Introduction to the boundary metaphor
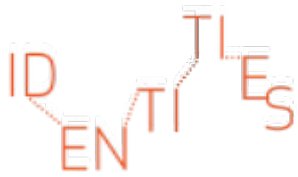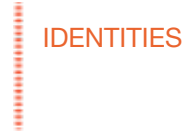
Key-words of the IDENTITIES approach

Inter-disciplinarity IS NOT a-disciplinarity (or a trans-disciplinarity that does not sink into disciplines), nor multi-disciplinarity

Disciplinary identity

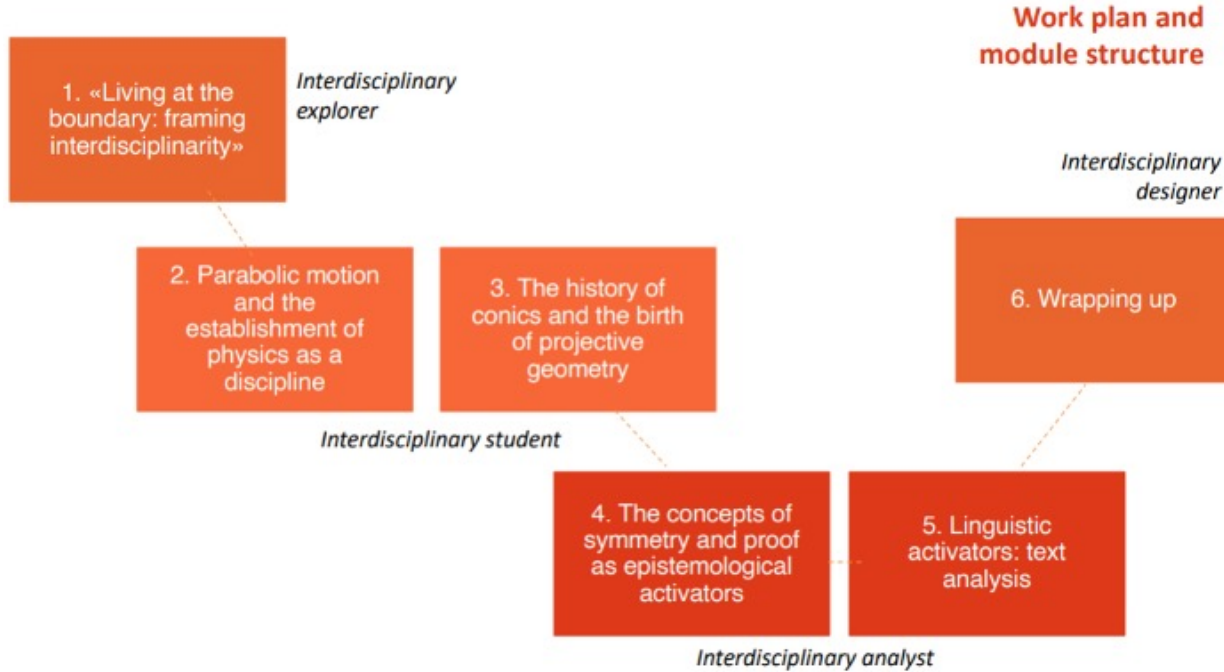Difference between discipline and subject

At the basis of inter-disciplinarity there are disciplinary identities

"The term "discipline" contains the Latin root "discere", whose meaning is to learn. Disciplines are re-organizations of the knowledge with the scope of teaching it. In particular, disciplines ground their roots into the didactical necessity to re-organize knowledge in such a way that students, whilst building their knowledge, can also develop epistemic skills, like problem solving, modelling, representing, arguing, explaining, testing, sharing... Disciplines have been built to help student to make gradually sense of different categories of problems, approaches, tools and criteria to evaluate the correctness and efficiency of a procedure, a reasoning, an argument. From this perspective, disciplines can still play a relevant educational role, provided that they are explicitly pointed out as forms of knowledge organization historically developed and grounded on specific epistemologies" (Branchetti, Fantini, Levrini, 2019).

Guide questions of IDENTITIES project

- What characterizes physics, mathematics and computer science as disciplines?

- Does the science of school textbooks return a sense of physics, mathematics and computer science as disciplines? Does it promote the development of thinking skills that are needed today to navigate the complexity of society of acceleration and uncertainty?

- What is the value of «disciplinary identities» and what is the added value of their «integration»?

IDENTITIES

Enlightening
Interdisciplinarity
in STEM for Teaching

**Work plan and
module structure**

*Interdisciplinary
explorer*

1. «Living at the
boundary: framing
interdisciplinarity»

*Interdisciplinary
designer*

2. Parabolic motion
and the
establishment of
physics as a
discipline

3. The history of
conics and the birth
of projective
geometry

6. Wrapping up

Interdisciplinary student

4. The concepts of
symmetry and proof
as epistemological
activators

5. Linguistic
activators: text
analysis

Interdisciplinary analyst

Adaptation of the "Study and Research Path to Teacher Education"
(Barquero, Bosch & Romo, 2018)

Switching the paradigm from *visiting monuments* to *questioning the world*. In the paradigm of questioning the world "knowledge to be taught is associated with the study of relevant questions. The study of these questions includes moments of study (searching for available answers in the media) and moments of research (deconstruction and reconstruction of knowledge to generate one's answer). Implementing question-led study processes provokes the knowledge to be taught to become dynamic, provisional and collective (compared to the traditional notion of knowledge in school institutions)."

Barquero, B., Florensa, I., & Ruiz-Olarría, A. (2019). The education of school and university teachers within the paradigm of questioning the world. In M. Bosch et al. (Eds.), Working with the Anthropological Theory of the Didactic in Mathematics Education: A Comprehensive Casebook (Chapter 12). London: Routledge.

ID EN TI TI ES

Enlightening
Interdisciplinarity
in STEM for Teaching

Boundary people
Boundary objects
Boundary mechanisms
(*coordination, identification, reflection, transformation*)

THE BOUNDARY METAPHOR

…to position ourselves to deal with interdisciplinarity and to be able to interpret the sensations that it can create…

People at the boundary

People at the boundary: an ambiguous position "[…] The experiences of these people illustrate the ambiguity of boundaries. […] Tanggaard (2007) characterizes their position at the boundary as that of marginal strangers "who sort of belong and sort of don't" (p. 460). Williams, Corbin, and McNamara (2007) point out how this ambiguous role can lead to conflicted narratives. […] The accounts of single groups and individuals crossing boundaries show how they not only act as bridge between worlds but also simultaneously represent the very division of related worlds. On one hand they have a very rich and valuable position since they are the ones who can introduce elements of one practice into the other (cf. Wenger, 1998). On the other hand, they face a difficult position because they are easily seen as being at the periphery, with the risk of never fully belonging to or being acknowledged as a participant in any one practice. How can people manage this ambiguous position at the boundary? […] it requires people to have dialogues with the actors of different practices, but also to have inner dialogues between the different perspectives they are able to take on (Akkerman, Admiraal, Simons, & Niessen, 2006). […] D. Walker and Nocon (2007) make an explicit plea for stimulating "boundary-crossing competence," which is the "ability to manage and integrate multiple, divergent discourses and practices across social boundaries" (p. 181).

Boundary Objects

Objects at the boundary. "In studies of boundary objects we also find the aforementioned **ambiguity**. On one hand, boundary objects are artifacts that articulate meaning and address multiple perspectives. As already indicated by the definition by Star and Griesemer (1989), boundary objects have different meanings in different social worlds but at the same time have a structure that is common enough to make them recognizable across these worlds. However, it is not only **interpretative flexibility** that turns objects into boundary objects; boundary objects are organic arrangements that allow different groups to work together, based on a back-and-forth movement between **ill-structured** use in cross-site work and **well-structured** use in local work (Star, 2010). […] As an in-between or middle ground, **the boundary belongs to both one world and another**. It is precisely this feature that seems to explain how the boundary divides as well as connects sides (Kerosuo, 2001). However, the boundary also reflects a nobody's land, belonging to neither one nor the other world. […] On one hand, they enact the boundary by addressing and articulating meanings and perspectives of various intersecting worlds. At the same time, these people and objects move beyond the boundary in that they have an unspecified quality of their own (neither–nor). We contend that it is precisely this **ambiguous nature** that explains the interest in boundaries and boundary crossing as phenomena of investigation for education scholars. Both the enactment of multivoicedness (both–and) and the unspecified quality (neither–nor) of boundaries create a need for dialogue, in which meanings have to be negotiated and from which something new may emerge.

The four mechanisms of boundary crossing («learning potential mechanisms»)

Identification

Identification is a process that occurs when "previous lines of demarcation between practices are uncertain or destabilized because of feelings of threat or because of increasing similarities or overlap between practices. The reported processes of identification entail a questioning of the core identity of each of the intersecting sites" (ibidem, p. 142). When the boundaries become uncertain, identification implies a dialogical process of othering, that is "defining one practice in light of another, delineating how it differs from the other practice". Furthermore, identification implies "need for legitimating coexistence": this dialogical process implies to consider multiple memberships (Bogenrieder and van Baalen, 2007) and accept possible interference between multiple participations of people in diverse groups

Coordination

Coordination refers to a process in which effective means and procedures could allow diverse practices to cooperate efficiently (ibidem, p. 143). Unlike identification, coordination does not imply reconstructing the boundaries and does not question the core identities at the two ends of the borders, but implies the search for effective ways to coordinate the two sides of the border and overcome the boundaries. These ways can regard establishing communicative connections, efforts of translation, increasing boundary permeability, routinization.

The four mechanisms of boundary crossing («learning potential mechanisms»)

Reflection

Reflection is a crossing boundary mechanism that, <u>explicating the differences between disciplines or practices</u>, leads to learning something new about their own through the eyes of others' (ibidem, p.144). The dialogical process of reflection implies "perspective taking or perspective making" (p.145).

Transformation

Transformation is a mechanism that leads to profound changes in practices, potentially even <u>the creation of a new, in-between practice, sometimes called a boundary practice</u> (ibidem, p.146). Transformation requires sharing a problem space, inhabiting the boundary, intersecting worlds.

ID ENTITIES

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