IDENTITIES

Enlightening
Interdisciplinarity
in STEM
for Teaching

Habermas' rationality to analyze scientific reasoning and textbooks

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1.

MAKE YOUR OWN EXPLORATION

“What is it possible to say about the divisors of two consecutive natural numbers?”

1- Write your reasonings time after time, keeping trace of each step

2- Formulate your own conjectures and try to prove them

3. Share your document

2.

HABERMAS' CONCEPT OF RATIONAL BEHAVIOUR IN DISCURSIVE PRACTICES

«Only she who is capable of saying «I» or «we», and of thematizing what she is or does, and attributing it to herself, is rational» (Habermas, 2003)

The construct of rationality is distinguished into three inter-related aspects: epistemic, teleologic, and communicative. Here we will focused on the adaptation of Habermas' framework specifically to mathematical reasoning, as presented in Morselli and Boero (2009)

2.

THREE DIMENSIONS OF RATIONALITY IN MATHEMATICS REASONING

- **epistemic:** the conscious formalization, interpretation, and transformation for validating the statements according to shared premises and legitimate ways of reasoning, shared inference rules from axioms and other theorems
- **teleological:** inherent in the “problem solving” character of proving, and the conscious choices to be made in order to obtain the aimed product
- **communicative:** the conscious adhering to rules that ensure both the possibility of communicating steps of reasoning, and the conformity of the products to standards in a given mathematical cultural context

2.

ANALYZE THE RATIONALITY OF STUDENTS' REASONING

Read the excerpt and analyze it in terms of dimensions of rationality:

- **epistemic:** what kinds of disciplinary forms of reasoning are used? are there conjectures or proofs? how are they validated? what is the role of examples? are there criteria that are not mathematically acceptable?
- **teleological:** what strategies are used? what goals are pursued, explicitly or implicitly?
- **communicative:** what are the main communicative choices made? what representations and kind of language is used? what is explicit and implicit in the reasoning? Is the language used with a logical role?

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3.

ANALYZE YOUR OWN EXCERPTS

Read YOUR OWN excerpts in couples (possibly people with different background) and analyze it in terms of dimensions of rationality:

- **epistemic:** what kinds of disciplinary forms of reasoning are used? are there conjectures or proofs? how are they validated? what is the role of examples? are there criteria that are not mathematically acceptable?
- **teleological:** what strategies are used? what goals are pursued, explicitly or implicitly?
- **communicative:** what are the main communicative choices made? what representations and kind of language is used? what is explicit and implicit in the reasoning? Is the language used with a logical role?

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4.

CHARACTERIZE MATHEMATICAL RATIONALITY

Compare the analysis of the students excerpts and your own analysis, trying to characterize mathematical rationality compared to other forms of reasoning that are not part of “identity of mathematics” or are not acceptable in mathematics.

Consider all the three dimensions of rationality and their intertwining.

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5.

FROM THE PROCESS OF PROVING TO PROOFS IN TEXTBOOKS IN A BOUNDARY CASE: PROOF IN PHYSICS TEXTBOOKS

1- Read the excerpts and identify key elements of the explanation proposed by the textbook concerning the fact that the motion of a projectile is parabolic.
2- Analyse the excerpt in terms of rational behavior, with particular attention to the epistemic dimension of explanation proposed by the textbooks.
3- Answer the question: “Is the explanation proposed by the textbooks a proof? why or why not?”

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6.

COMPARE MATHEMATICAL AND PHYSICAL RATIONALITY IN A BOUNDARY CASE: PROOF IN PHYSICS TEXTBOOKS

1- Compare, in terms of dimensions of rational behavior, the rationalities of proving in mathematics and physics, finding common aspects and differences.
2- Write three keywords that in your mind represent the interdisciplinary relationships between mathematics and physics in the textbooks (the role of mathematics in physics, how far mathematical reasoning appears in the text)

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At the end of the linguistic analysis, we will come back to this document to see if the linguistic analysis enlights other aspects of the disciplinary identities and of their intertwining.

7.

YOUR EXPERIENCE WITH INTERDISCIPLINARITY

Let’s discuss together about linguistic and epistemic issue of interdisciplinarity, figuring out possible innovations in teaching that can favour a better representation of disciplinary identities/interdisciplinarity at school.

8.

RETHINKING AND REFORMULATE THE TEXT IN DIALOGICAL STYLE

As in the Galilean dialogue, start from the text of the physics textbook (proof page) and imagine a dialogue between Salviati and Simplicio (an expert and a non-expert). What would it be like?

Share your written dialogue

REFERENCES

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ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

UNIVERSITAT DE
BARCELONA

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
UNIVERSITY OF CRETE

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DI PARMA

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