

IDENTITIES

Enlightening
Interdisciplinarity
in STEM
for Teaching

Habermas' rationality to analyze scientific reasoning and textbooks



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 enlightens 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.



REFERENCES

Habermas, J. (2003). *Truth and justification*. MIT Press.

Morselli, F., & Boero, P. (2009). Habermas' construct of rational behaviour as a comprehensive frame for research on the teaching and learning of proof. In F.-L. Lin, F.-J. Hsieh, G. Hanna, & M. de Villiers (A c. Di), *Proceedings of the ICMI Study 19 conference: Proof and Proving in Mathematics Education* (Vol. 2, pp. 100–105).

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Exercices de
style





In the S bus, in the rush hour. A chap of about 26, felt hat with a cord instead of a ribbon, neck too long, as if someone's been having a tug-of-war with it. People getting off. The chap in question gets annoyed with one of the men standing next to him. He accuses him of jostling him every time anyone goes past. A snivelling tone which is meant to be aggressive. When he sees a vacant seat he throws himself on to it.

Two hours later, I meet him in the Cour de Rome, in front of the gare Saint-Lazare. He's with a friend who's saying: "You ought to get

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an extra button put on your overcoat." He shows him where (at the lapels) and why.



How tightly packed in we were on that bus platform! And how stupid and ridiculous that young man looked! And what was he doing? Well, if he wasn't actually trying to pick a quarrel with a chap who—so he claimed! the young fop! kept on pushing him! And then he didn't find anything better to do than to rush off and grab a seat which had become free! Instead of leaving it for a lady!

Two hours after, guess whom I met in front of the gare Saint-Lazare! The same fancy-pants! Being given some sartorial advice! By a friend!

You'd never believe it!



In the centre of the day, tossed among the shoal of travelling sardines in a coleopter with a big white carapace, a chicken with a long, featherless neck suddenly harangued one, a peace-abiding one, of their number, and its parlance, moist with protest, was unfolded upon the airs. Then, attracted by a void, the fledgling precipitated itself thereunto.

In a bleak, urban desert, I saw it again that self-same day, drinking the cup of humiliation offered by a lowly button.



You ought to put another button on your overcoat, his friend told him. I met him in the middle of the Cour de Rome, after having left him rushing avidly towards a seat. He had just protested against being pushed by another passenger who, he said, was jostling him every time anyone got off. This scraggy young man was the wearer of a ridiculous hat. This took place on the platform of an S bus which was full that particular midday.

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)

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