Sound check

Present-day Practicals webinar series ’25/’26

PRESENT-DAY PRACTICALS

Welcome to webinar 1:

“How do students truly learn in the lab?”

Dr Hendra Y. Agustian
University of Copenhagen

We’re all familiar with the phrase that “hands-on” lab work is a great way to learn. This hands-on aspect is often assumed to be the key pedagogical value of laboratory education. But have you ever stopped to think about why?

We encourage you to **turn on your camera** to help create a more personal and interactive atmosphere.

This webinar will **not be recorded** to help create an open, interactive atmosphere where everyone feels comfortable to share ideas and ask questions. Instead, we’ll share a **recap** afterwards

PRESENT-DAY PRACTICALS

Who are we?

Marjo de Graauw

Janine Geerling

Carolien Koppejan

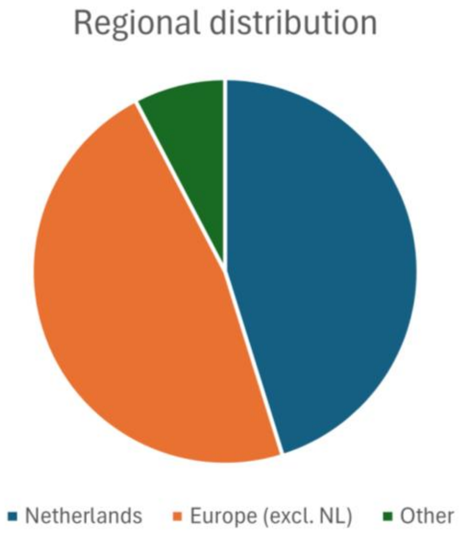
Charita Furumaya

Bianca Bakker

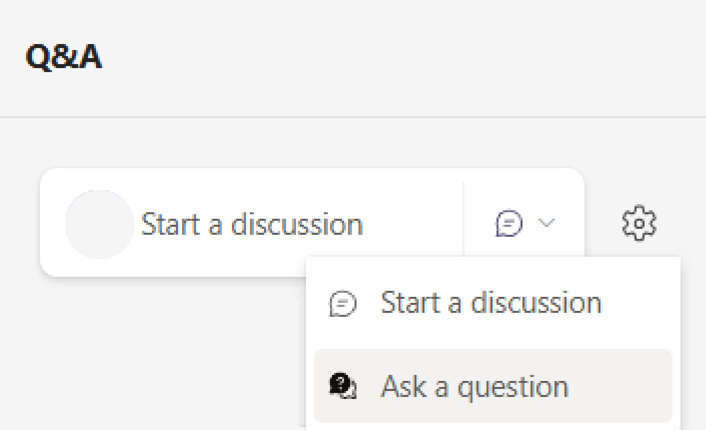
Who are you?

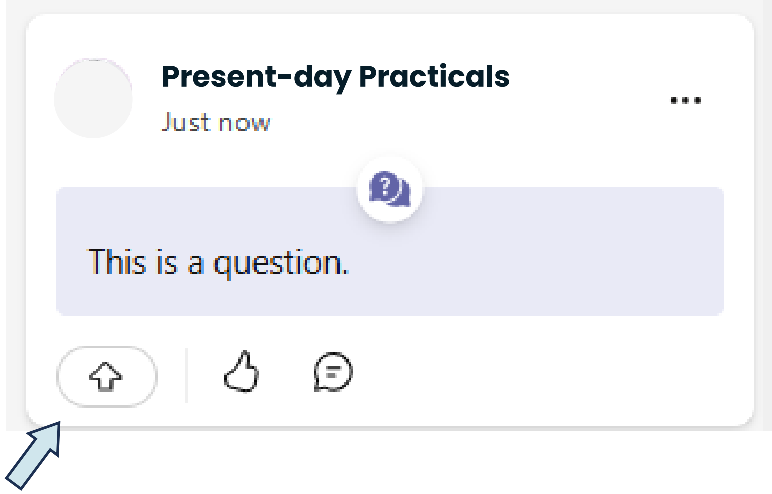
21 different countries:

- Aruba
- Australia
- Austria
- Belgium
- Czech Republic
- Denmark
- Ecuador
- Ethiopia
- Germany
- Greece
- Hungary
- Ireland
- Jordan
- Latvia
- Norway
- Slovakia
- Spain
- Switzerland
- The Netherlands
- United Kingdom
- United States of America



Use the **Q&A** to post your questions and share your ideas





After the webinar, we'll share a **recap** containing slides, lessons learned, and additional information and resources

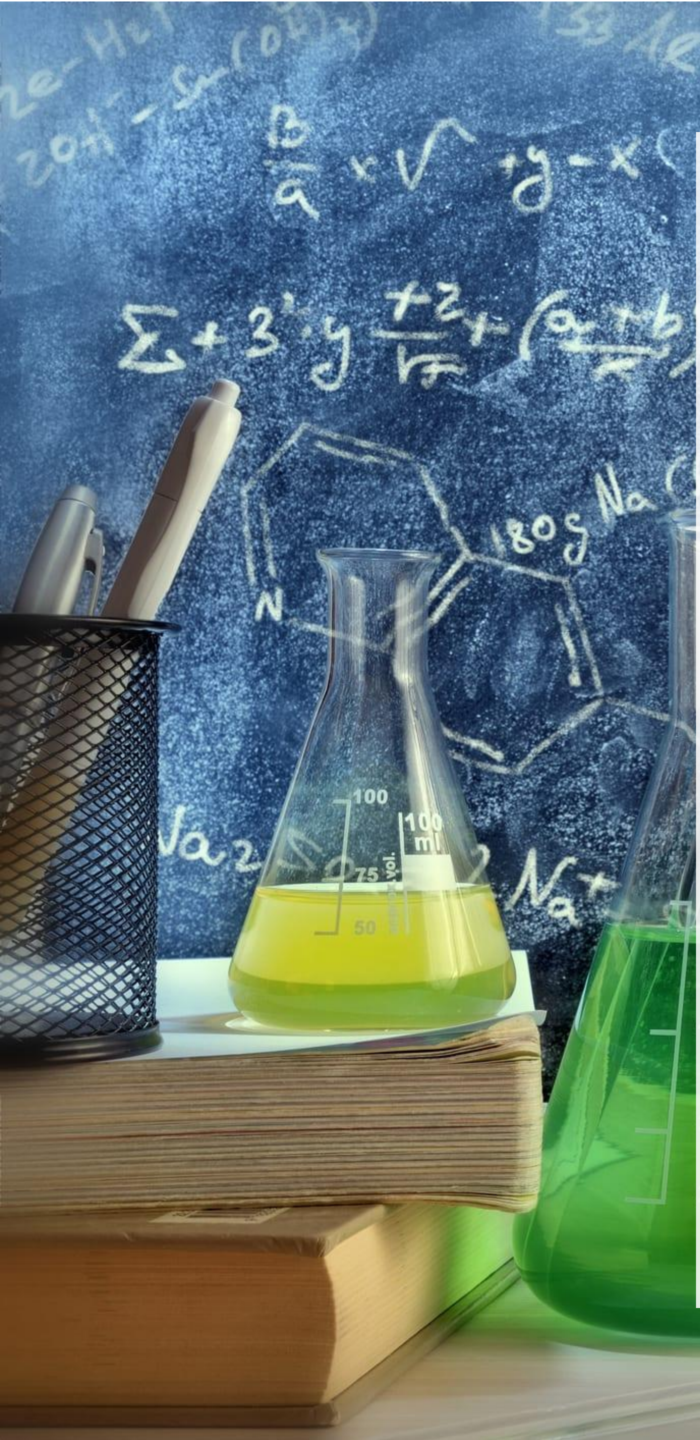
PRESENT-DAY PRACTICALS

Webinar 1:

"How do students truly learn in the lab?"

Dr Hendra Y. Agustian
University of Copenhagen

We're all familiar with the phrase that "hands-on" lab work is a great way to learn. This hands-on aspect is often assumed to be the key pedagogical value of laboratory education. But have you ever stopped to think about why?



How do students truly learn in the lab?

Hendra Agustian

Department of Science Education, University of Copenhagen

KØBENHAVNS UNIVERSITET

Acknowledgements

The IQ-Lab project was funded by the Novo Nordisk Foundation, grant number NNF18SA0034990, and was a collaborative work between Department of Science Education and Department of Pharmacy, at University of Copenhagen.

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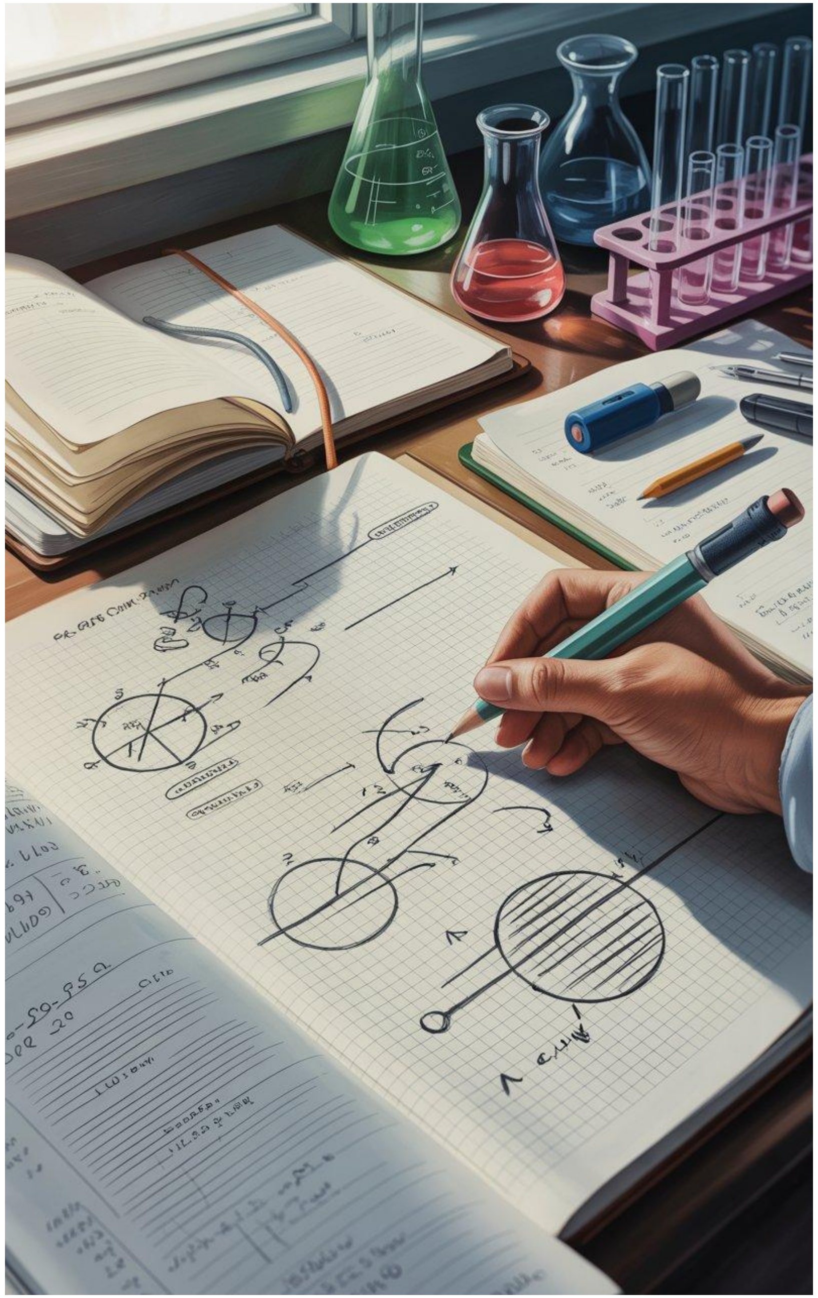
Why focus on lab learning?

- Substantial part of higher science education **curriculum**
- A part of an **identity** as a scientist: *doing* science, working with *physical materials*, (wearing a lab coat?), and *talking* about *ideas* in science with each other
- Expensive! Gotta make that investment worthwhile
- So that we can actually provide some **evidence** for whether, if, what, and how students truly learn and develop their lab-related competencies

Question for you

What makes lab learning special in your experience?

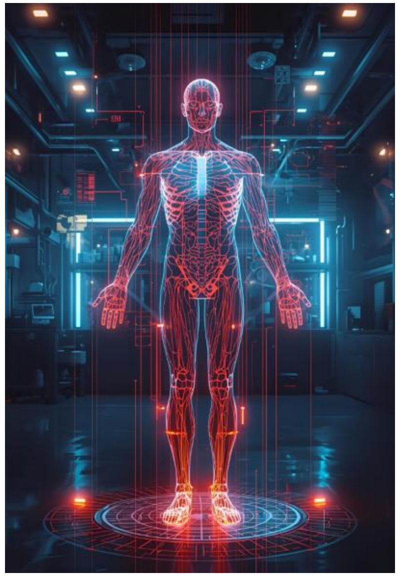
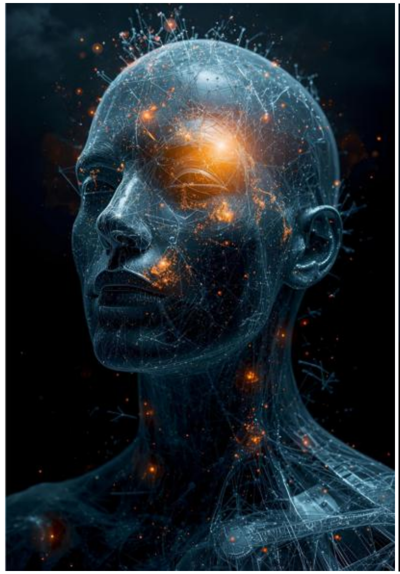
Share a quick response in the chat.

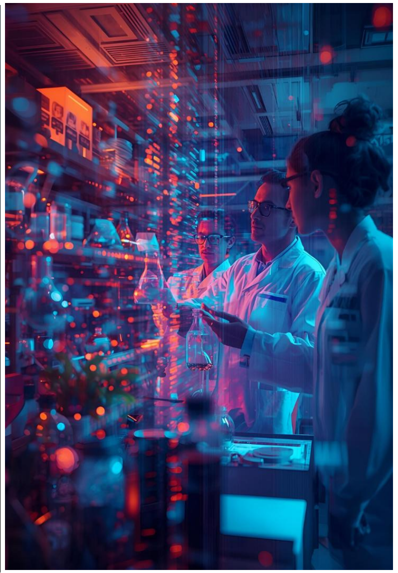


Using our body in learning science

- Physical
- Phenomenological (experiential)
- Ecological
- Interactional

Embodied cognition



Kersting ea (2021) Four senses of embodiment. *Sci & Ed*.

Knowledge and knowing in science

- When learning science, we think about knowledge (concepts, procedures)
- Also, we judge a lot
  - Is this good?
  - How do I know it's good?
  - How do I know that I know?

Epistemic cognition

Greene ea (2016) Handbook on epistemic cognition. *Routledge*.

Question for you

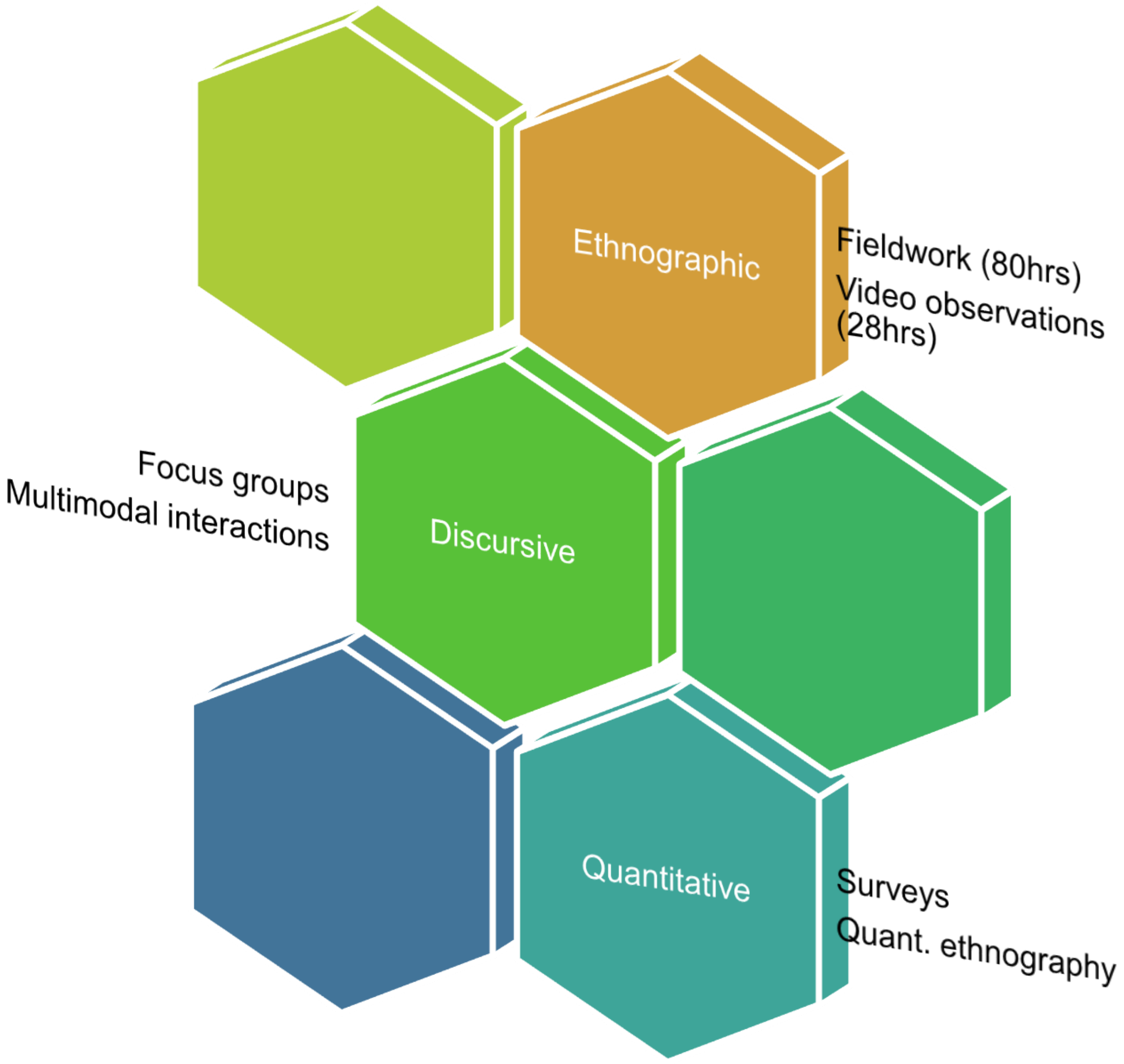
How do students use their bodies while learning in your lab?

- Share one surprising example from your own teaching experience.
- Discuss in the breakout rooms (ca. 5 mins).
- Share out in the plenum.

Key question for today

How do actions and thinking link together when students learn in the lab?

Today, we'll explore how the mind and body combine to build understanding, what we call "**embodied epistemic cognition**"

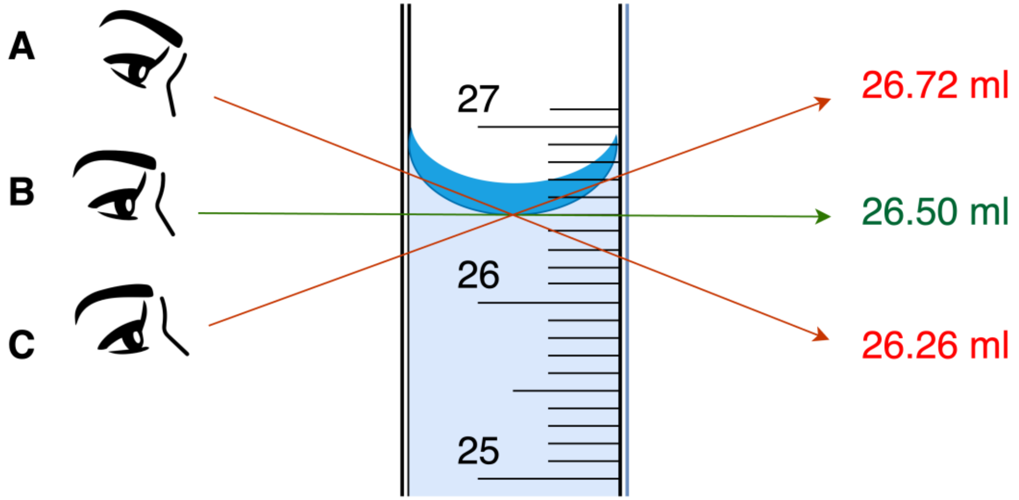


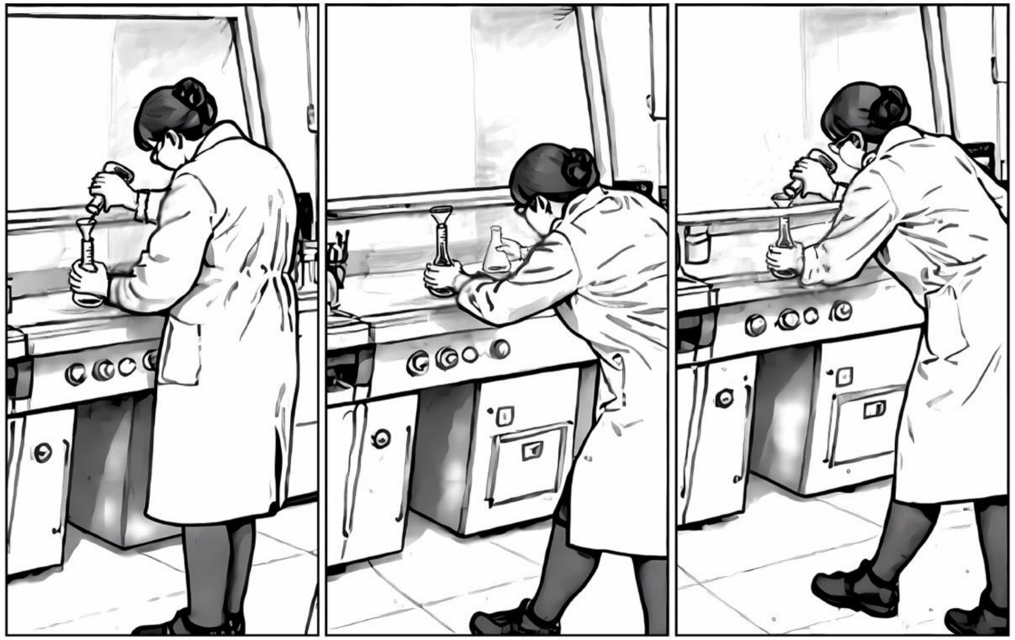
Methods

- Laboratories of pharmaceutical physical and analytical chemistry, 2nd year BSc
- Focus: Experiment on quantitative determination of acetaminophen and caffeine in commercial tablets using HPLC

Data corpus	n	Note
Focus group transcripts	30	Based on excerpts of video recording or laboratory report
Laboratory discourse	47	Focus on 4 pairs of students
Video recordings	47	Multimodal observations
Survey responses	912 +	Across 4 universities in DK, CZ, US, and ID

Real-life lab examples





Agustian ea (forthcoming) Embodied epistemic cognition in the lab.

Real-life lab examples

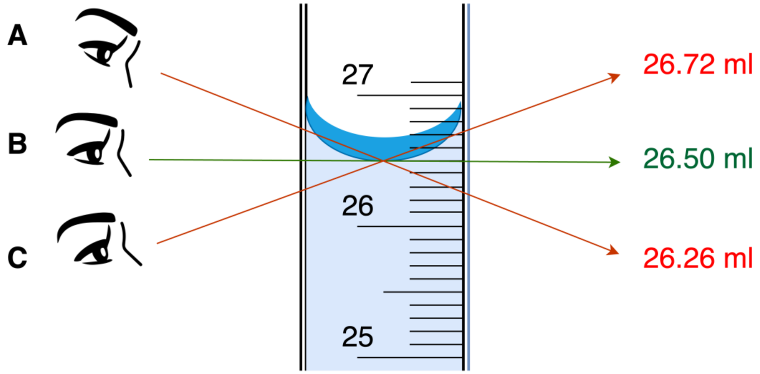
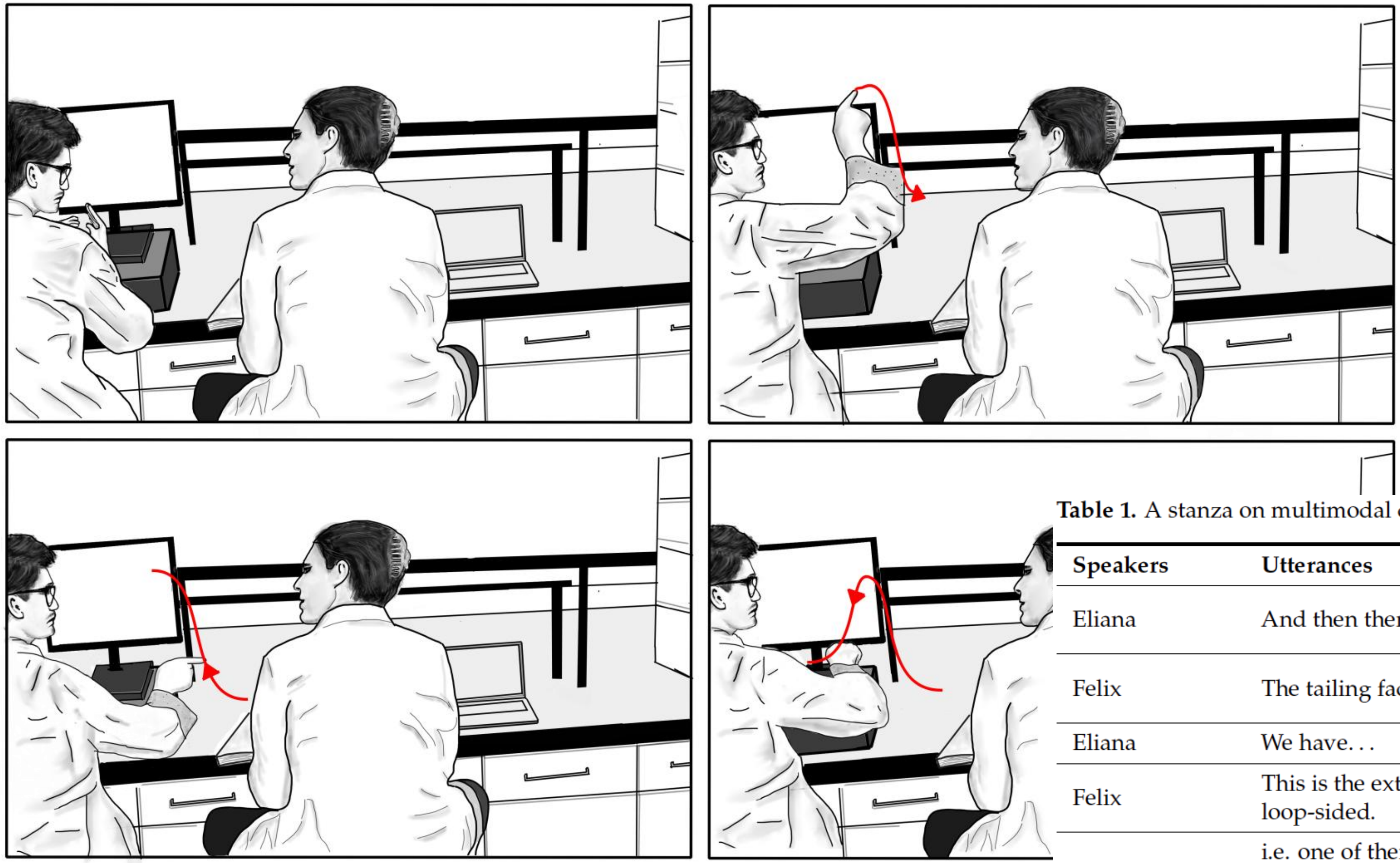


TABLE 6 A stanza on body awareness and spatial navigation (Day 1, EF, line 5012-5021)

Interlocutor	Utterance	Non-verbal cue and action
Felix	I think it's..., it's one of the short ones.	Kneeling, Felix looks at the scale on the cylinder closely.
Eliana	1... Isn't that long, you think?	Eliana looks at the scale on the cylinder closely.
Felix	Uh..., no, it's the short.	Kneeling, Felix looks at the scale on the cylinder closely.
Eliana	Or that... The middle there?	Eliana looks at the scale on the cylinder closely.
Eliana	Or that... The middle there?	Eliana looks at the scale on the cylinder closely.
Felix	The long lines digits are 10' interval, the short digits are 5'.	Kneeling, Felix looks at the scale on the cylinder closely.
Eliana	1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Yes, OK.	Eliana dispenses the solutions, Felix immediately stands up.
Felix	It was up to 3, you should have the next.	Felix stands up.
Eliana	No, I'm going to have the next little.	Eliana proceeds with another.
Felix	Uh... Stop, I think you're there. ... Yes...	Felix watches as Eliana works.
Eliana	Yes, it is now a very nice drink. I don't think methanol smells as much...	Felix quickly fetches the methanol from Eliana, covers it with his hand.

Real-life lab examples



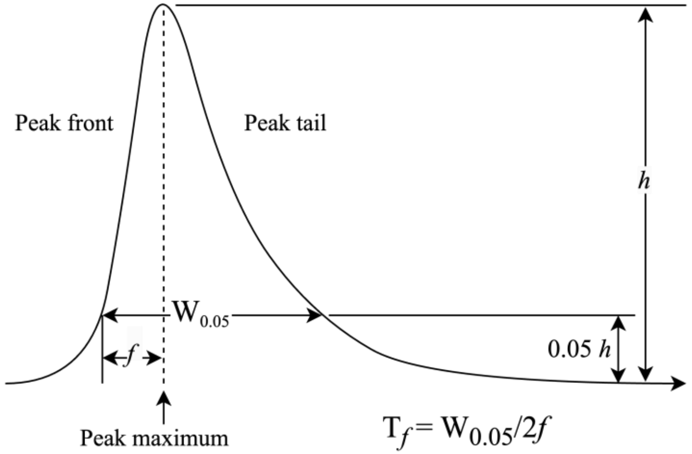


Table 1. A stanza on multimodal conceptual discourse.

Speakers	Utterances	Non-Verbal Cues and Action
Eliana	And then there is the tailing factor?	Eliana invokes a concept specific to chromatography.
Felix	The tailing factor. . .	Felix intends to type, but discusses the concept instead.
Eliana	We have. . .	Eliana looks at Felix.
Felix	This is the extent to which it is loop-sided.	Felix looks at Eliana, explains the concept using hand gestures.
Felix	i.e. one of them runs down, and the other it is like that where there is a tail, is it not like that?	Felix looks at Eliana, explains the concept using hand gestures.

More examples

TABLE 8 A stanza on interbody cognitive load distribution (Day 3, GH, line 11218-11228)

Interlocutor	Utterance	Non-verbal cue and action
Theo	This now contains all the data you have been running, also from Module 2.	Theo points to the screen.
Grace	And this is the one we have used this time.	Grace works on the HPLC computer while Hayley stands by, working on her laptop.
Theo	Yes, so you click on that one, and double-click over in it.	Theo looks at the screen..
Grace	Here.	Grace works on the HPLC computer.
Theo	Actually, there is. I think you can do it in both places.	Theo points to the screen.
Grace	For all of it, or just on one of them.	Grace works on the HPLC computer
Theo	Just click the 1 and it does it to load data, you could also have click load data. Then all your runs in the sequence are loaded.	Theo points to the screen.
Grace	Yes, what should I press here?	Grace works on the HPLC computer.
Theo	It then all depends on what you are interested in doing with your data processing.	Theo points to the screen.
Grace	Ok.	Grace responds.
Theo	So what it is on now, it is that you can only just make identification, and some area. If you choose that 3D UV concept, there will be additional options. Then we can do everything with data.	Theo points to the screen.

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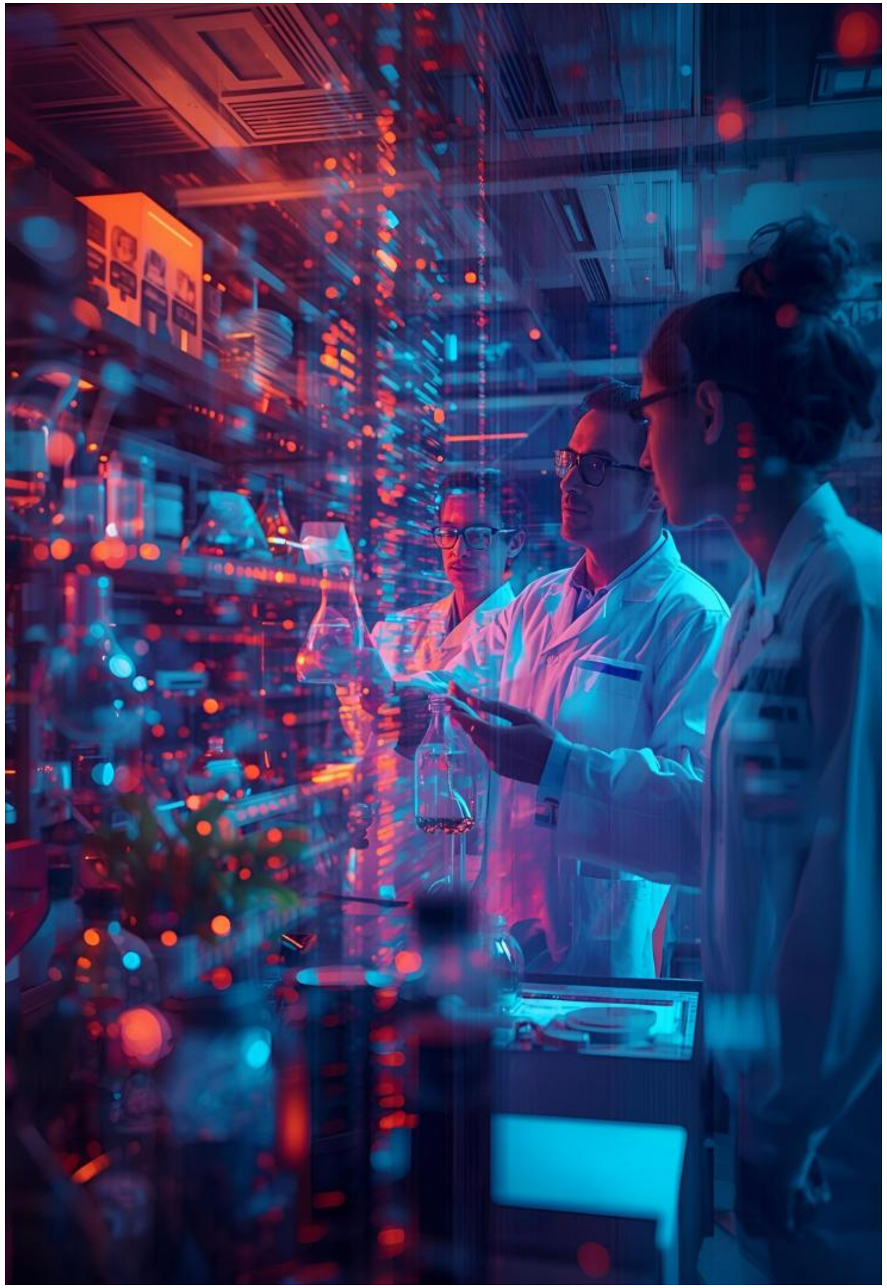
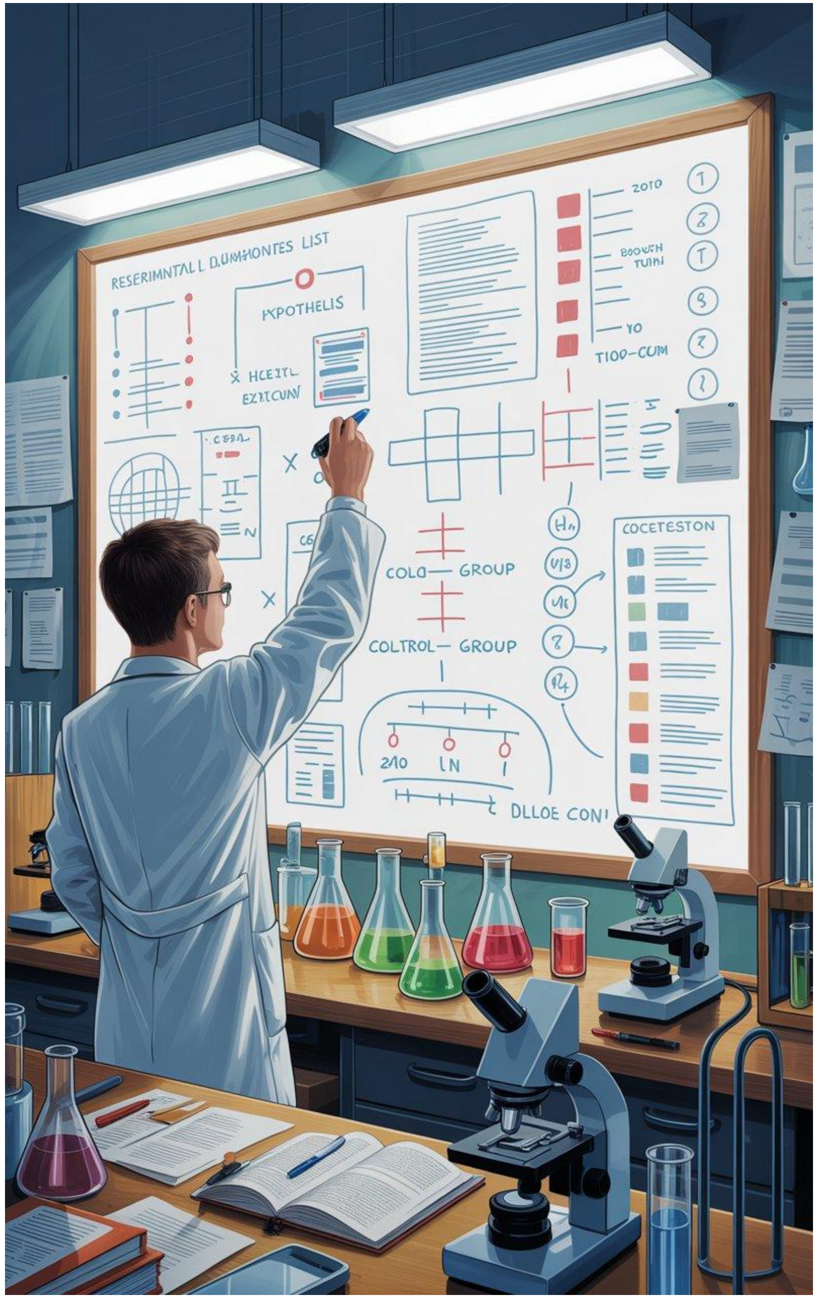
7 ways bodies play a role in lab learning

- Practice technical skills
- Use senses to guide actions (seeing, smelling, touching)
- Be aware of their positioning and space
- Use instruments to assist thinking
- Gesture to explain or solve tasks
- Divide tasks and thinking together
- Support each other through hands-on help



8 ways students think about knowledge and knowing in science

- Frame concepts and theories
- Generate hypotheses/questions
- Design experiments
- Evaluate data
- Explain results and build arguments
- Validate findings
- Acknowledge uncertainties
- Collaborate and communicate



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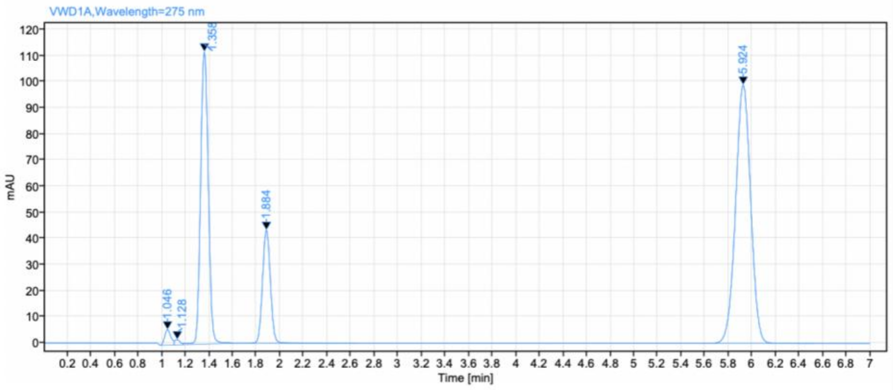
When hands and minds intertwine

Hendra: [Pointing to a page in the lab report] If you get this as a result of your SST, what can you tell me about this chromatogram? (See Figure) Is it a good one? Why?



Alexis: It's good because the peaks are well separated. Um, so···

Brooks: Yea, ··· so you get a pretty clear separation of the different compounds within the tablet. Which one to do, which one you would like to analyse. If the peaks weren't separated from each other, it would be impossible to analyse the areas. So that's also why we test the resolution, to see···

Alexis: How separated they are.

Brooks: And they are sufficient to do some analysis on.

Alexis: And you can also look at the chemical structure of the compound, to see, and then tell which will be held in the column the longest.

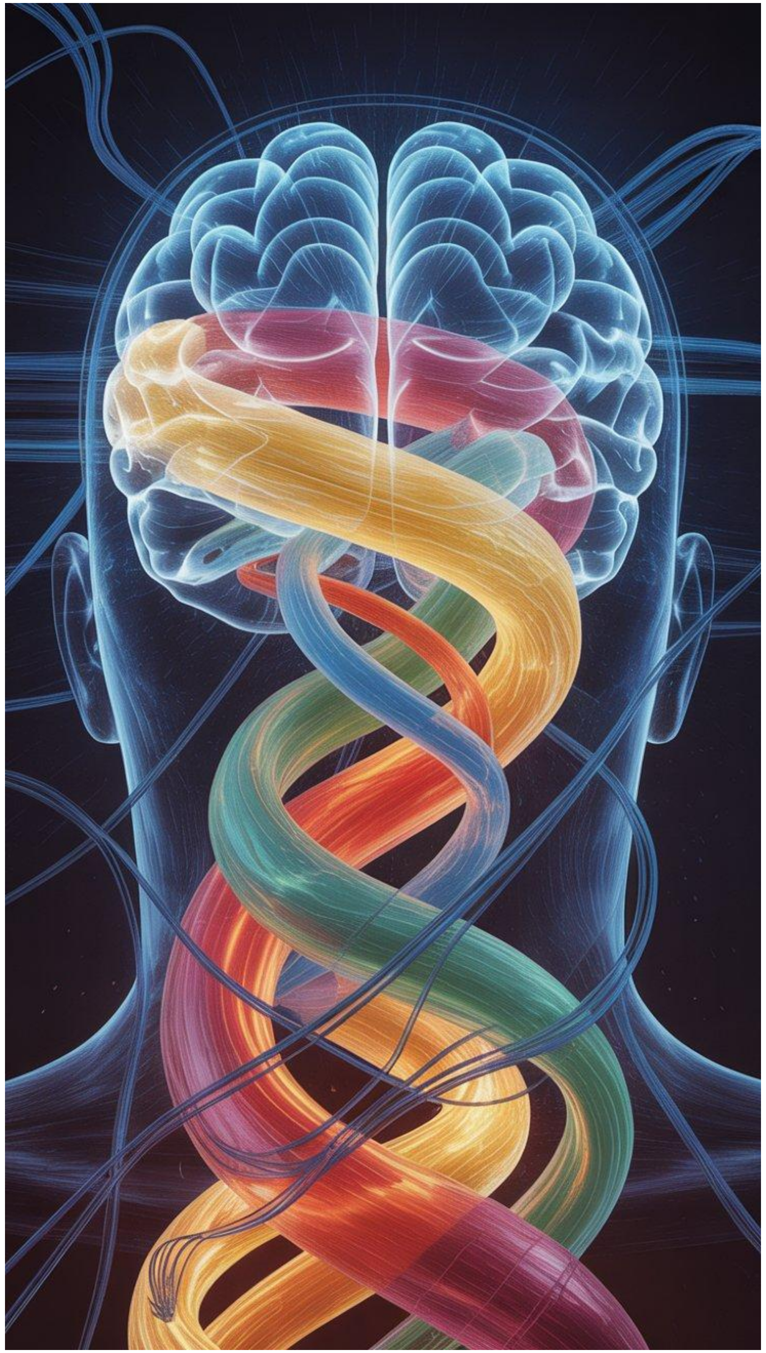
Brooks: Mmm. Tendencies.

When cognition and emotion intertwine

Hendra: How do you feel about having to use this, another set of data?

Hayley: Well usually I don't mind, but I was a bit *embarrassed*, I could say. Usually, it's very common, that things go wrong in the laboratory. And also when I have to speak with my friends, and they are all, oh yes, mistakes, mistakes, mistakes. And I would say the *[procedural] mistake* we made, I'm sort of *happy for it*, because we didn't really do anything wrong with the calculations or anything. We have understood the entire process, so I was alright with it, other than of course, [alas]! I made a mistake, ha ha ha ha ha.

Grace: I think *we learn a lot from making mistakes* because once you make a mistake, it sticks. *That's how you remember*. So it's a learning experience where you really get stuck, don't do this now. Now you have tried it and learned it, and now you know what to do, and is actually really beneficial sometimes, because if you do everything correctly all the time, then there isn't really any learning experience.



Question for you

Think about a recent lab. Which of these ways of engaging the body in knowledge co-construction did your students use?

- Discuss in the breakout rooms (ca. 5 mins).
- Share out in the plenum.

Link to padlet: tiny.cc/pdp25

Take home messages

- Consider designing laboratory experiences that explicitly engage both epistemic and embodied dimensions of learning.
- Provide opportunities for students to engage in scientific practices, eg. **experimental design** and **critical data evaluation**.
- Facilitate this **reflective practice** through **dialogic prompts** that specifically address how embodied experiences are relevant to understanding scientific concepts and procedures.

Further reading

Chemistry Education Research and Practice — ROYAL SOCIETY OF CHEMISTRY
PERSPECTIVE
Cite this: Chem. Educ. Res. Pract., 2022, 23, 518

Considering the hexad of learning domains in the laboratory to address the overlooked aspects of chemistry education and fragmentary approach to assessment of student learning

Hendra Y. Agustian

Received 30th September 2021, Accepted 3rd April 2022
DOI: 10.1039/d1rp00271f

Science & Education (2021) 30:1183–1210
https://doi.org/10.1007/s11191-021-00232-z
ARTICLE

A Growing Body of Knowledge

On Four Different Senses of Embodiment in Science Education

Magdalena Kersting[1] · Jesper Haglund[2] · Rolf Steier[3]

Accepted: 13 April 2021 / Published online: 28 April 2021
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Science Education — WILEY
RESEARCH ARTICLE

"I Feel Like a Real Chemist Right Now": Epistemic Affect as a Fundamental Driver of Inquiry in the Chemistry Laboratory

Hendra Y. Agustian[1] | Bente Gammelgaard[2] | Muhammad Aswin Rangkuti[3] | Jonas Niemann[1]

Received: 13 March 2024 | Revised: 11 November 2024 | Accepted: 18 November 2024
Science Education, 2025; 109:722–744
https://doi.org/10.1002/sce.21933

Chemistry Education Research and Practice — ROYAL SOCIETY OF CHEMISTRY
PAPER
Cite this: DOI: 10.1039/d5rp00232j

Striving to learn to do chemistry in the laboratory: epistemic conation as a fundamental driver of inquiry

Hendra Y. Agustian, Bente Gammelgaard, Muhammad Aswin Rangkuti and Marie Larsen Ryberg

Received 26th June 2025, Accepted 8th September 2025
DOI: 10.1039/d5rp00232j

Thank you for your participation!

PRESENT-DAY PRACTICALS

Upcoming webinars

Link to evaluation

Present-day Practicals webinar series ‘25/’26

1.	How do students truly learn in the lab?	Thu 06/11/’25
2.	Extended reality in lab education	Thu 20/11/’25
3.	Refocusing labs: from cookbook to open inquiry	Tue 02/12/’25
4.	Fostering sustainability in lab education	Tue 13/01/’26
5.	Artificial intelligence in lab education	Thu 29/01/’26
6.	TBA	Tue 17/02/’26

LabBuddy webinar: Enhancing lab education — March 2026

info@presentdaypracticals.nl

THANK YOU

for attending this webinar

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