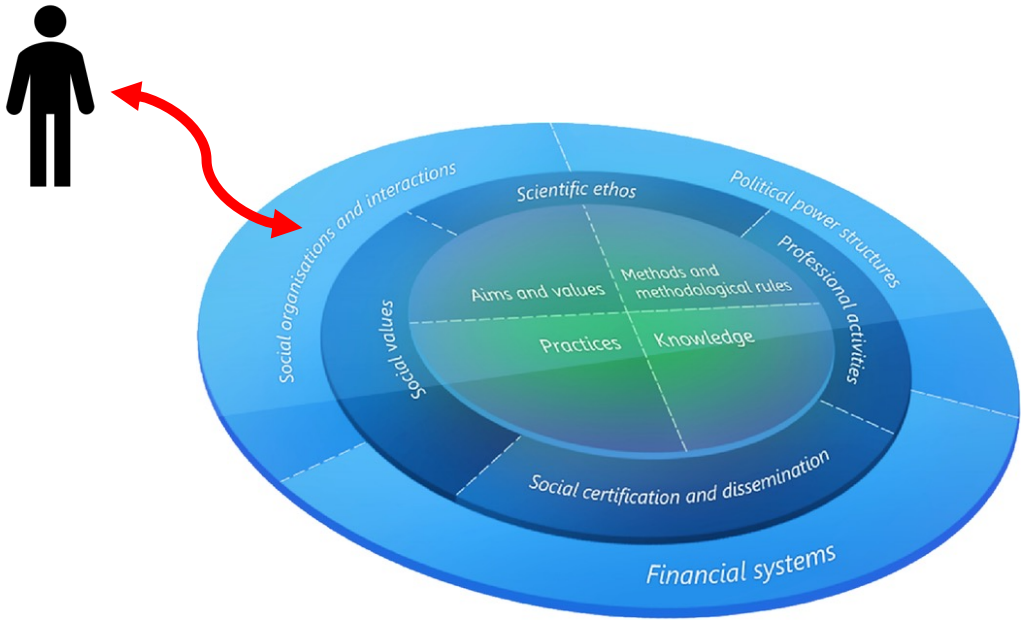
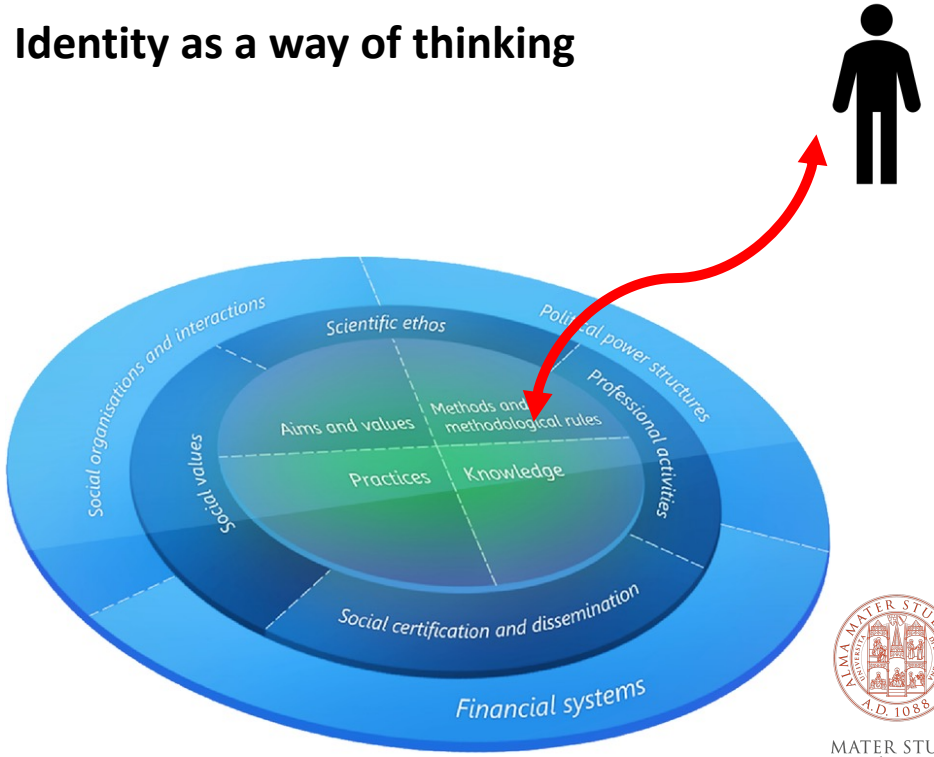


Inquire the relationship between individual and the cognitive-epistemic nuances of science.

Hence, for commensurability, a **cognitivist approach to identity,** based on conceptual change scholarship.

→ **Identity as a way of thinking**



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An example from conceptual change

Context:

- Extended intervention on thermodynamics with secondary school students (grade 12)

Design principles:

- Longitudinality
- Multiperspectiveness
- Multidimensionality

Articles

Defining and Operationalizing Appropriation for Science Learning

Olivia Levrini, Paola Fantini, Giulia Tasquier, Barbara Pecori & Mariana Levin

Pages 93-136 | Accepted author version posted online: 06 Jun 2014, Published online: 09 Dec 2014

Download citation https://doi.org/10.1080/10508406.2014.928215 Check for updates

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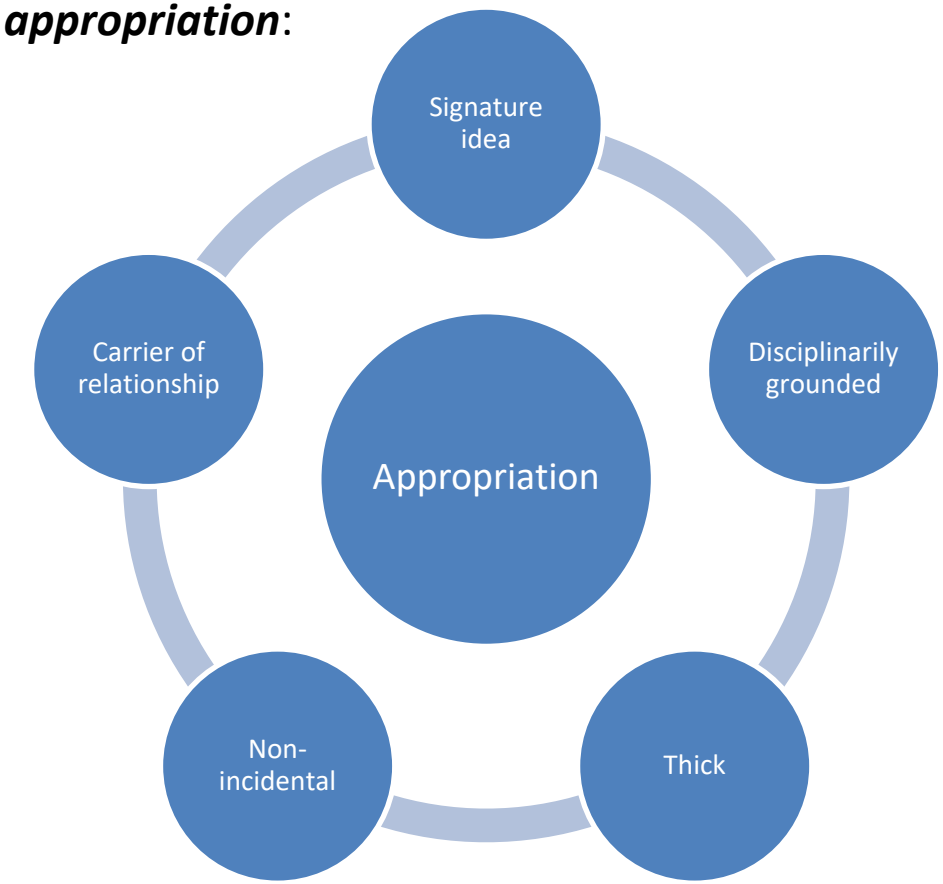

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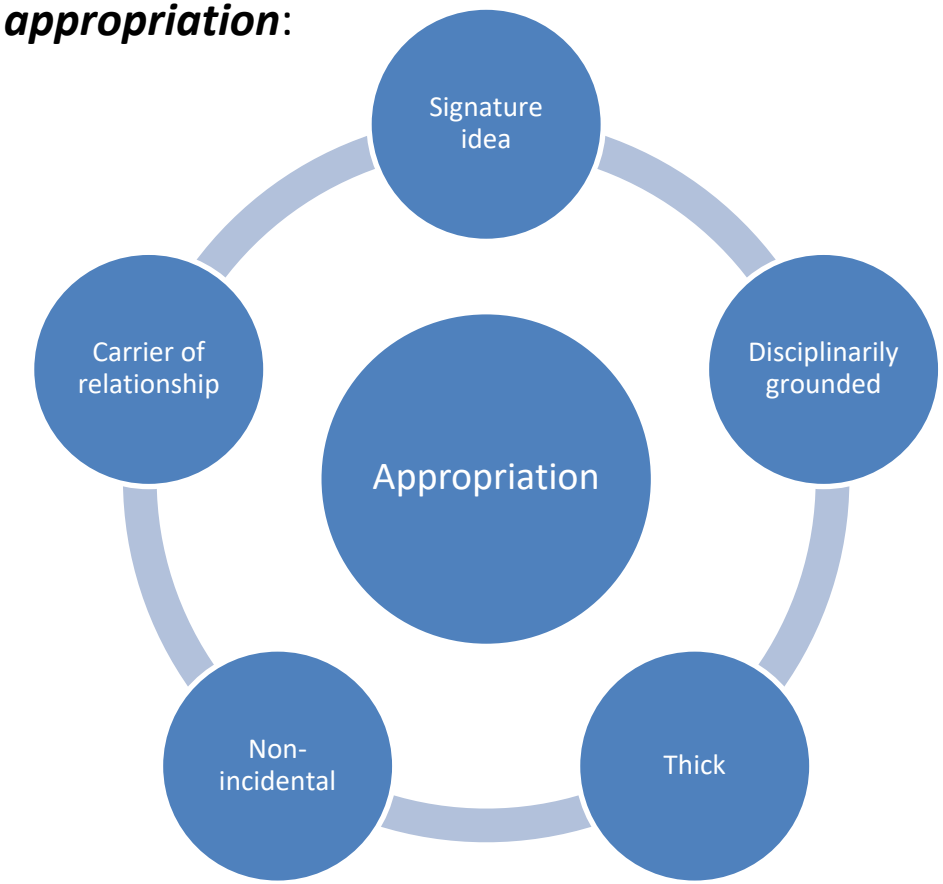

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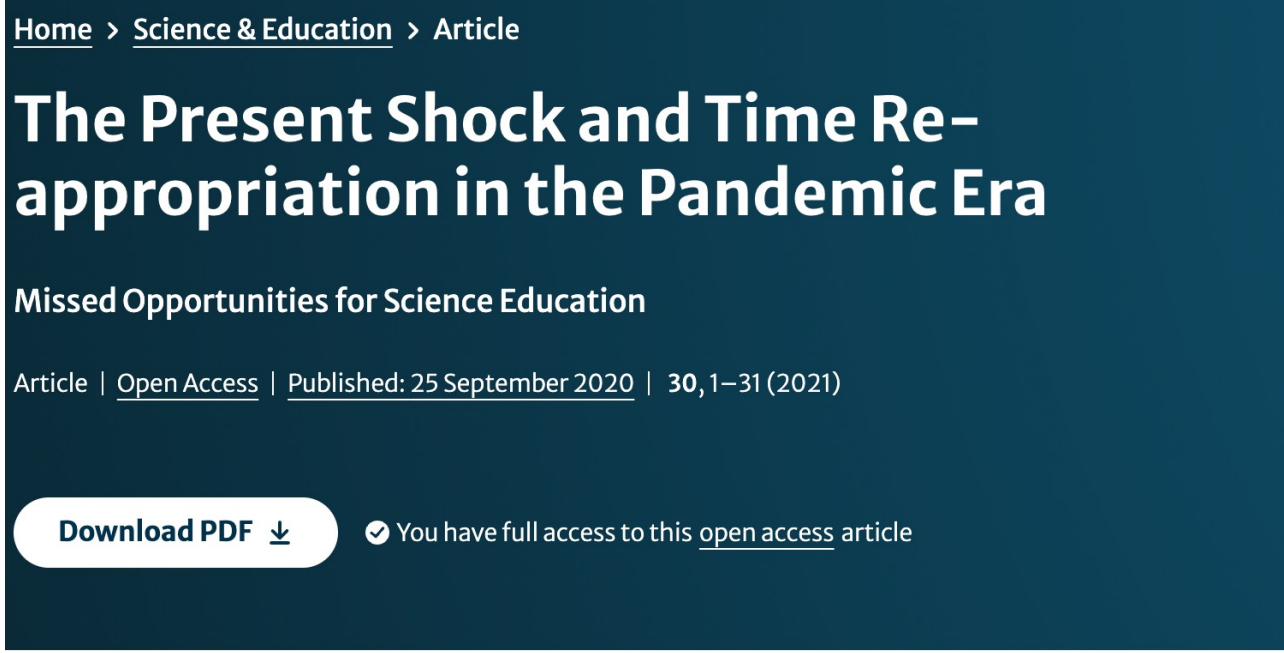
"Appropriation (means) learning science in a way that is deeply integrated into students' personal construction of their sense of self " (Levrini et al., 2014)

Time in the society of acceleration

- Time is too fast (Rosa, 2013), we feel alienated from it
- Tension between **external** and **internal time** (Prigogine, 1978; Levrini, 2020)
- Alienation from the self and the others: ***situational identity*** (Rosa, 2013)



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The Present Shock and Time Re-appropriation in the Pandemic Era

Missed Opportunities for Science Education

Article | Open Access | Published: 25 September 2020 | 30, 1–31 (2021)

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Olivia Levrini, Paola Fantini, Eleonora Barelli, Laura Branchetti, Sara Satanassi & Giulia Tasquier

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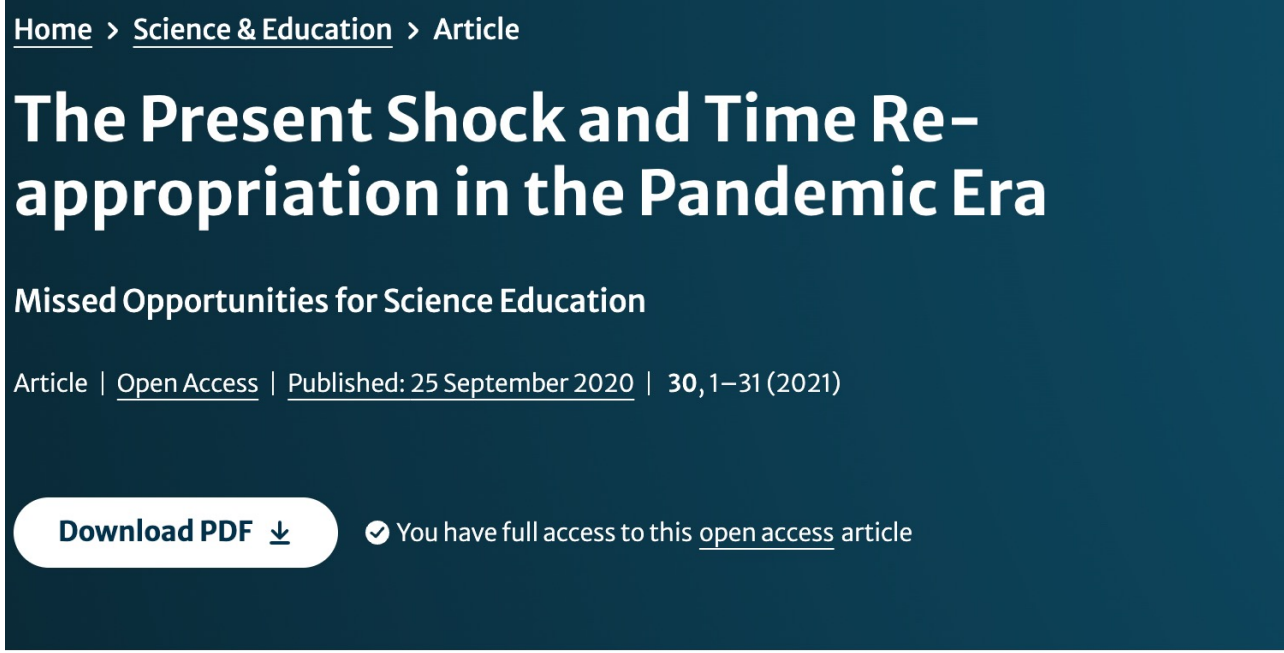
Time-appropriation:

- Time as an agenda
- Time as a container
- Time as an opportunity for yourself



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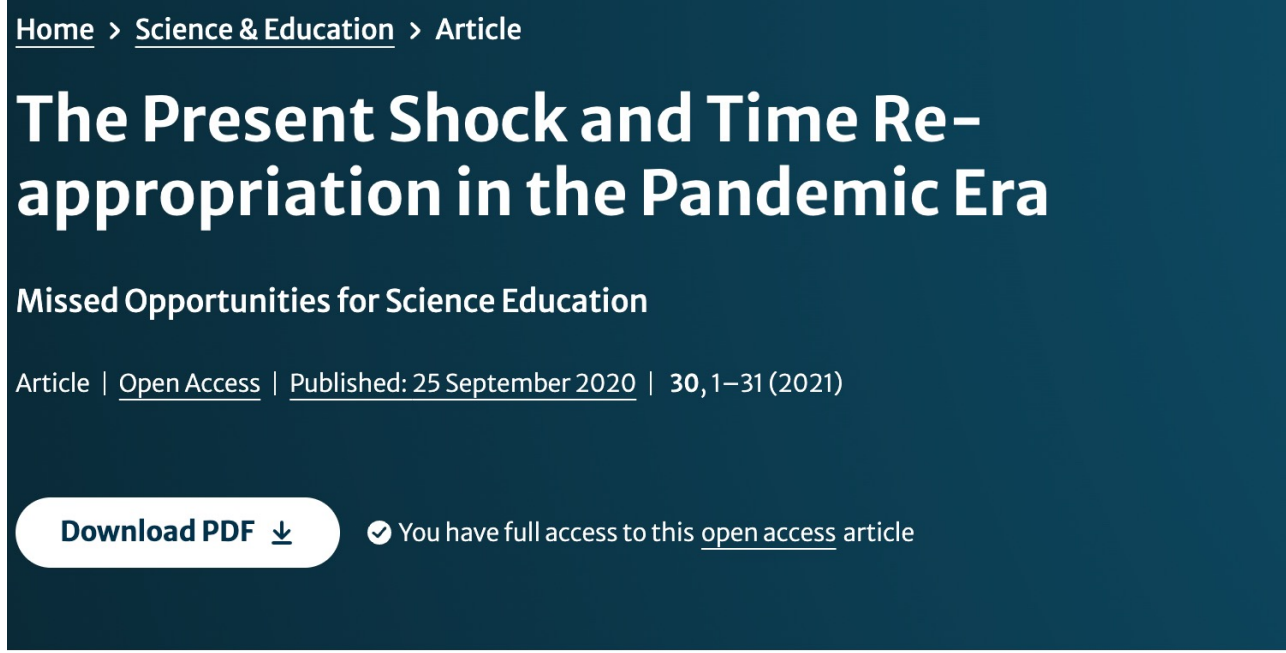

Re-discover rituals

Find a sense of directionality

Agency

→ To re-appropriate time → To "*overcome situationality*"

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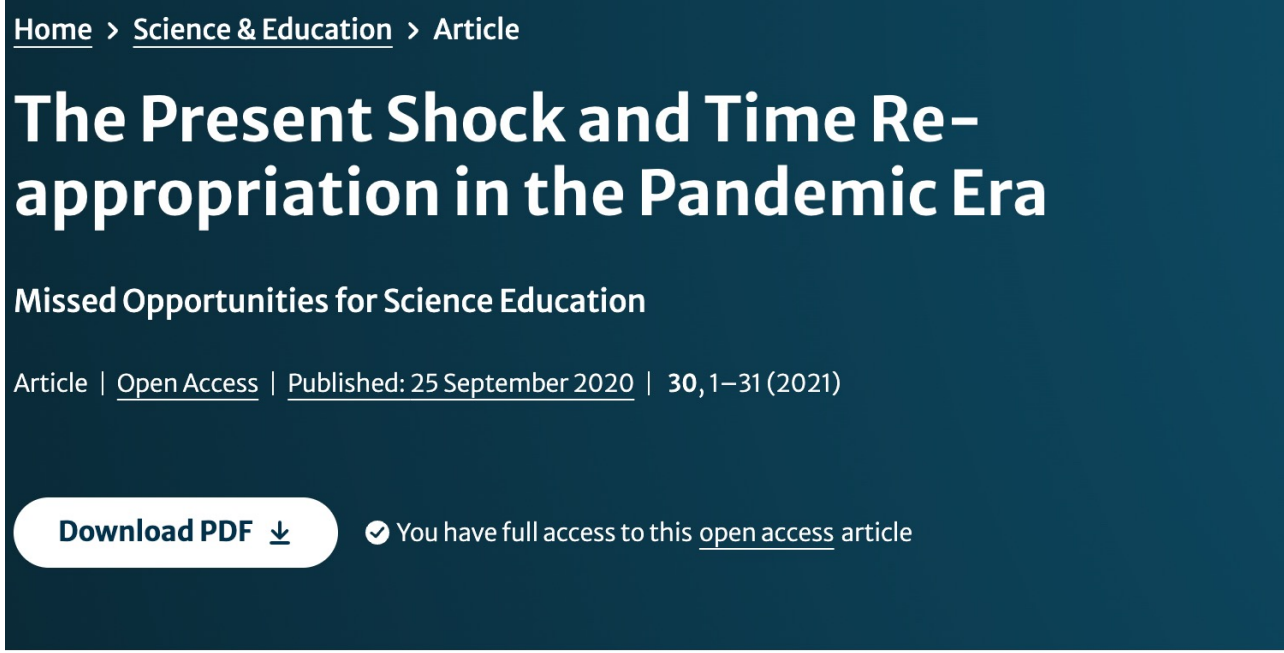
Time in the society of acceleration

Do students capitalize on school science to **re-appropriate** time, and overcome **situationality**?

- School science as a "*source of escape from the thoughness of reality*", which "*restore a sense of normality*" since its "*a-historical and certain paradigm*" helps to establish "*isolated safe bubbles detached from society*". (Levrini et al., 2021).



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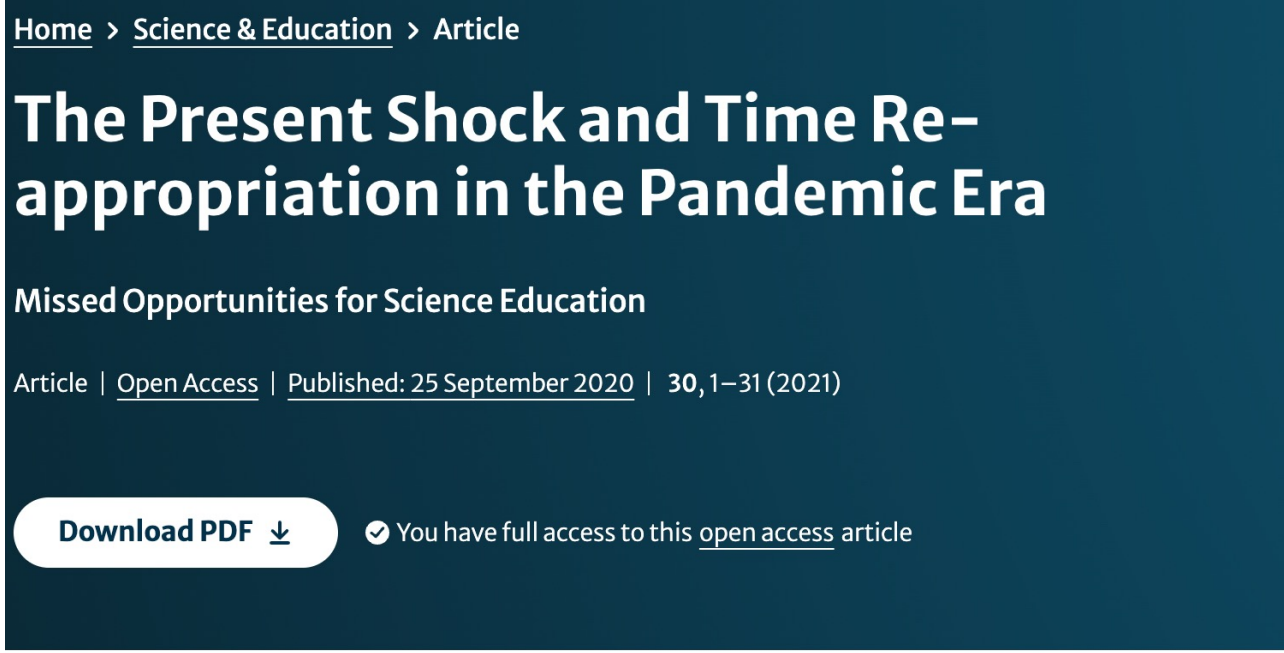
- School science does not help to align the **internal** and **external** time, hence reinforcing the sense of **situationality**.



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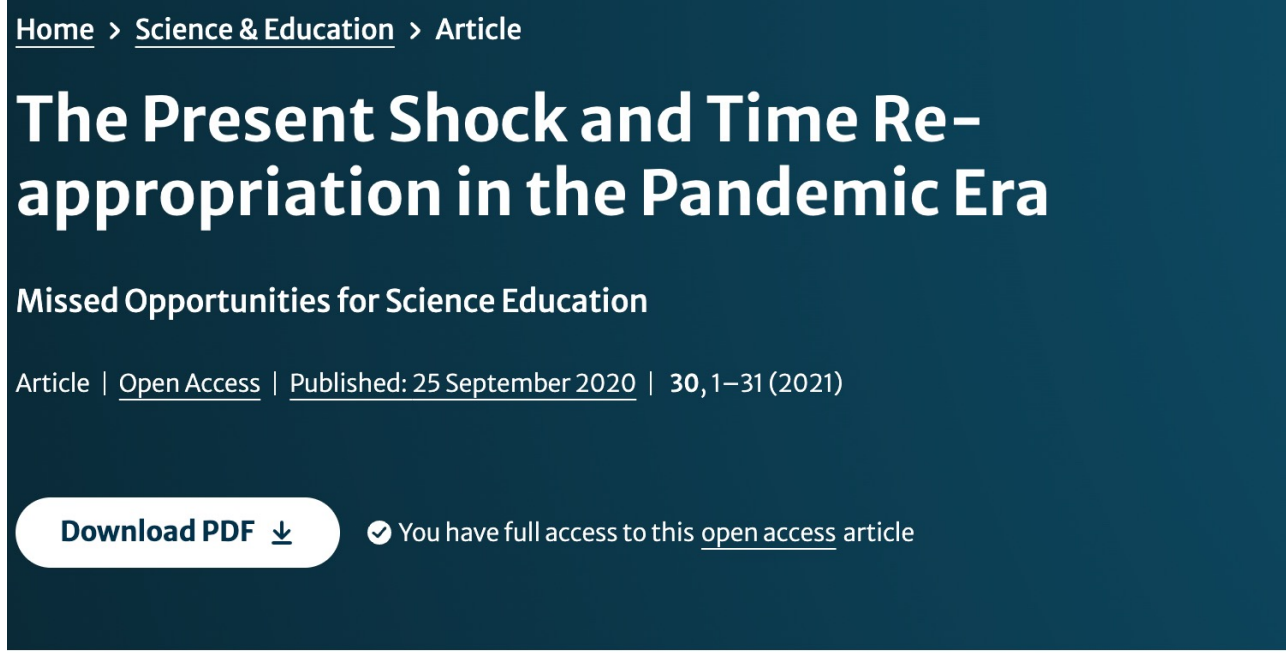


→ *"the almost-univocal focus of **science curricula** on Newtonian paradigm, where determinism, linearity and prediction are the keywords"* does not help to conceptualize and manage time and prepare for the society of acceleration

Why complex systems break the security?

- Indeed:

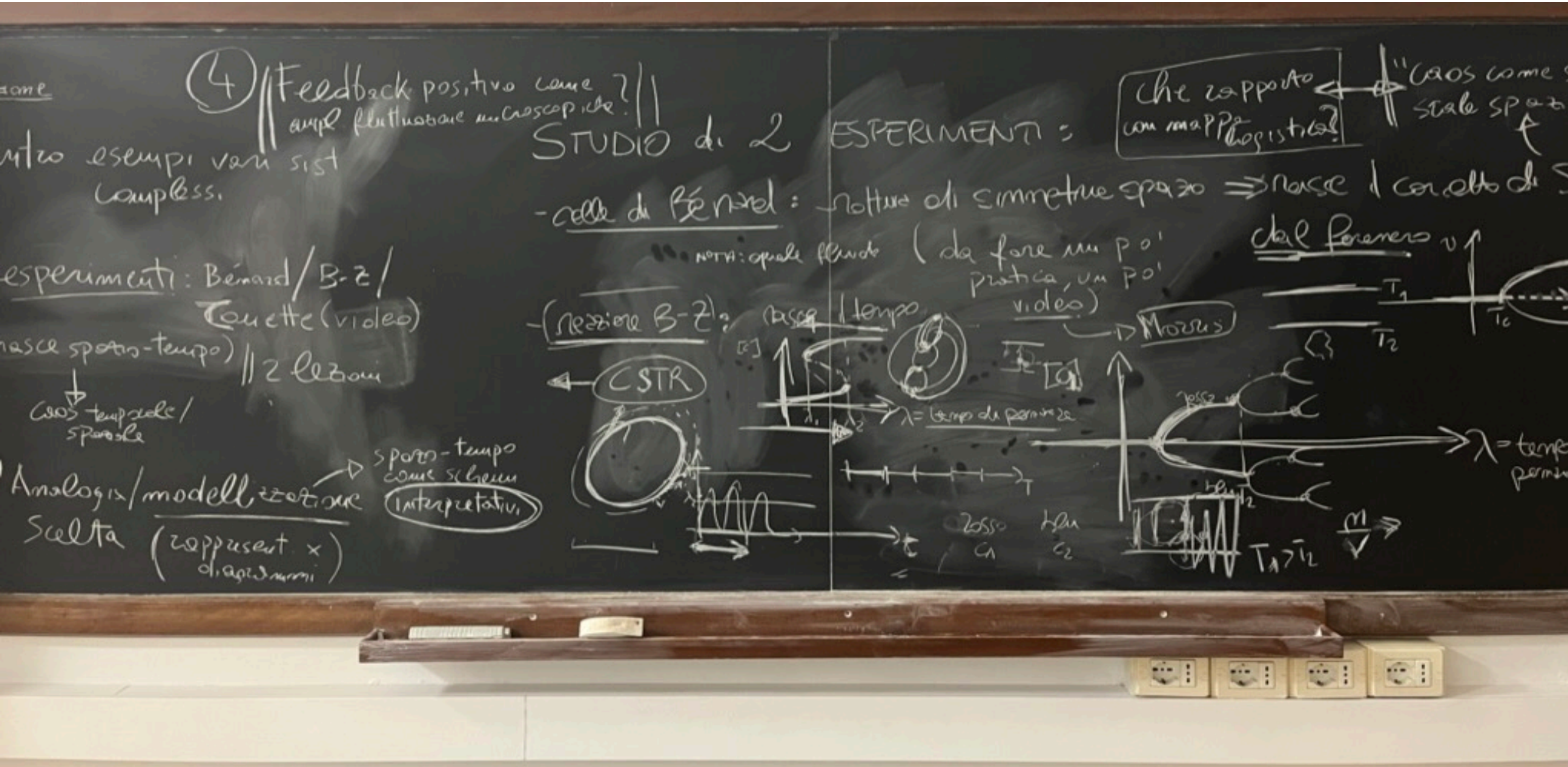
at the basis of the risk society, there is a very different paradigm, i.e. the complexity paradigm, where different temporal patterns and models of causal explanation are conceptualized*. As we already mentioned […] the science of complex systems could be a very rich source of concepts like scenarios, feedback, deterministic chaos and agent, which could play crucial roles to open up new ways to conceive the scientific enterprise and its relationship with socially relevant themes like a pandemic.* ***The concept of uncertainty could also be revalued in science education: not as something negative (lack-of-certainty) but as a concept that opens up a variety of possibilities for everyone's imagination****.* (Levrini et al., 2021)

Why complex systems break the?

- The physics of complex systems is close to the paradigms used in the **society of acceleration**, as other topics like **climate change or artificial intelligence**, because it is intrinsically:
  - Uncertain
  - Non linear
  - Circular (feedbacks effects)
  - Open to multiple perspectives

- Can they be used to educate to ***external time of society*** and ***internal time*****?**

Kairos: an example of time education



Kairos: what kind of school?

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- public scientifically-oriented secondary school
- not selective from a social and economical point of view but the majority of the families has a relatively high level of education
- the students in the school learn physics through the five years of upper secondary school (grades 9–13).

Kairos: what kind of school?

Structural activities (curricular hours)

Vision of knowledge as **complex** and **interdisciplinary -**

INTERDISCIPLINARY ACTIVITIES as **SCHOOL SIGNATURE**

Co-designed by diverse teachers

Shared and approved by class council

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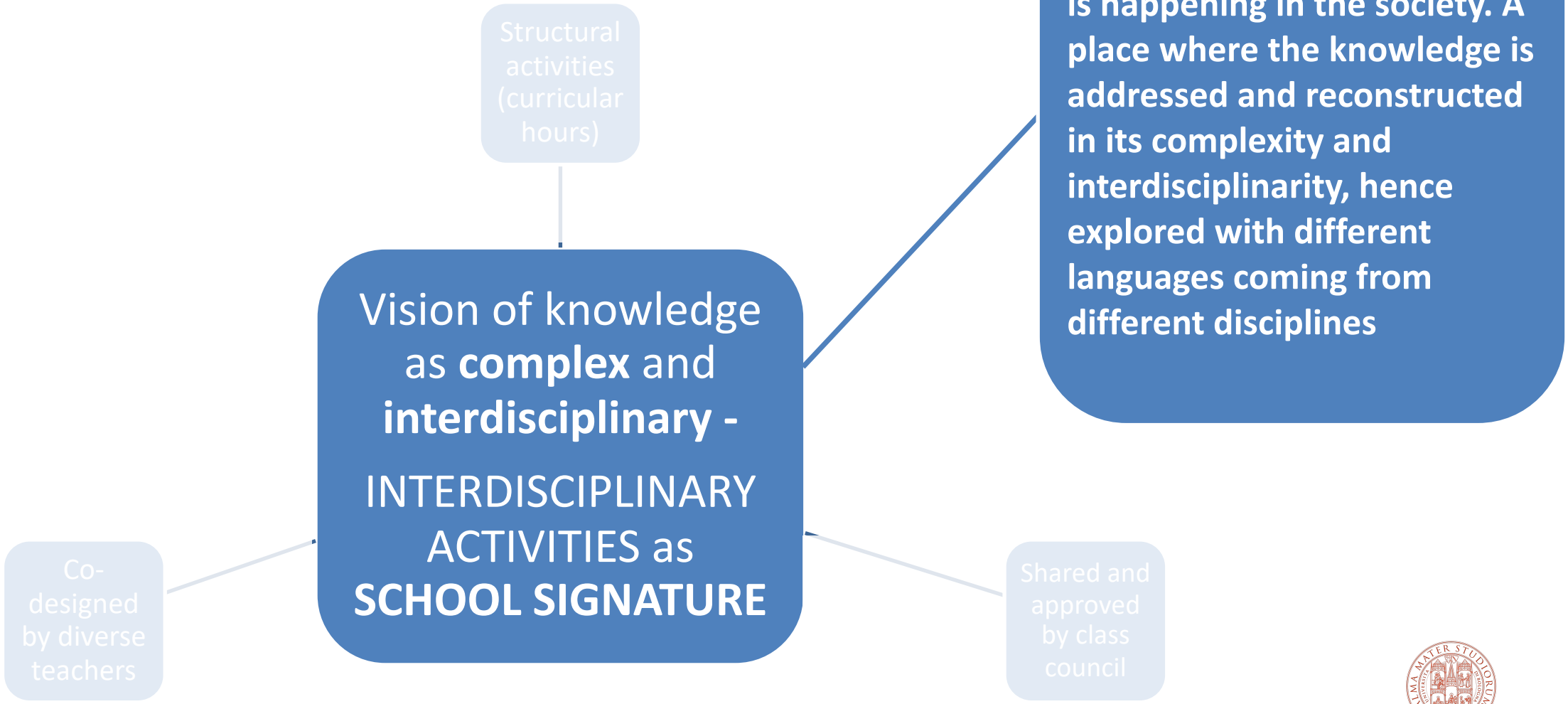
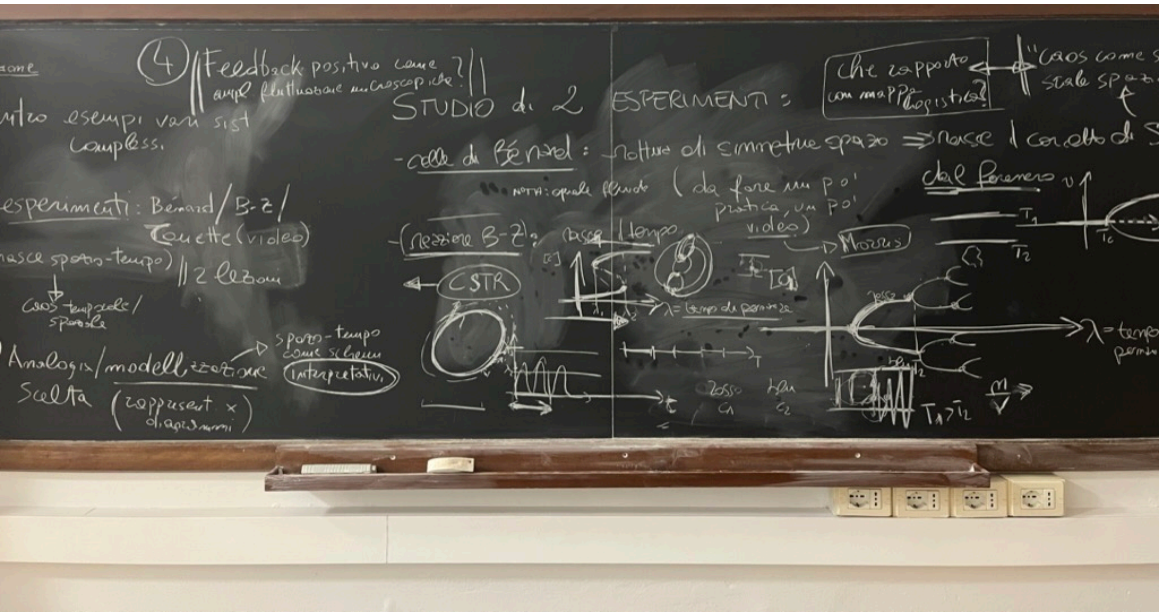
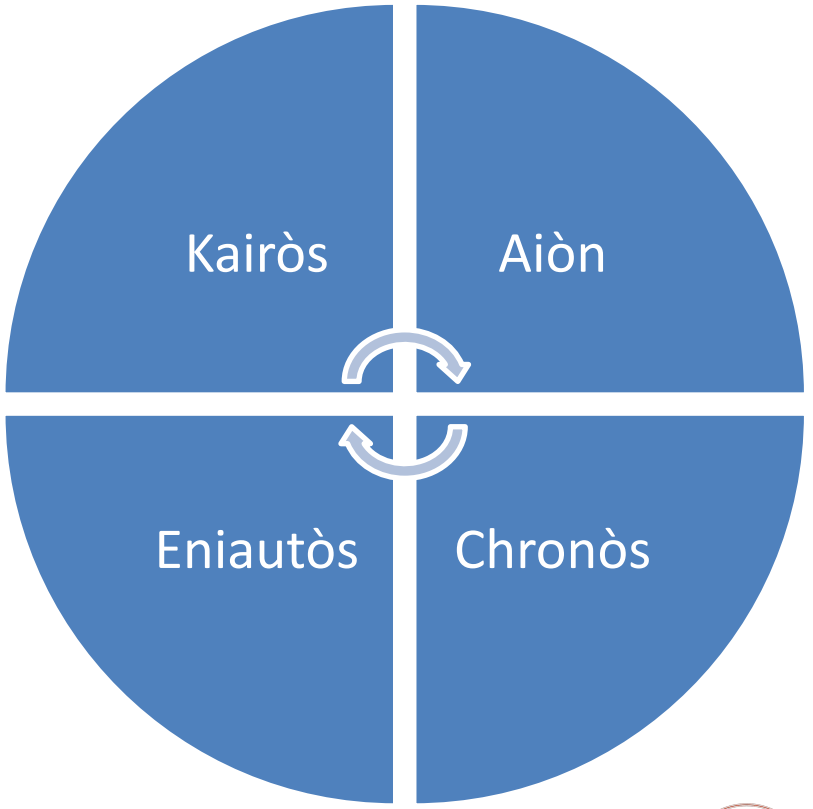
Kairos: what kind of school?



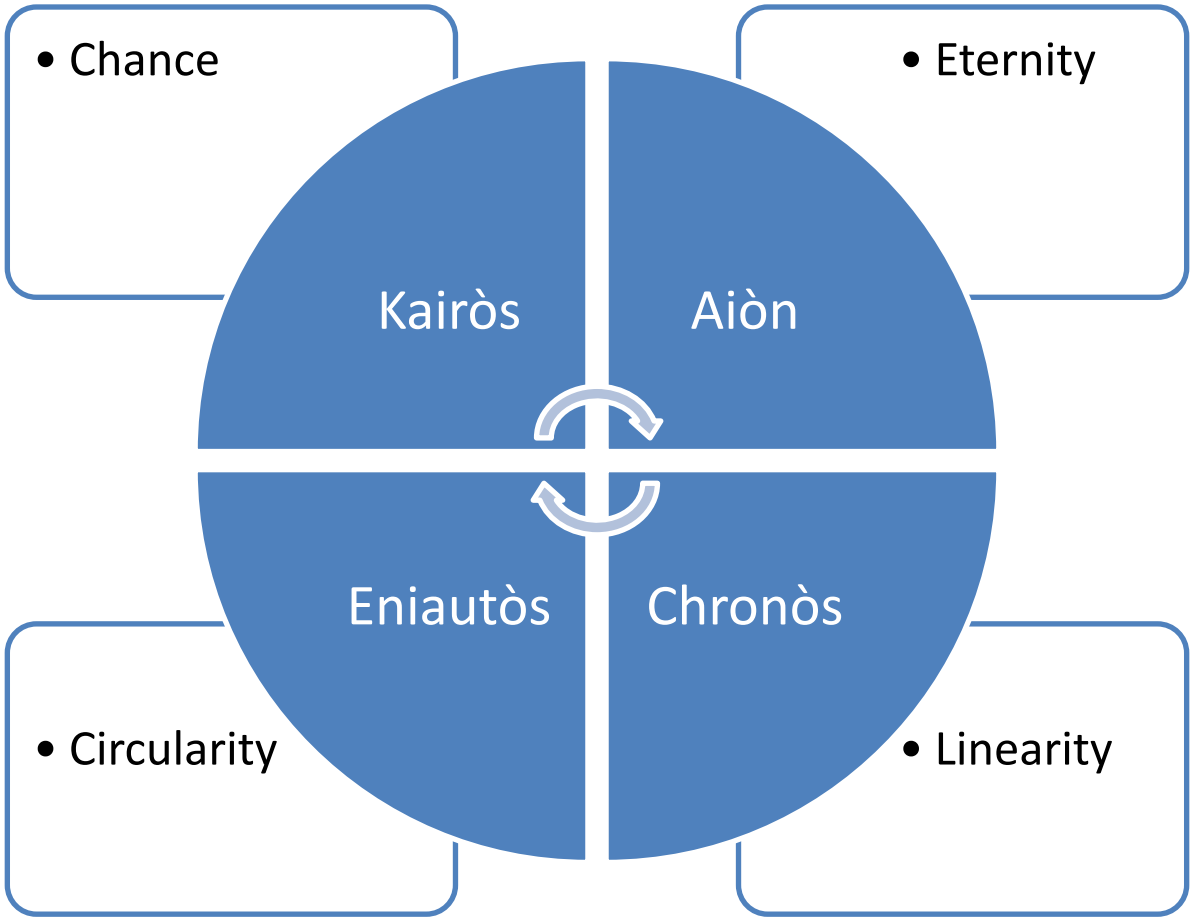
Kairos: educating to time

- What images of time can we construct in physics education?

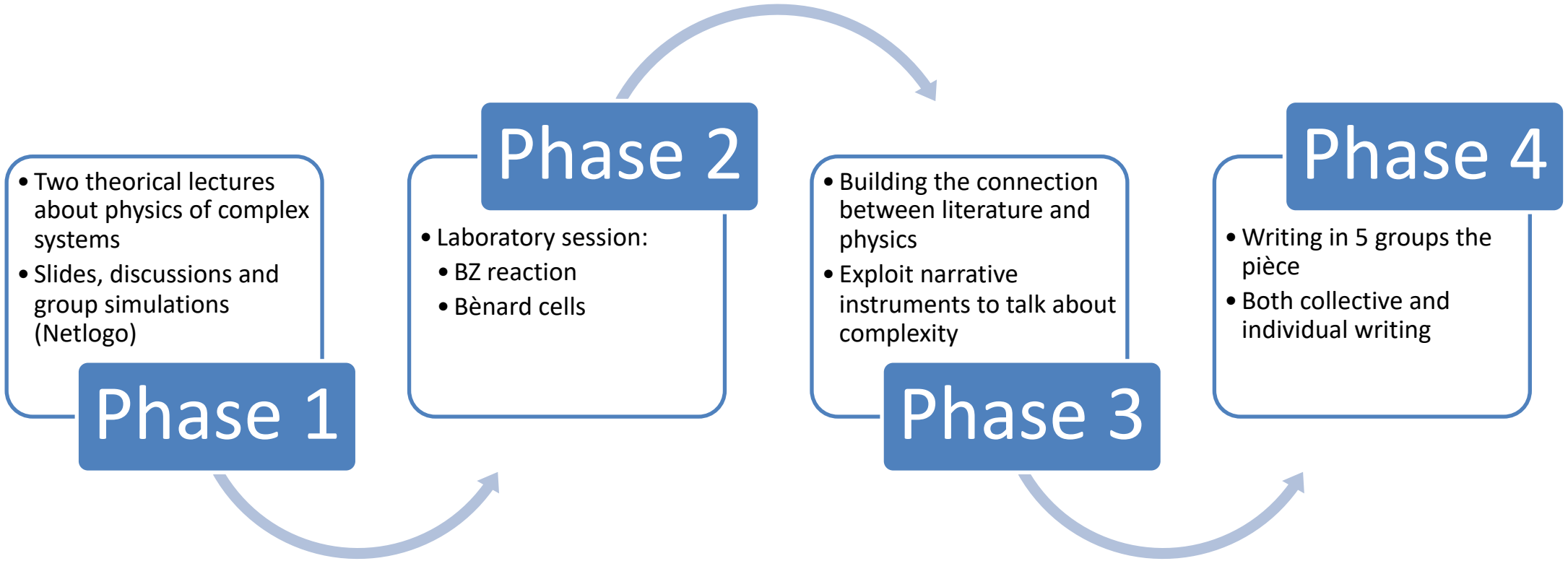




Kairos: educating to time



Activity pipeline



Kairos: educating to time

- On the one hand

the science of complex systems provides concepts such as uncertainty, unexpected, disorder, contradiction, possible scenarios, the interweaving of individual and collective, changes in spatial and temporal scale, and management of "different times", that can help ***to better grapple with the "time-features" of contemporary society****.*

- On the other hand

the Greek conceptions of time shed light on these "time-features" , provide new words to conceptualize them enlarging their meaning, but they also open a reflection on an anthropological perspective of time.

Kairos: educating to time

What is the value of kairòs?

- Kairòs as a time for emerging; is a time of becoming starting from a non-equilibrium status.

Is an intrinsic time of the system (**internal time)** to display its meaningful character within the world (**external time).**

Kairos: educating to time

We work with time conceptions from complex systems, both as **contents and as epistemological frames** (Hammer et al., 2005), since

"the conceptual basis of complex systems ideas reflects a dramatic change in perspective that is increasingly important for students to develop as it opens up new intellectual horizons, new explanatory frameworks, and new methodologies" (Jacobson et al., 2006) **(EXTERNAL TIME)**

With the same visions of time, we claim we are providing instruments to work on **INTERNAL TIME** conceptualization.

Against the *time*-tension

To cope with post-modern society

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