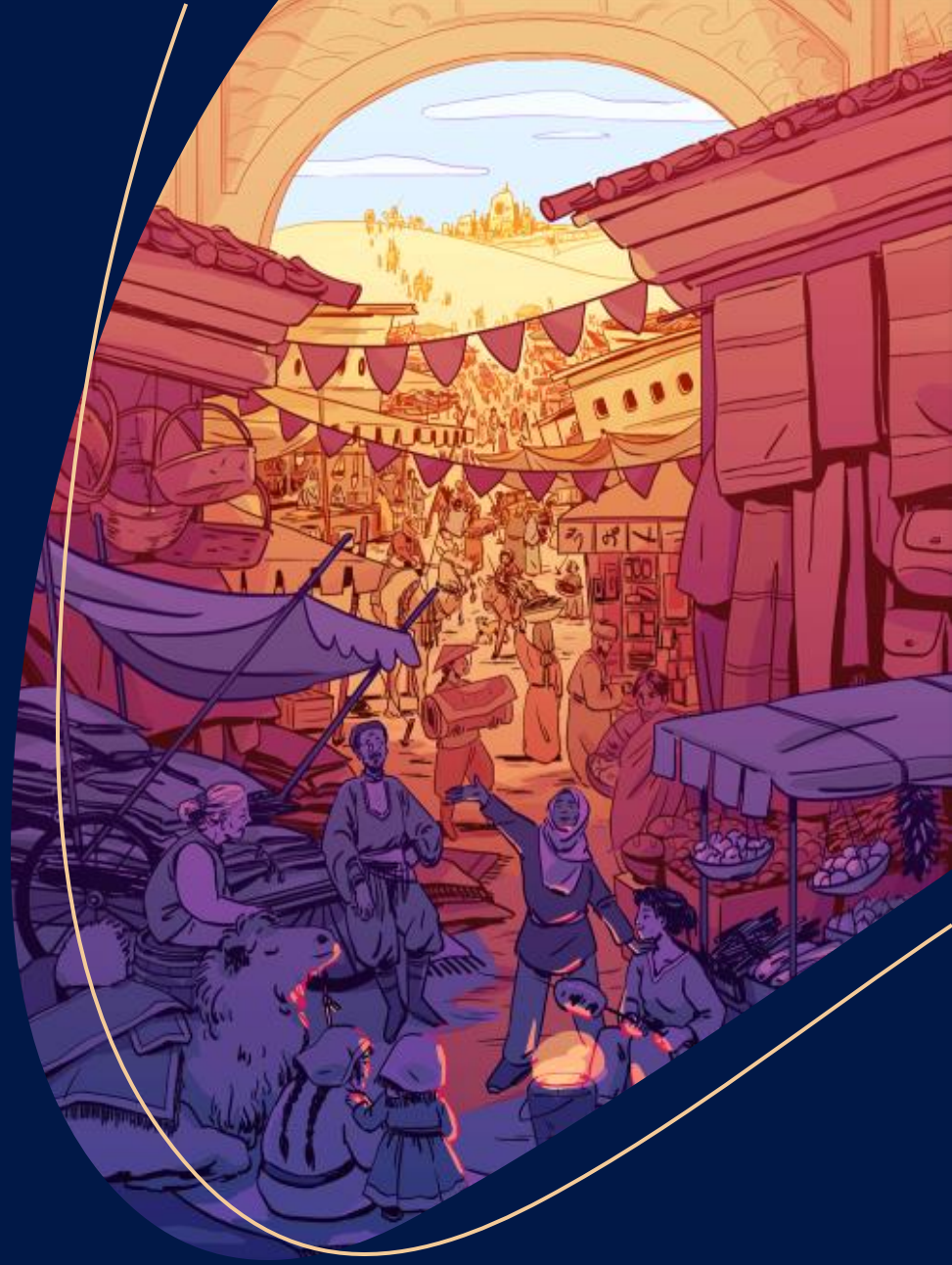
INDRUM2024 : Fifth conference of the International Network for Didactic Research in University Mathematics

10-14 Jun 2024 Barcelona (Spain)

Plenary Panel

Mathematics and other disciplines: epistemological issues and their impact on teaching practices at tertiary level



Plenary Panel

Mathematics and other disciplines: epistemological issues and their impact on teaching practices at tertiary level

Laura Branchetti

(Chair of the panel)

INDRUM

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UNIVERSITÀ DEGLI STUDI DI MILANO

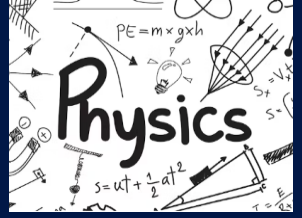
DIPARTIMENTO DI MATEMATICA "FEDERIGO ENRIQUES"

Introduction

The speakers

Epistemological and institutional perspectives

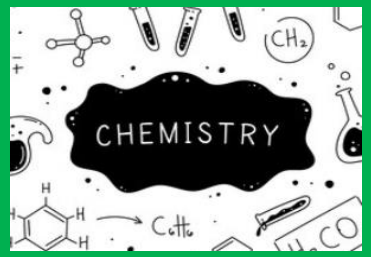
Our questions



Ricardo Karam

History of Physics and Physics education

University of Copenhagen (DK)



Felix Ho

Chemistry education

University of Uppsala (SW)

UPPSALA UNIVERSITET

Frank Feudel

Mathematics & Economics education

Humboldt-University of Berlin (D)

Noemí Ruiz Munzón

Modelling

Escola Universitària Salesiana de Sarrià
TecnoCampus

euss School of Engineering

TecnoCampus

Structure of the panel

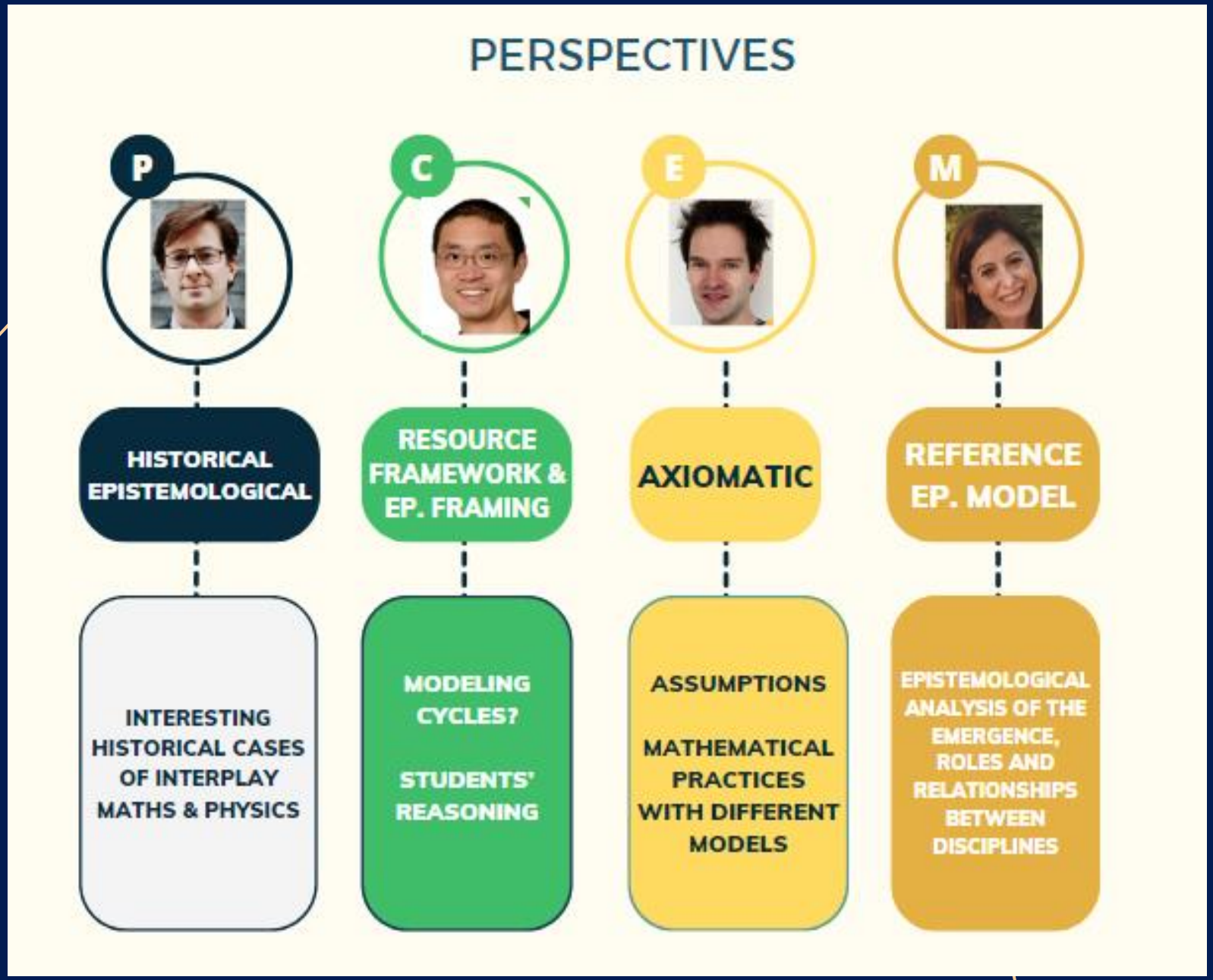
Presentations

Discussion

Q&A sessions

General discussion

Epistemological perspectives



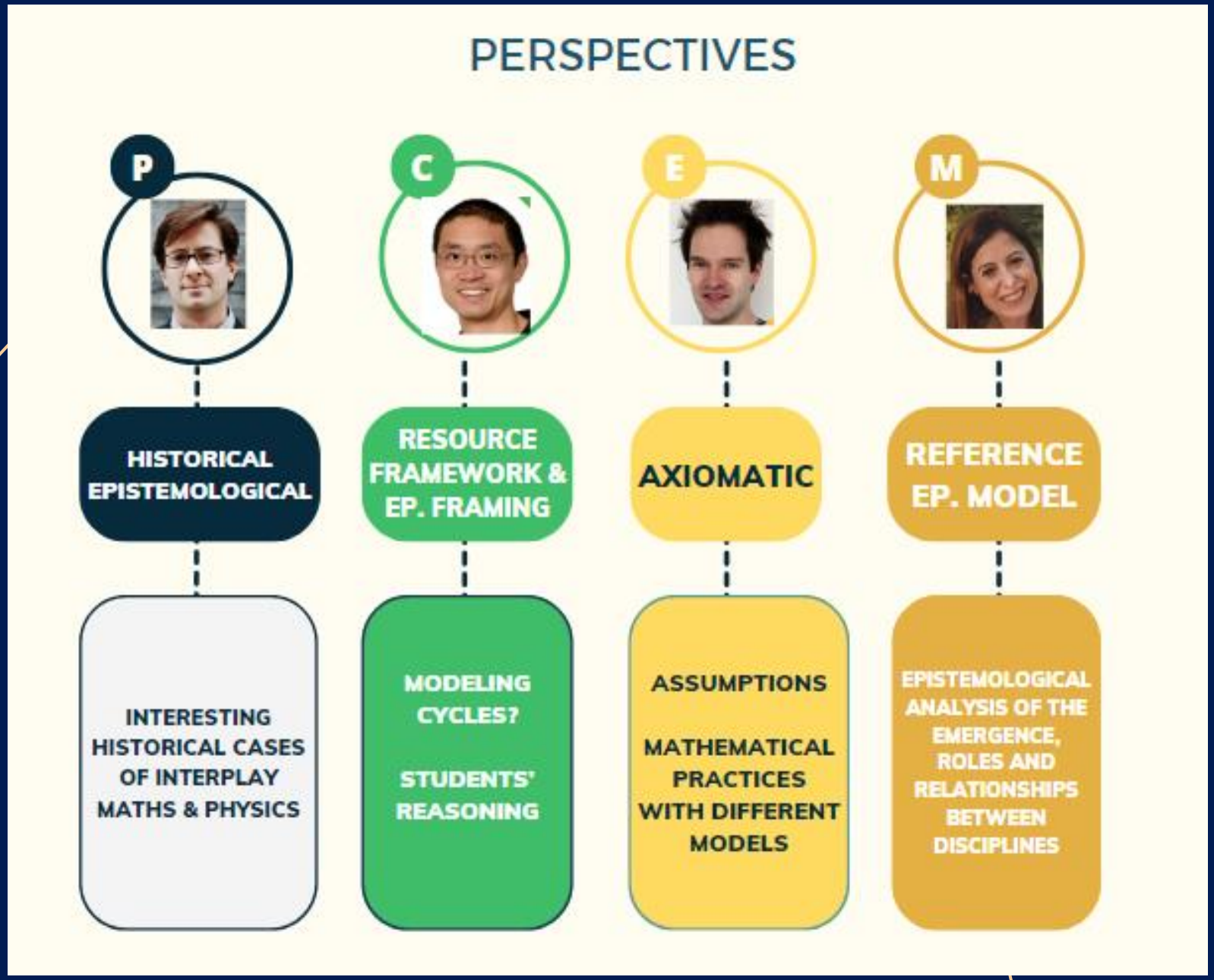
INSTITUTIONS

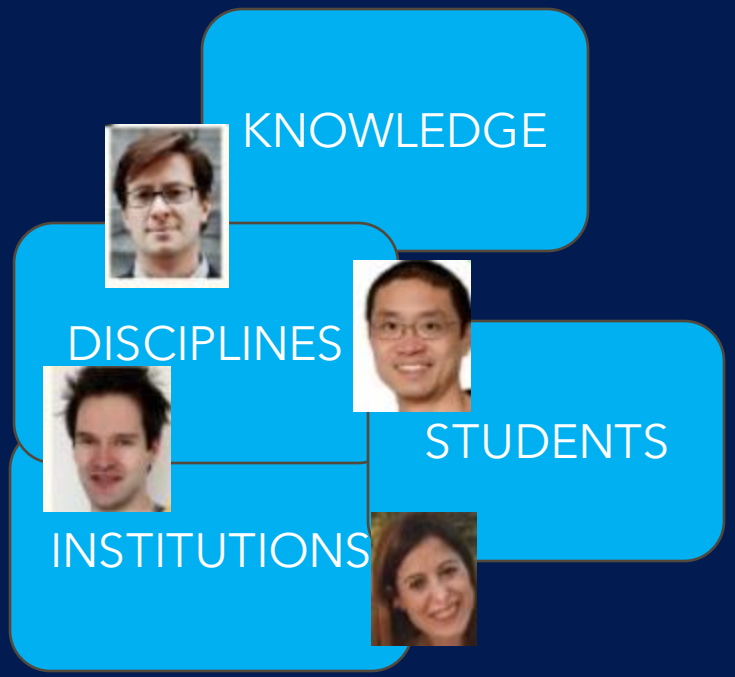
KNOWLEDGE

DISCIPLINES

STUDENTS

Epistemological perspectives





To what extent do the epistemological issues at stake influence the teaching at tertiary level?

First guiding question

To what extent does the institutional "disciplinarization" of knowledge allow to address the complex epistemological relationships between mathematics and other disciplines in teaching?

Second guiding question

Mirò board

QUESTION 1

To what extent is it possible and realistic to design math service courses to teach "prerequisites" for other disciplines?
If so, what should students possibly acquire/learn in such courses? Is there something missing in this approach?

QUESTION 2

From a didactical perspective, are there differences between teaching mathematical modelling and integrating mathematical practices into modelling for other disciplines or professional fields?
If so, what are the main differences?

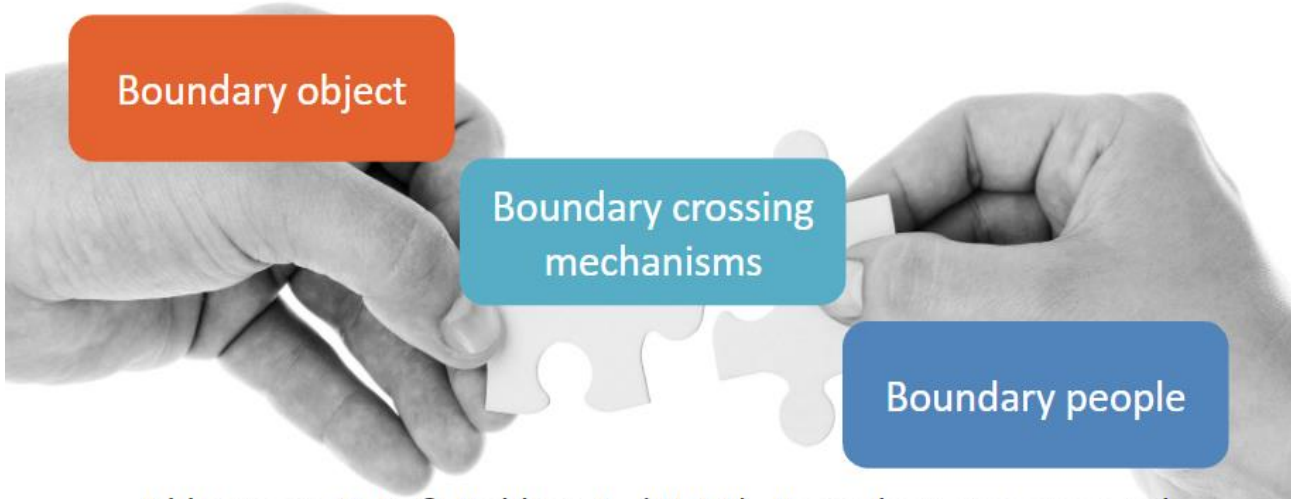
QUESTION 3

How can mathematics as a discipline and mathematical practices from other disciplines be integrated in students' math courses to provide meaningful learning opportunities?
Who should be responsible for this integration at the institutional level?

Discussion

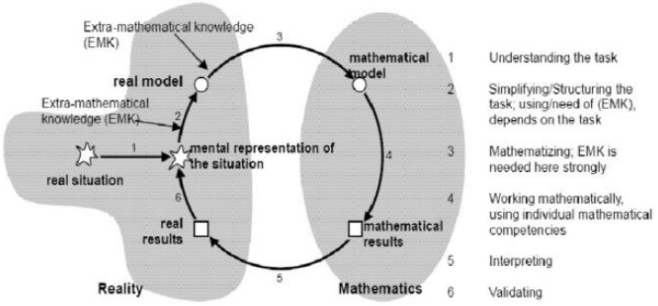
WIN
CASINO
WIN

Boundary zones



Akkerman, S. F. & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of educational research*, 81(2), 132-169.

Boundary people



$$\mathcal{S}_0 \searrow \mathcal{W}_1 \nearrow \mathcal{S}_1$$

Model 1

An adequate model M is defined due to a set of assumption (definitions, hypotheses) $A.1$ to $A.n$:

$$M = \{A.1, \ldots, A.n\}$$

Theorem 1

A theorem is formulated related to statement of X

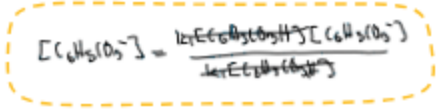
Proof 1

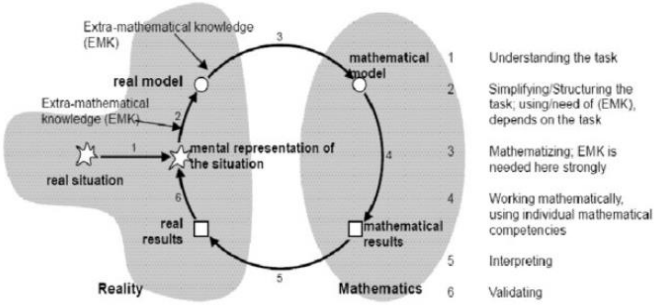
Proof of the theorem using $A.1$ to $A.n$.

Need to question the modelling cycle

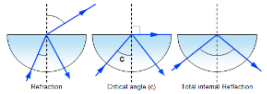
MODELING

$$\frac{d[O_2]}{dt} = \frac{k_1 k_2 [C_6H_5CO_3H]^2}{k_{-1}[H^+] + k_2[C_6H_5CO_3H]}$$





When $n^2 \sin^2(\theta_1)$ < 1: $|r_\perp| < 1$; $= 1$: $r_\perp = 1$; > 1: $r_\perp$ is not real!



It seems more appropriate to consider relative changes: $\frac{\frac{\Delta x}{x}}{\frac{\Delta p}{p}}$

If $\Delta p \to 0$, we get: $\varepsilon := \frac{dx}{dp} \cdot \frac{p}{x}$

Concept "Price elasticity of demand"

Mathematics does not directly model the Reality (whatever it means..); disciplines provide intermediate models /resources

MODELS/REALITY

DISCIPLINES

The institutional "disciplinarization" of knowledge can hide the complexity of students'reasoning

but

disciplines provide epistemological criteria to validate reasonings and teachers play a crucial role
("truth is not validity", models have always assumptions!)

1. **Questioning the assumptions** and "breaking the models" in the other disciplines or in inquiry practices

2. **Prerequisites**: toolbox, resources?

Prototypical examples of problems to have more resources & skills to creatively adapt to new problems (examples, prototypes) and not adapt the new problems to the resources!

DISCIPLINES vol. 1

Within the "other-disciplinary" courses

Co-evolution (avoid before/after) (as Tzanakis, 2016)

Modelling in new infrastructures (?)

Prerequisites or "postrequisites": manage new resources needed during the activity on both sides (Math&Others)

DISCIPLINES vol. 2

Teachers'
expertise developed thanks to
research in interdisciplinary
educational research

Inspirations

Co-teaching
(different
disciplines/fields)

Prerequisites or
"postrequisites": consequences on institutional
infrastructures and
knowledge organization/presentation

TEACHING

Metacognitive + Meaning making, interpretation

Pedagogical values of examples (overcoming trivial relationships)

Modelling as a new epistemological tool

More **awareness of assumptions of models**

Not MORE mathematical contents but a different kind of interdisciplinary contextualized modelling practices + "metareasonings"

MORE MATHS?

Avoid to fill their box with things you hope they will use, but they will never use!

MORE TOOLS?

Q&A sessions

General discussion

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