

How to Design a Textbook When the Curriculum Falls Short

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Johannes Vermeer, *The Astronomer*, 1668

Adriaen Metius, *Institutiones Astronomicae & Geographicae*, 2nd ed. 1621. Book III, About the observation of stars

Was it a textbook?

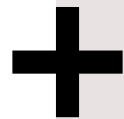


From school books to textbooks

“during the nineteenth century, ... **book ... produced explicitly for school education**” (Sammler 2018, p. 16)

“... **national education systems** ... textbooks were written to fit **national curricula**” (Id., p. 17).

From *schoolbooks* to *textbooks*:
from text! – to books to handle: Manuals!



But... are textbooks important?

At the turn of the century: TIMMS and other ILSA:

- “textbooks exert a strong influence on what teachers teach”.
- “This seems to be true in most countries despite the difference in the nature and use of textbooks.”
- “Textbook coverage is important both for what topics are taught”
- “and for the levels of performance and accomplishment expected of students.”

(Schmidt et al. 2001, p. 357).



Yes, textbooks are important!

- Textbooks importance is greater when teachers have weaker knowledge
- PISA shows greater relevance for countries in which teachers are not well prepared (Wilkins 2011)
- TIMSS shows countries with better results use intensively textbooks (Mullis et al 2012, Oates 2014)
- Gambi & De Witte (2025). Textbook choice has an effect
- Independently of teachers' quality, textbooks use is positive (Agodini & Harris 2016)

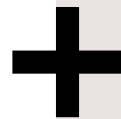


Quality matters

RCT 131 teachers, 39 schools:

- Differences in textbooks can cause 30% s.d.
- In similar environments: 28% to 70% s.d.

(Agodini et al. 2009)



Textbooks should be demanding

- Teachers follow textbooks questions, but use the lower levels of questioning (Folgado & Araújo, 2009)

	Localizar e Retirar do Texto Informação Explícita	Fazer Inferências Directas	Interpretar e Integrar Ideias e Informação	Examinar e Avaliar o Conteúdo, a Linguagem e os Elementos Textuais
	Nível 1	Nível 2	Nível 3	Nível 4
Pasta Mágica	44%	30.7%	25%	0.3%
Giroflé	56%	26.5%	17%	0.5%
Amiguinhos	60%	24%	15%	1%
PIRLS	20%	30%	30%	20%

		Localizar e Retirar do Texto Informação Explícita	Fazer Inferências Directas	Interpretar e Integrar Ideias e Informação	Examinar e Avaliar o Conteúdo, a Linguagem e os Elementos Textuais
		Nível 1	Nível 2	Nível 3	Nível 4
Amiguinhos	Prof.1	81%	4 %	15%	0%
	Prof.2	68%	7%	18%	7%
Pasta Mágica	Prof.3	28%	17%	47%	8%
	Prof.4	37%	27%	34%	2%



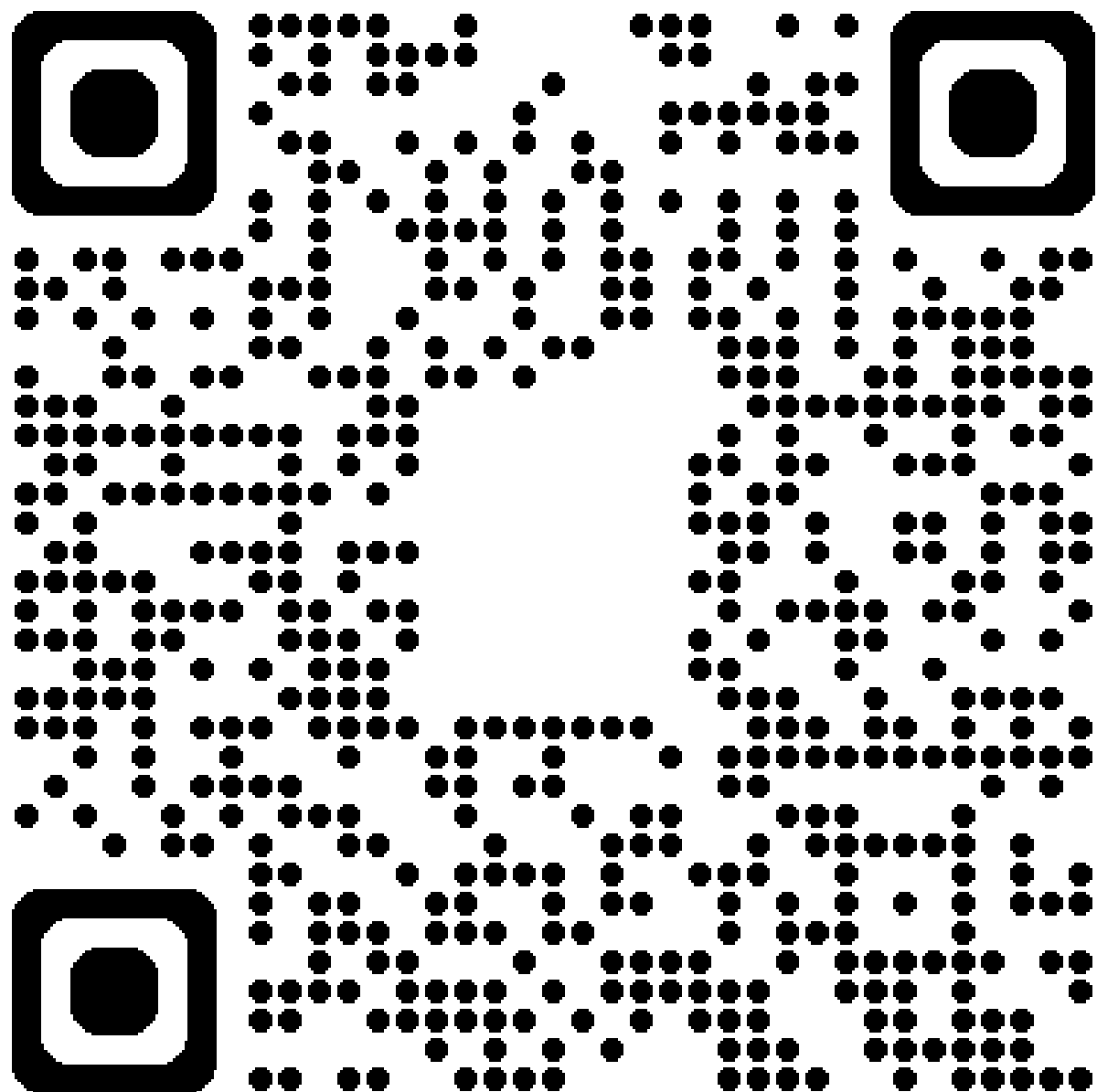
APOLOGÍA DEL LIBRO DE TEXTO

*Cómo escribir, elegir y utilizar
un buen manual*

Nuno Crato



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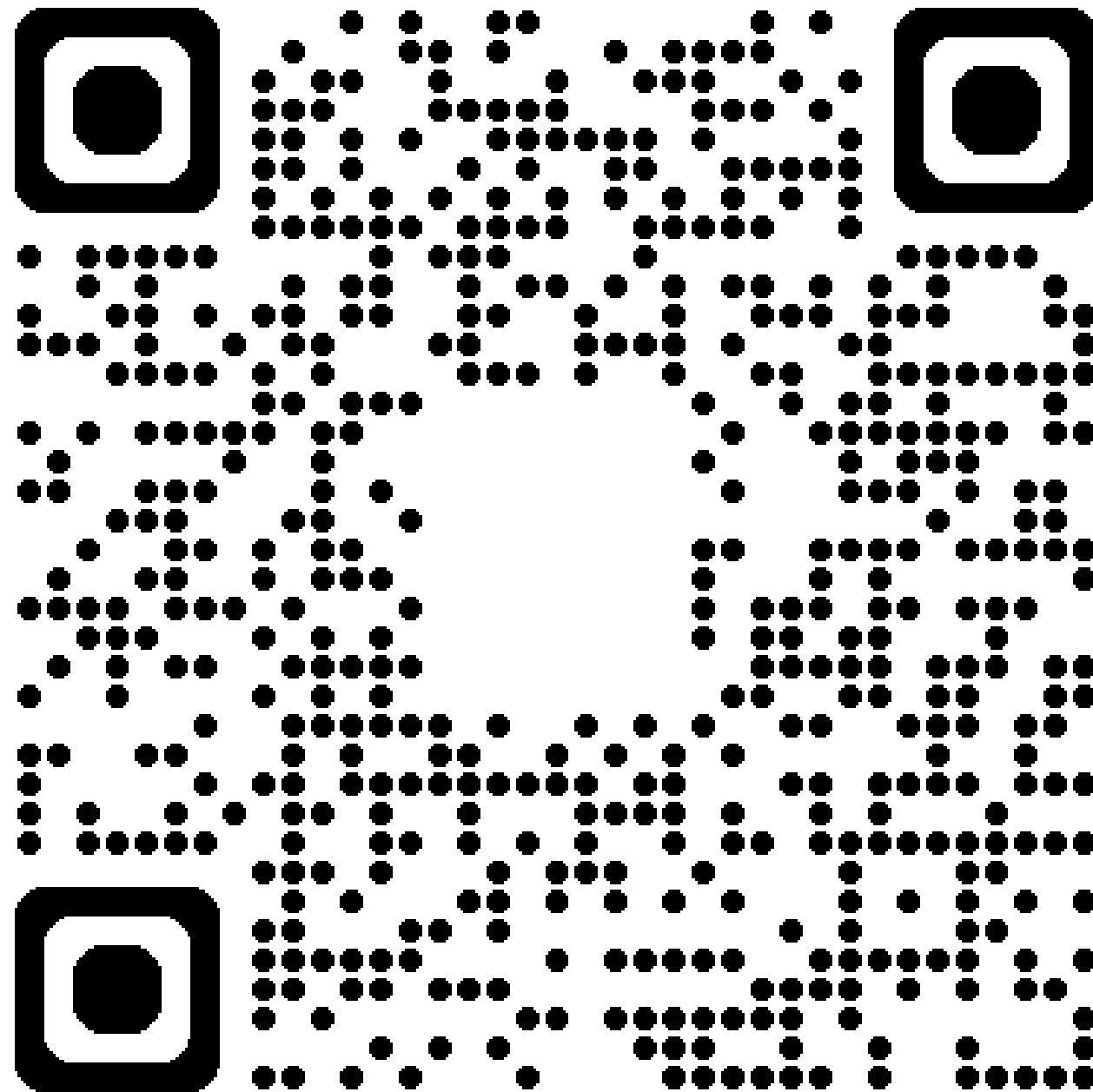


NUNO
CRATO

O MANUAL ESCOLAR

COMO CONCEBER,
SELECIONAR E UTILIZAR
UM BOM MANUAL PARA UMA
APRENDIZAGEM ATIVA


ALAMEDA



Everything starts with the curriculum

Lev Vygotsky (1934): "Instruction is what precedes development and leads it." → **collective**: classes

Antonio Gramsci (1935): Teach scientific ideas that **contradict** the **popular culture** (folklore) and that elevate young people out of their environment (Entwistle, 1979, 2023)

Michael Young (2008): *Bringing Knowledge Back In*

There is better knowledge: **powerful knowledge**

Right to **advanced** knowledge

Knowledge is **disciplinary**

Academic, modern and **central** knowledge

E.D. Hirsch (2025):

Shared knowledge is the goal of education

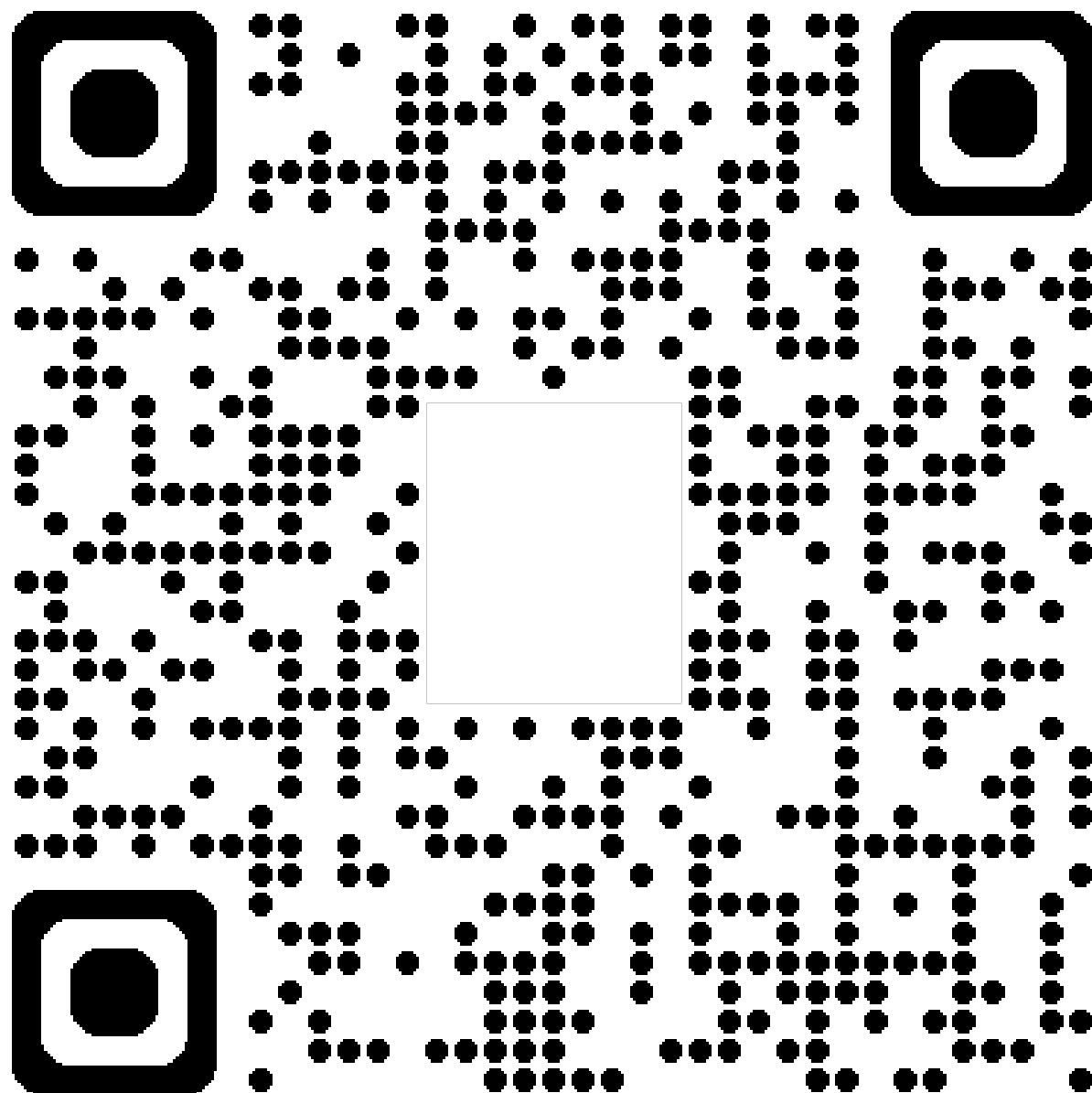
SpringerBriefs in Education

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Developing Curriculum for Deep Thinking The Knowledge Revival

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It all starts with the curriculum

It includes knowledge and skills, but it must be guided and structured by knowledge – skills have no structure

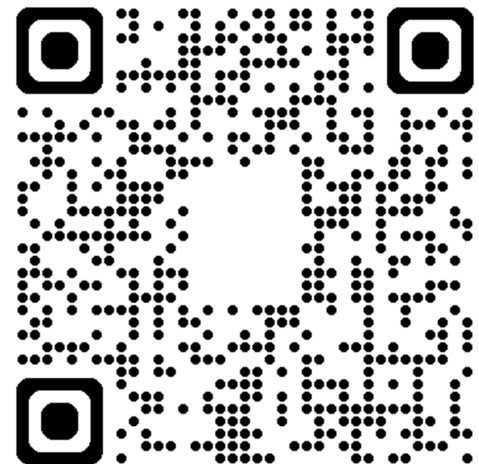
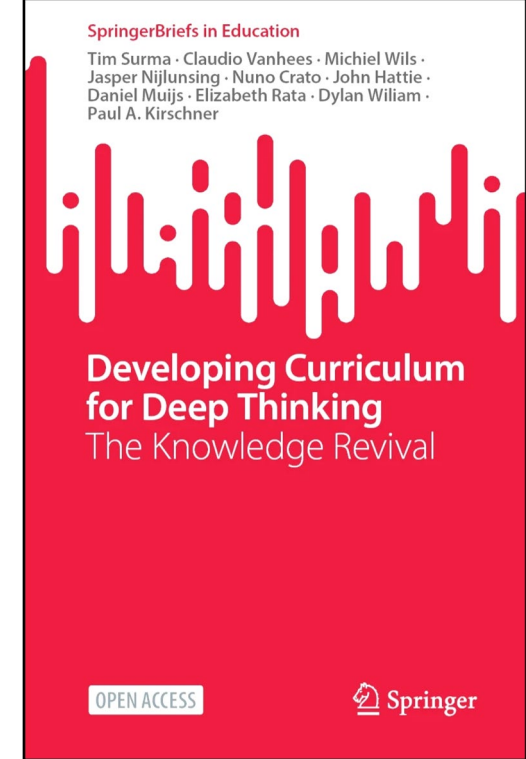
Generic skills outside of specific knowledge are illusory – skills are "domain specific"

Knowledge allows for more knowledge – vertical coherence – dispersed activities do not lead to coherent structures

The deep structure should be emphasized and not the surface

Knowledge must be interconnected – horizontal coherence

Deep learning: Moving from facts to simple schemas and from these to more complex schemas



It all starts with the curriculum

The curriculum builds new conceptual schemas on top of conceptual schemas already acquired

*“Es solo cuando se sabe algo que se siente la necesidad de saber más.
Es cuando no se sabe nada que la curiosidad desaparece”*

Josep Pla, *Lo infinitamente pequeño*

“The most important single factor influencing learning is what the learner already knows. Ascertain this and teach accordingly”

David Ausubel, 1968

Rote vs. meaningful learning

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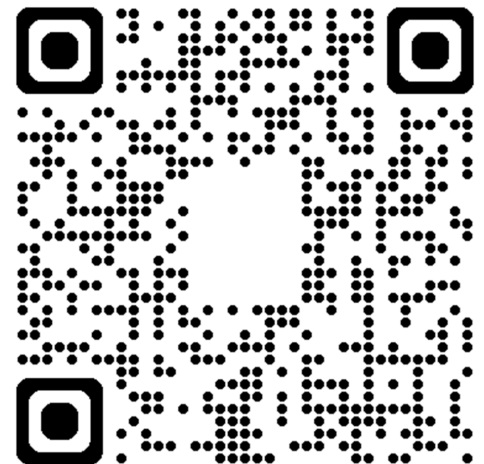
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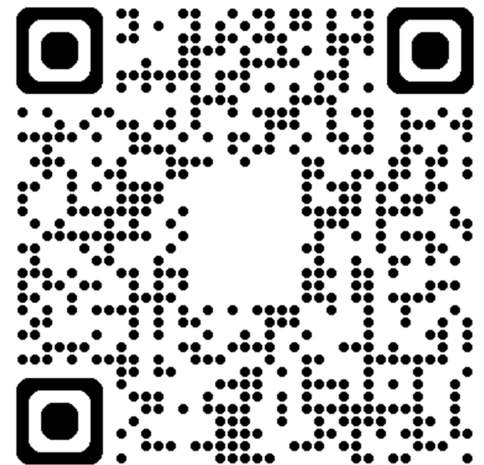
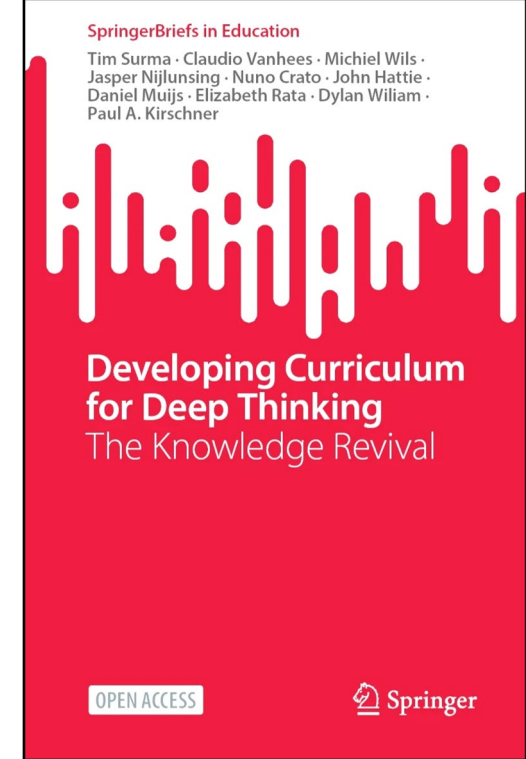
The curriculum must be clear and precise: teachers and students must understand how new concepts arise from previous ones

It must be ambitious, taking students to higher levels

You should not overdo the spiralling

Flexibility should not be exaggerated – we need a common culture

It must allow for a valid assessment → detailed + precise



Textbooks should translate the curriculum

Everything starts with the curriculum:

- Class content
- Desired learning outcomes
- Students' expectations
- Parents expectations and ways to help their kids
- Assessment, formative and summative

In a way, textbooks *are* the curriculum

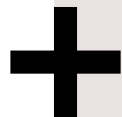
Textbooks' functions

Textbooks can translate curriculum structure and logic

It is important to understand how facts fit together.

“A collection of learning resources is no more a textbook than a pile of bricks is a house” (~D. Wiliam 2018)

An “initiation into the world of intelligent reading”
(Marsden 2001)

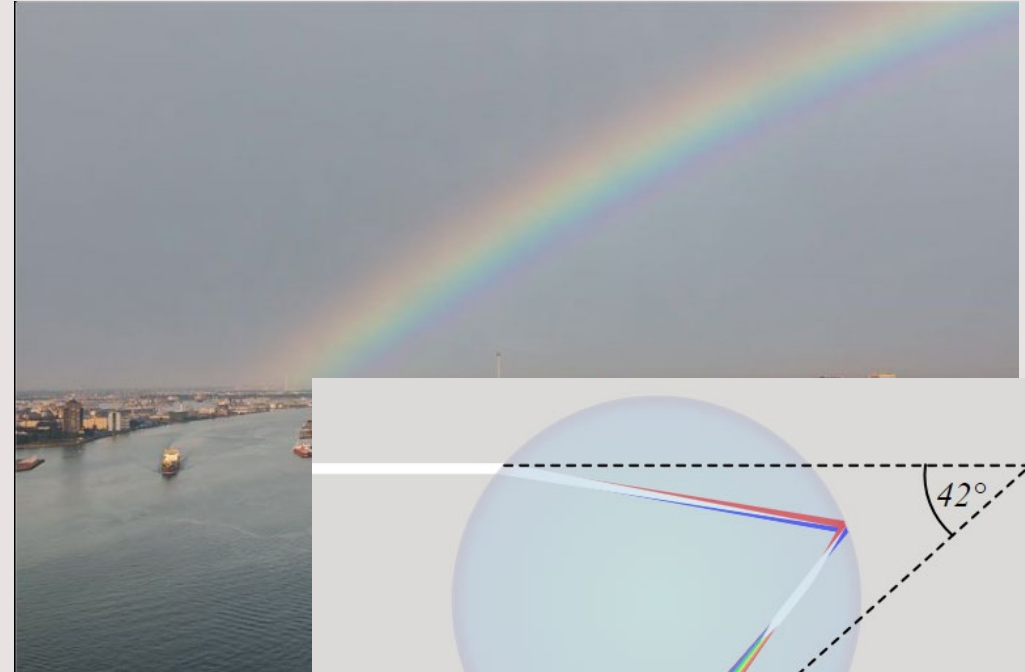
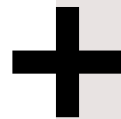


What's a good textbook?

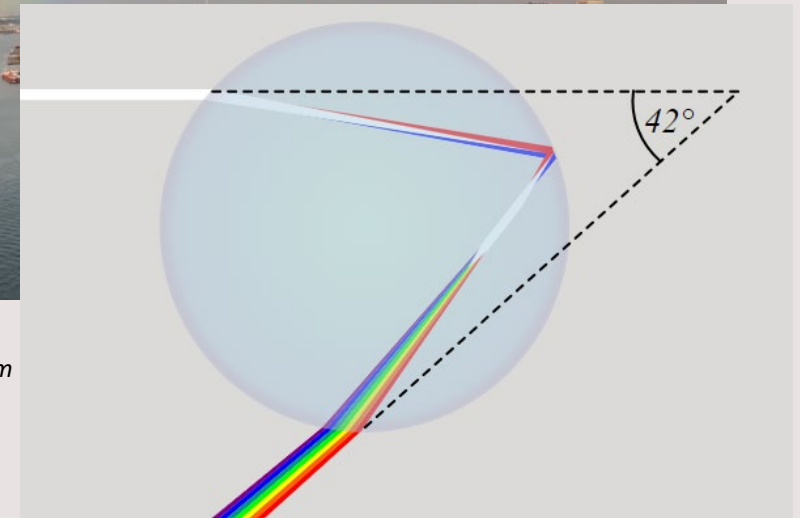
Cognitive principles

SEQUENTIAL PRINCIPLE

Concepts over concepts – integrating knowledge with previous knowledge



Rainbow above Rotterdam



What's a good textbook?

Cognitive principles

SEQUENTIAL PRINCIPLE

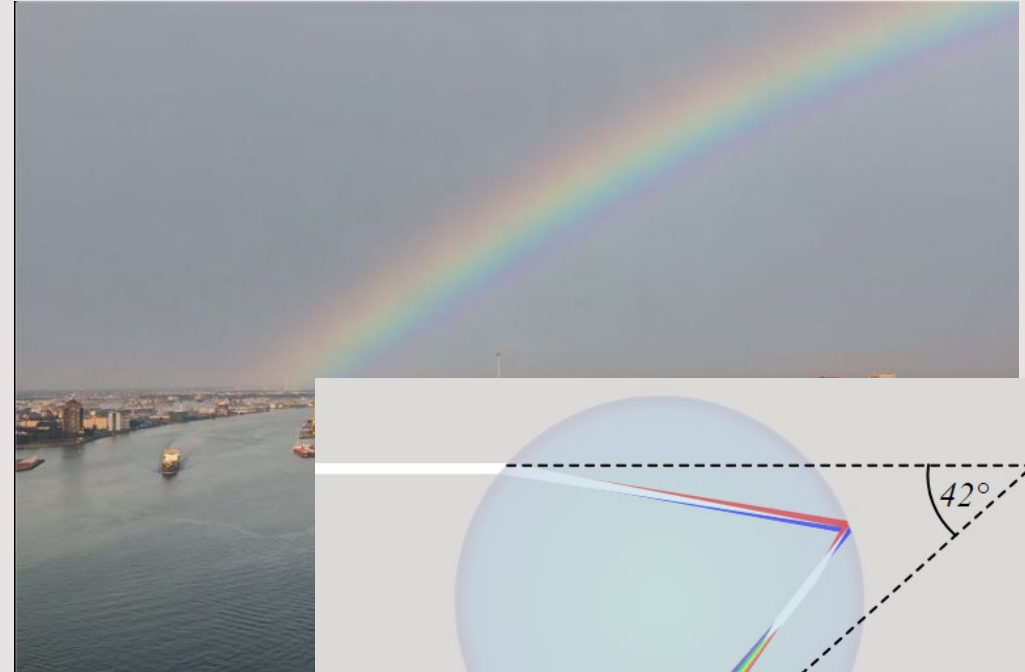
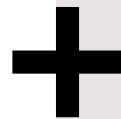
Concepts over concepts – integrating knowledge with previous knowledge

COGNITIVE LOAD

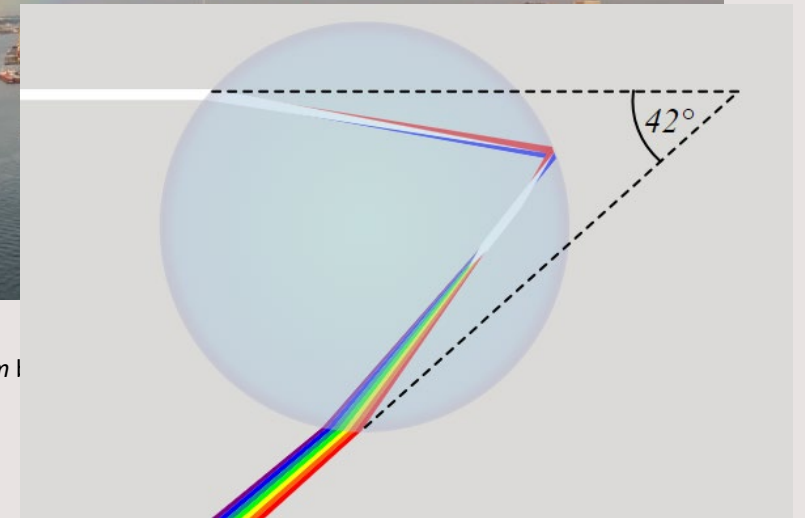
Step by step

SPACING

Wait for key concepts to be assimilated into long-memory schema



Rainbow above Rotterdam I



What's a good textbook?

Cognitive principles

MULTIMEDIA PRINCIPLE

Paivio two channels concept

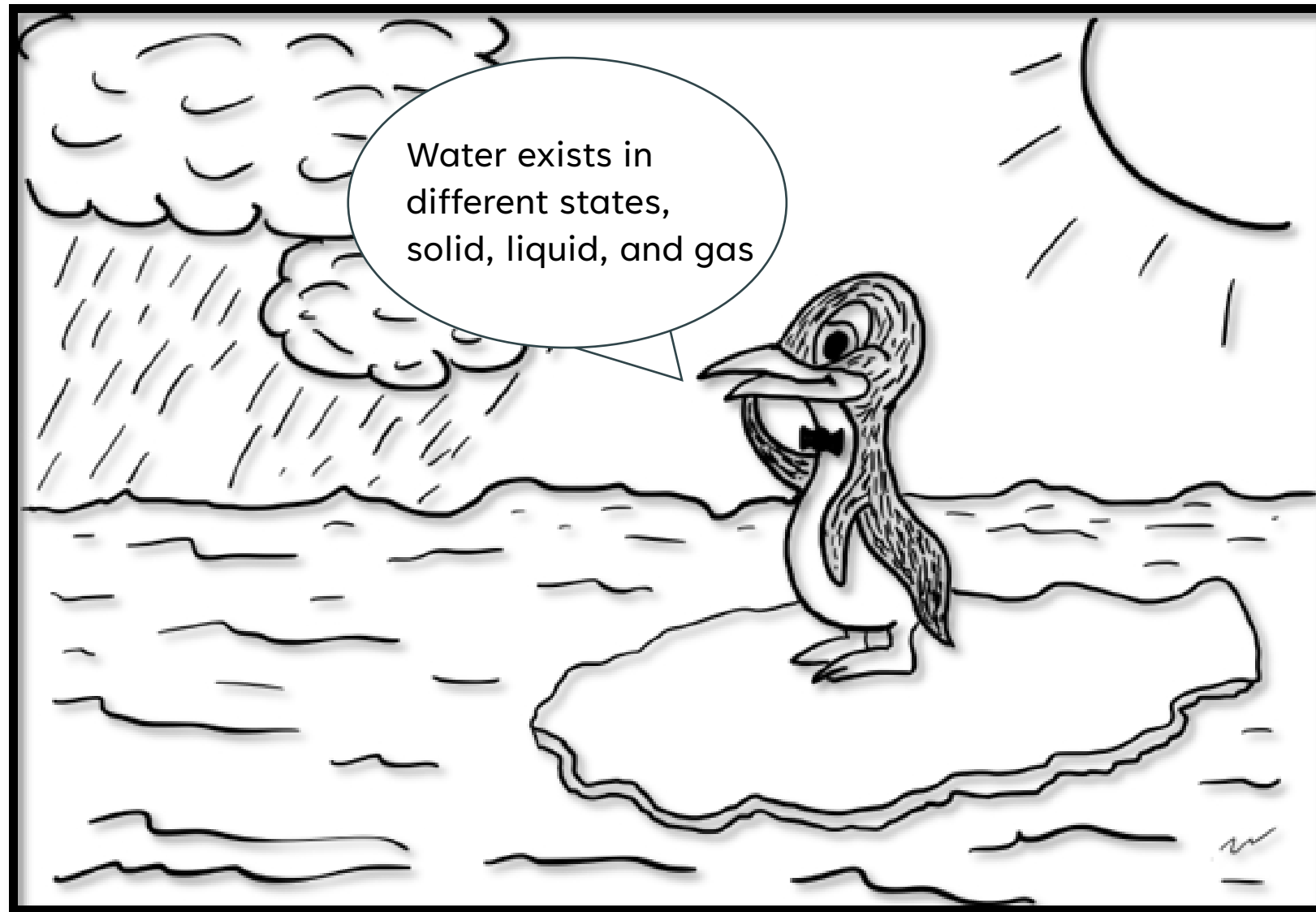
COHERENCE PRINCIPLE

When explaining water is H₂O...

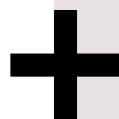
Avoid *seductive details*

- Distraction
- Prevent the cognitive coherence
- Interfere, by activating inappropriate prior knowledge

Harm **retention** and **transfer**



Now for a good example...



Constellations are arbitrary,
but help to organize the skies



What's a good textbook?

Good exposition principles

SIMPLICITY

Simple sentences. Right to the point.

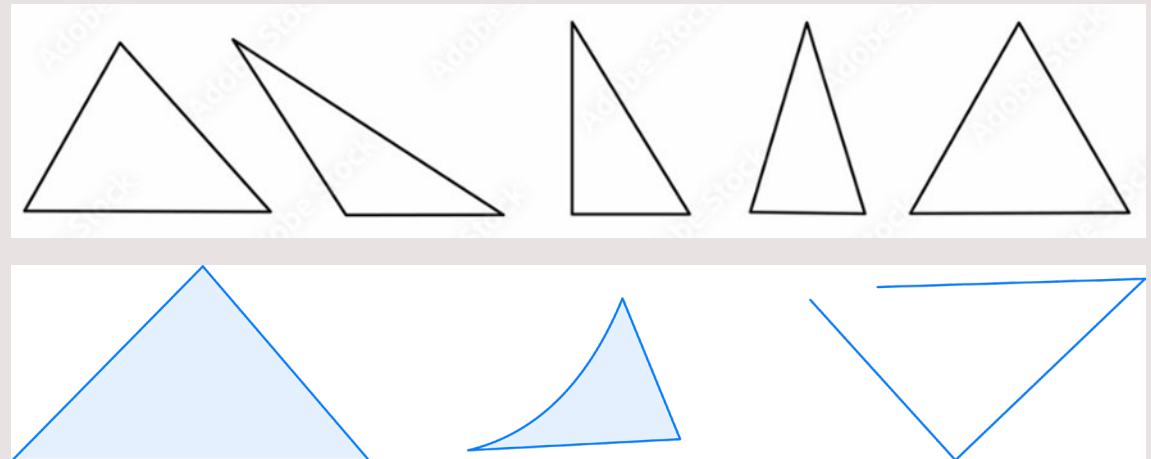
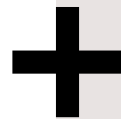
Concentrate on **conveying the message**

Use simple wording, but **precise**

Build precise and **rich vocabulary** – Tiers 2, 3

ANTICIPATE AND AVOID AMBIGUITY

DISCRIMINATIVE CONTRAST



What's a good textbook?

Active learning

SPACING

Concepts reappear later

RECUPERATION

Quizzes and exercises

INTERLEAVING

Promote alternation

ELABORATION

Suggest activities such as dialog reconstruction, explanations, summaries

Students process information selectively and activate a mental representation of new knowledge

They are active when:

- they select actively the information
- organize it in a coherent mental representation
- integrate it with previous knowledge



What's a good textbook?

Promoting transfer

1st – to develop automatisms allows for more abstract thinking

2nd – to promote deep understanding – to see the relationships between concepts

3rd – to give varied examples

4th – to indagate and nudge into deep and not superficial connections – to see the general strategies common to different procedures

We don't learn math studying Latin, neither we learn chemistry studying music

We don't learn critical thinking or other generic skills by focusing on critical thinking

PISA results also show “competencies”, i.e., application skills can't be developed by centring schools on application skills

But transfer is important: in a sense that's the holy grail of education



Textbooks' usage



Good practices

- Follow textbooks *sequence* and *content* as closely as possible
- Use textbooks' *notations* and *definitions*
- Use textbooks *exercises*
- Refer to textbooks *frequently*
- Nudge students *to read* the textbook

Bad practices

- Depart from textbooks in notation, order, and content
- Refer to textbooks sparsely
- Replace textbooks' content with sparse xerox copies or files



Bad practices consequences?

Memorization of scattered facts

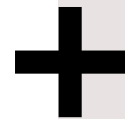
Vision of a discipline as a collection of tricks

Non-meaningful learning

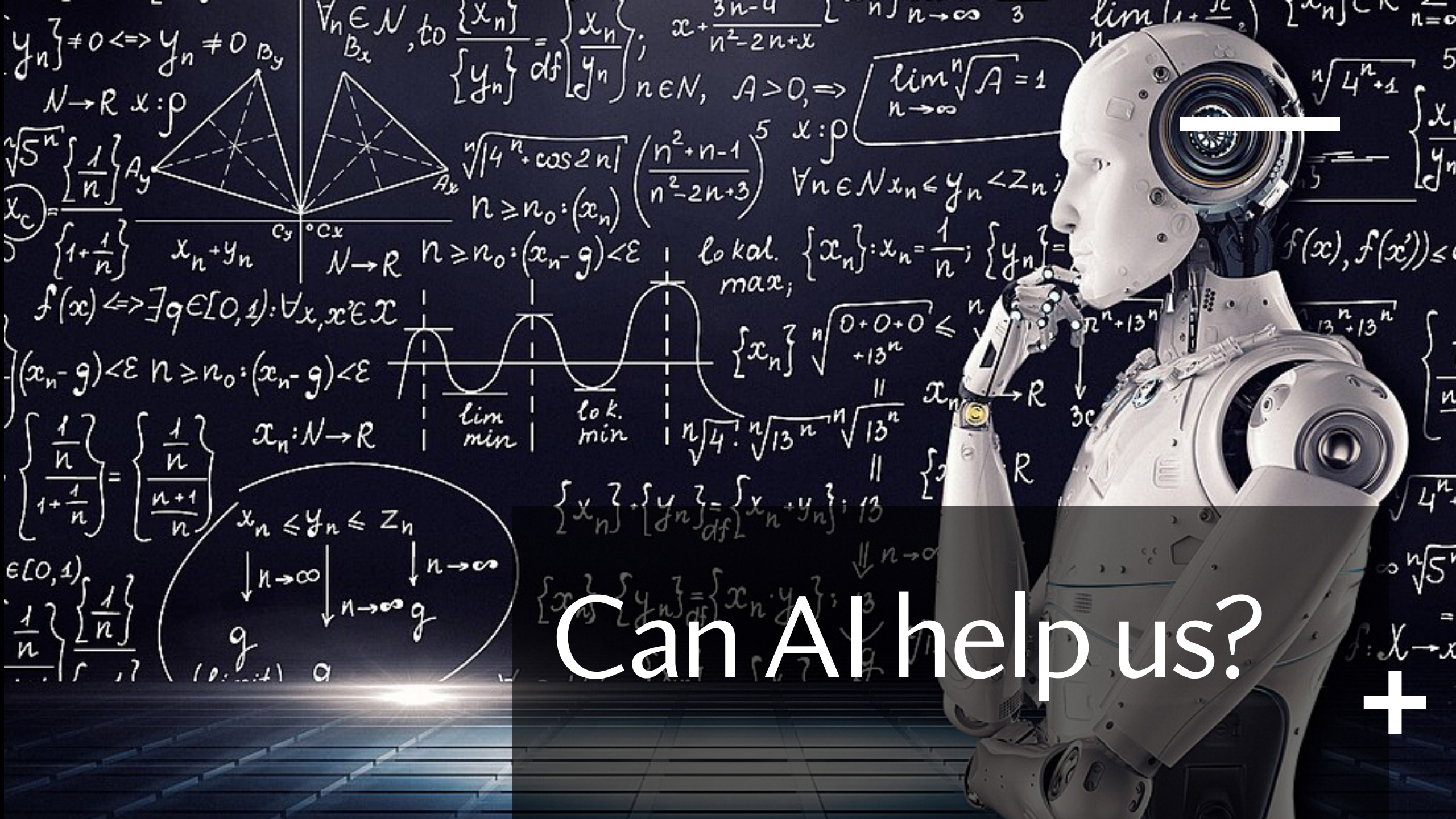
Mechanical preparation for evaluations, followed by quick forgetfulness, i.e....

... valuing immediate performance rather than learning (Soderstrom & Bjork, 2013)

Students' boredom...



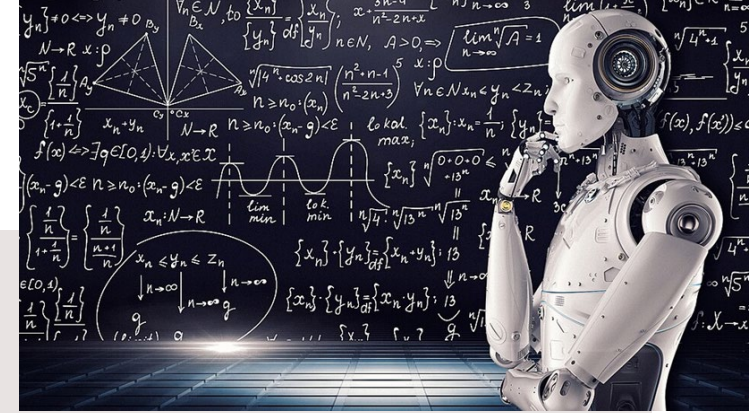
Devaluation of knowledge



Can AI help us?



Can AI help us?



No, if we persist with myths:

- Look it up...
- Critical thinking is what matters...
- Develop the “art of prompts”...

These myths lead to *cognitive offloading*:

- Delegate memorization, reasoning, and problem-solving

No, if we ultra-personalize and ultra-differentiate:

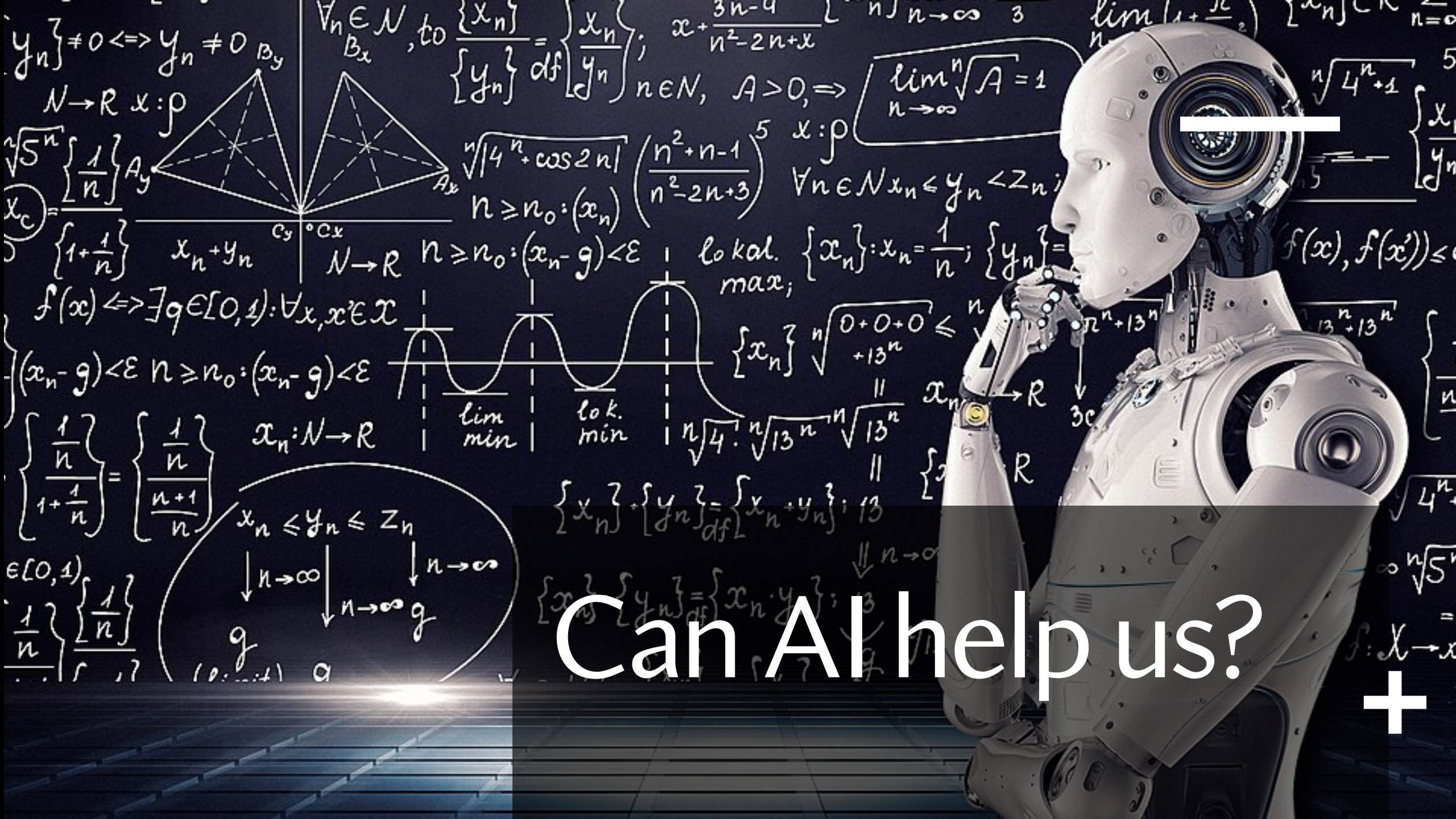
- It destroy collective learning, socialization, and national culture

Yes, if we *integrate* it and *align* it with good textbooks:

- Textbooks provide *trusted content*
- Textbook-based AI nudges teachers to refer to textbooks
- Textbook-based AI forces students to use the textbook
- AI students’ interactions reveals their difficulties to teachers

Yes, AI can *make textbooks visible* and more useful





Can AI help us?



Yes! Thank you, AI!



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Main references

Agodini, Roberto, Harris, Barbara, Atkins-Burnett, Sally, Heaviside, Sheila, Novak, Timothy, Murphy, Robert, & Pendleton, Audrey (2009). *Achievement Effects of Four Early Elementary School Math Curricula: Findings from First Graders in 39 Schools*, (NCEE 2009-4052). U.S. Department of Education

Altbach, Philip G. (1991). Textbooks: The International Dimension. In: Apple, Michael W. & Christian-Smith, Linda K. *The Politics of Textbooks*. New York: Routledge, 1991. pp 242–258.

Choppin, Alain (1991). *Les manuels scolaires. Histoire et actualité*. Paris: Hachette.

Crato, Nuno (2022). Math curriculum matters: Statistical evidence and the Portuguese experience. *Eur. Math. Soc. Mag.* 124, pp. 49–56.

Foster, Stuart (2011). Dominant Traditions in International Textbook Research and Revision, *Education Inquiry* 2-1, pp.5–20.

Gambi, Letizia & De Witte, Kristof (2025). Textbook choice, teaching practices, and student achievement in primary schools, University of Leuven preprint.

Ivić, Ivan, Pešikan, Ana & Antić, Slobodanka (Editors) (2013). *Textbook Quality: A Guide to Textbook Standards* (Eckert. Expertise), Goettingen: V&R unipress.

Mullis I., Martin M., Foy P. & Arora A. (2012). *TIMSS 2011 International results in mathematics*, Boston College.

Oates, Tim (2014). *Why Textbooks Count: A Policy Paper*. University of Cambridge Local Examination Syndicate.
<http://www.cambridgeassessment.org.uk/images/181744-why-textbooks-count-tim-oates.pdf>

Priouret, Jacques (1981). *Le statut du manuel scolaire dans l'enseignement contemporain*, in Mialaret, Gaston & Vial, Jean, *Histoire Mondiale de l'Éducation* (vol. 4, De 1945 a nos jours).Paris : Presses Universitaires de France.

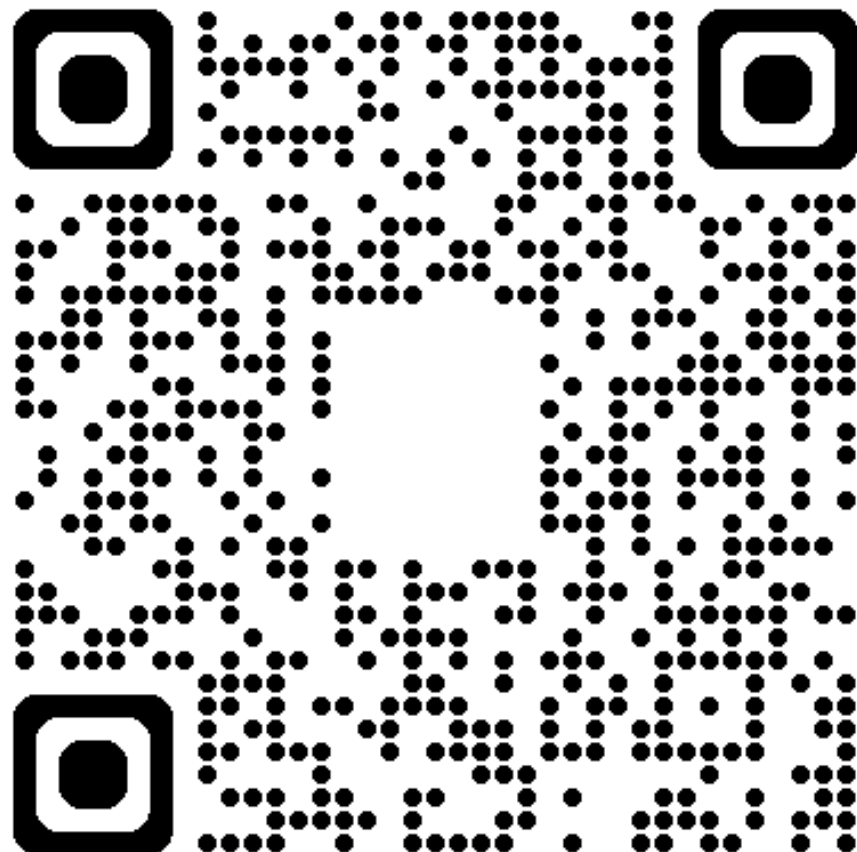
Sammler, Steffen (2018). History of the school textbook, in Fuchs, Eckhardt & Bock, Annekatrin, eds. (2018). *The Palgrave Handbook of Textbook Studies*, NY: Springer Nature.

Schmidt, William H., et al. (2001). *Why Schools Matter: A Cross-National Comparison of Curriculum and Learning*, San Francisco: Jossey Bass.

Vera, Eugenia Roldán (2018). Textbooks and education, in Fuchs, Eckhardt & Bock, Annekatrin, eds., *The Palgrave Handbook of Textbook Studies*, NY: Springer Nature.

Wilkins, Hendrianne J. (2011). Textbook approval systems and the Program for International Assessment (PISA) Results. A preliminary analysis, *IARTEM e-Journal* 4, pp. 63-74.

Woodward, Arthur (1993). Introduction: Learning from textbooks, in Britton, Bruce K., Woodward, Arthur & Binkley, Marilyn (Eds.) (1993), *Learning from textbooks: Theory and Practice*, New York: Routledge.



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Thank you!

