

Natuurkunde op maat?

Practicum op maat?

14 december 2019
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I USE MULTI-MILLION
DOLLAR SATELLITES
TO FIND TUPPERWARE
IN THE WOODS.



WHAT'S YOUR HOBBY?

2



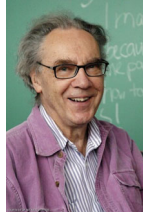
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rijksuniversiteit
 groningen



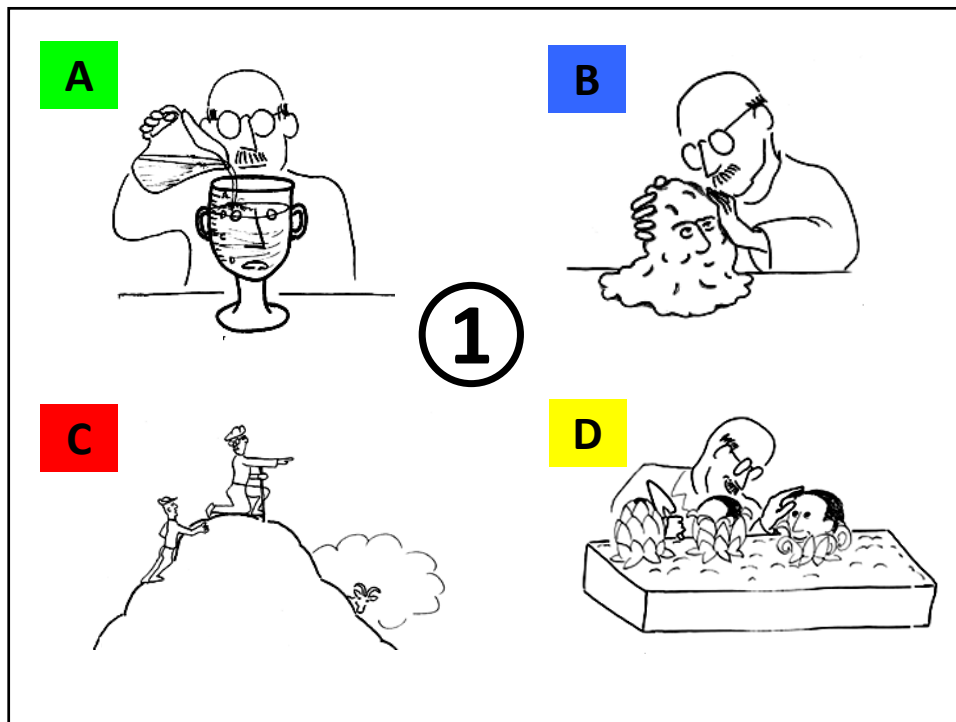


NATUURKUNDE
OLYMPIADE

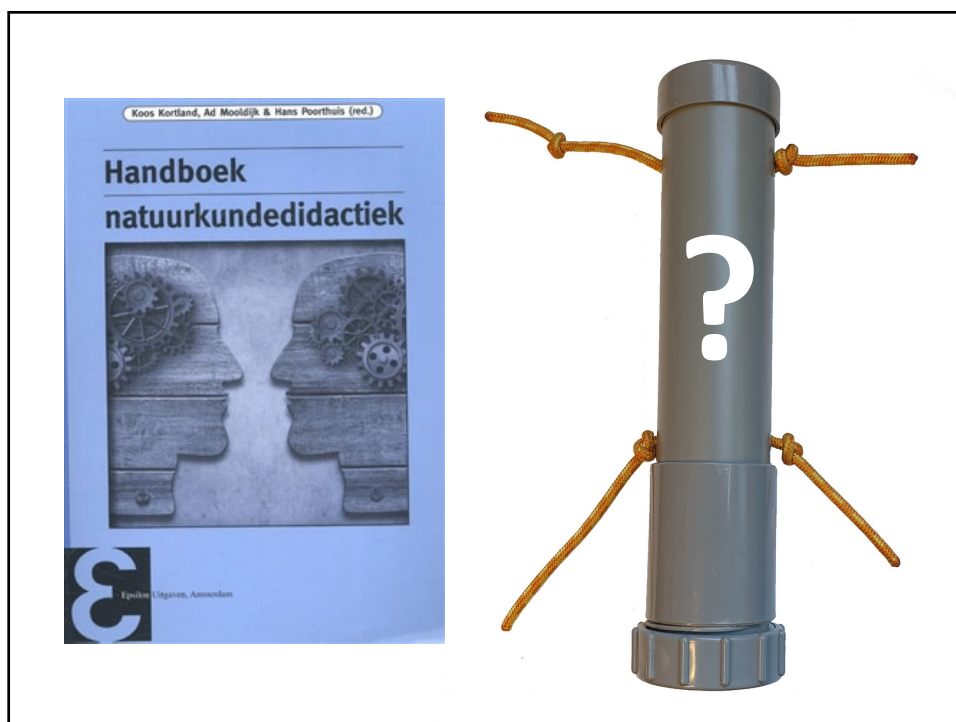


Getting Practical

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A lecture is a process by which the notes of the lecturer become the notes of the students without passing through the minds of either.

(A. K. Rathbun)

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Great Truth 1

Teachers seldom accept responsibility for themselves.

Great Truth 2

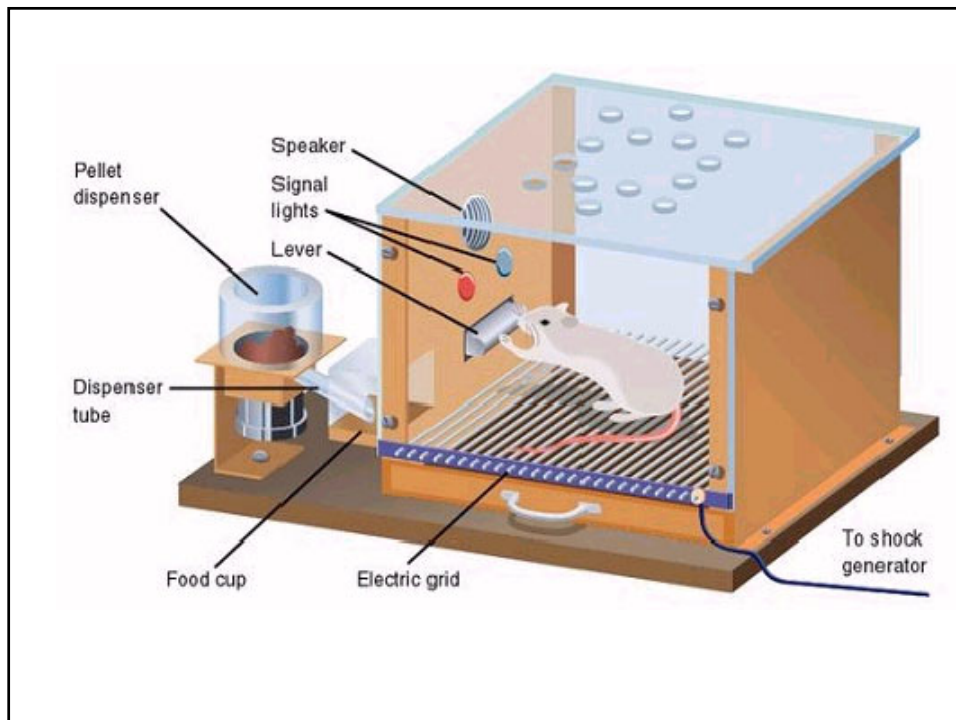
Teachers rationalize away evidence that contradicts their beliefs. Teaching methodology then is based on opinion, not data.

Great Truth 3

Telling is not teaching. I cannot transfer an idea intact from my head to the head of a learner.

(Spencer, 2006)

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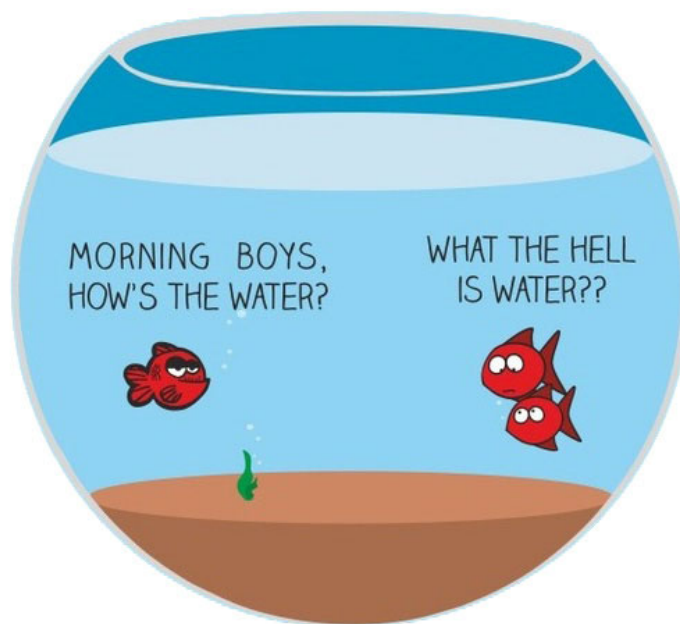


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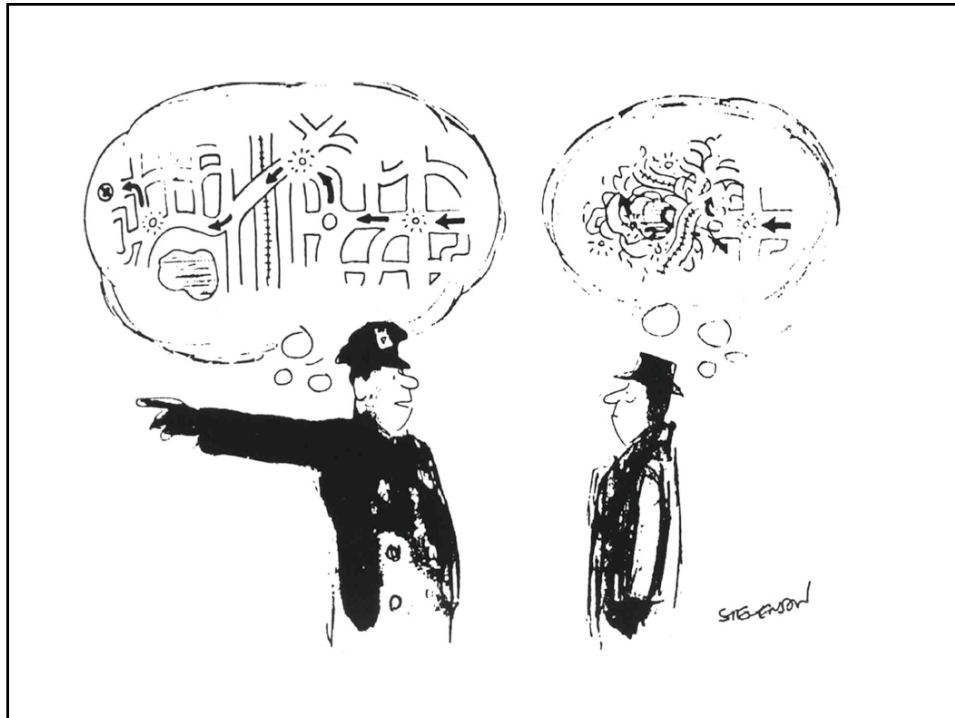
Telling is not teaching



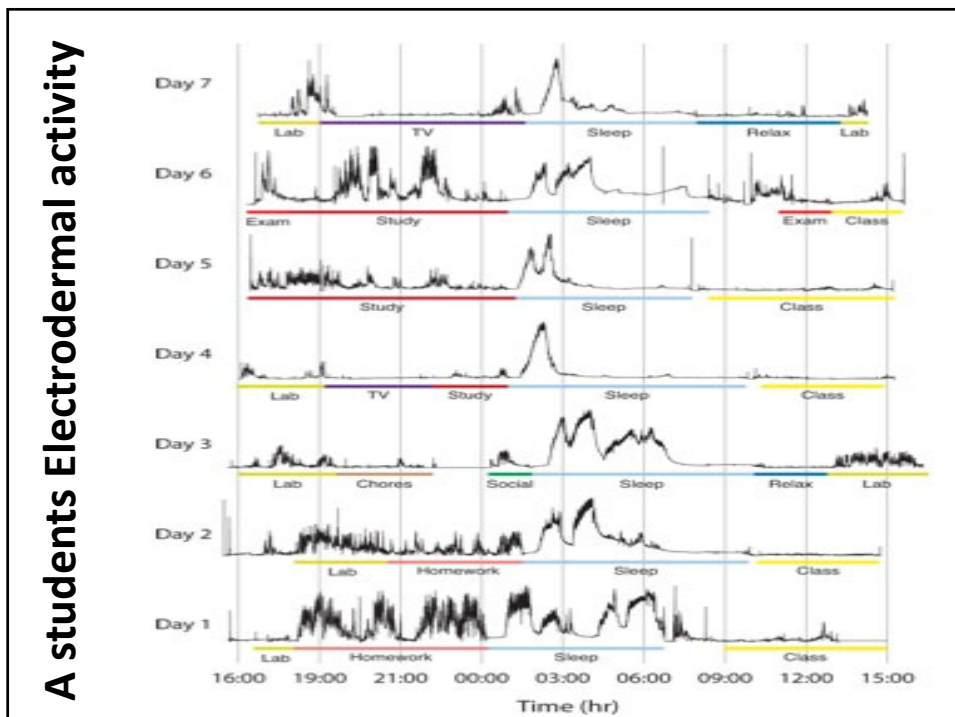
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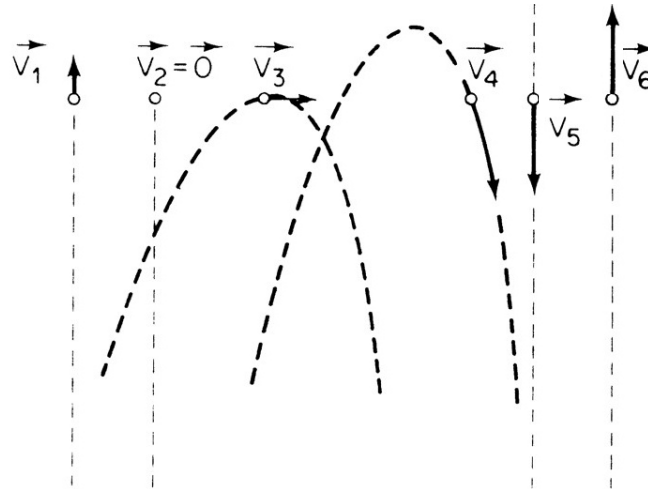


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6 maal een jongleerbal in de lucht.



In welke gevallen is de kracht op het voorwerp gelijk?

(Viennot, 1979)

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Papa Enno

$$v = \frac{s}{t} = \frac{\Delta s}{\Delta t} = \frac{v_e + v_b}{2} = \dots$$

$$R = \frac{U}{I} \quad P = \frac{E}{t} \quad \rho = \frac{m}{V}$$

$$\frac{pV}{T} = C \quad \begin{aligned} Q &= mc\Delta T \\ Q &= C\Delta T \end{aligned}$$

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Papa Enno

- Wat is U ?
- Wat is E ?
- Ik krijg de m niet vrij!

$$Q = mc\Delta T$$

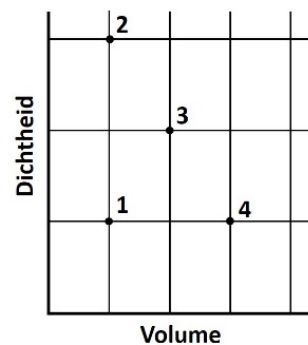
m (g)	6,4	?
V (cm ³)	3,2	1

$$\rho = \frac{m}{V}$$

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De dichtheid en het volume van vier blokken homogeen materiaal zijn in het diagram hiernaast uitgezet.

- Welke twee blokken hebben dezelfde massa?



- A** Blok 1 en 2
- B** Blok 1 en 3
- C** Blok 1 en 4
- D** Blok 2 en 4

2

(SNON 2016)

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Claims t.a.v. leren

- Leren is een actief proces
- Kennis wordt geconstrueerd
- Alle kennis is persoonlijk
- Leren is een proces van betekenis geven

(Kanselaar, 2002; Fox, 2001)

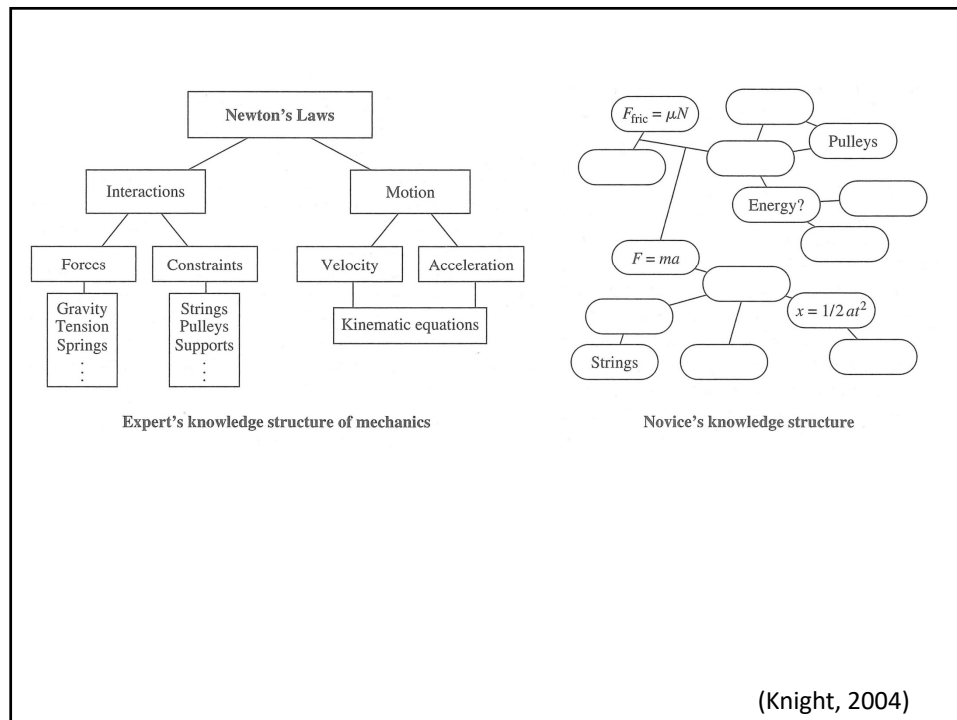
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Findings form Educational Research

- Students enter the classroom **not** as *tabula rasa*
- Students enter the classroom filled with many **prior conceptions**
- These prior concepts are remarkably **resistant to change**
- Student's knowledge is **not organized** in any coherent framework

(Knight, 2004)

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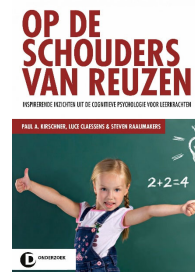
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MAAR HOE DAN?

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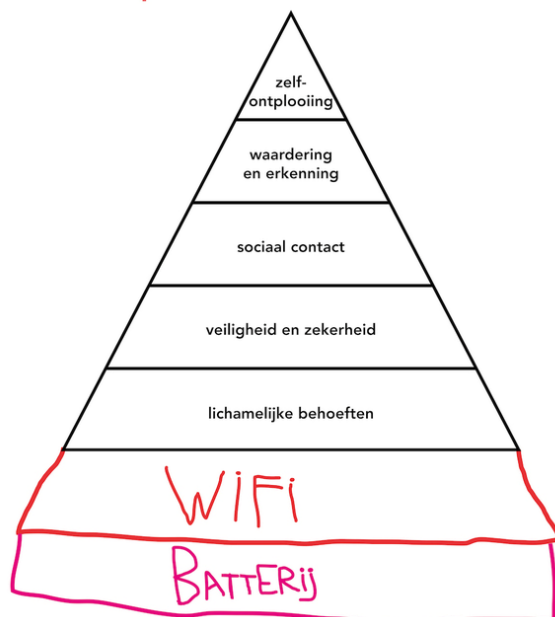
10 HOOFDZONDEN VAN DE DIDACTIEK

- 1 Volg de leerpiramide
- 2 Elk kind heeft een eigen leerstijl
- 3 Kinderen zijn digital natives en denken anders dan vorige generaties
- 4 Kinderen kunnen multitasken
- 5 Met Google is kennis niet meer belangrijk
- 6 Je leert problemen op te lossen door problemen op te lossen
- 7 Ontdekkend leren is de beste vorm van leren
- 8 Motivatie leert tot leren
- 9 Zonder grit geen leren
- 10 De school doodt creativiteit



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piramide van Maslow



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To Enno
With best regards
Eric
Groningen, 10 may 2012

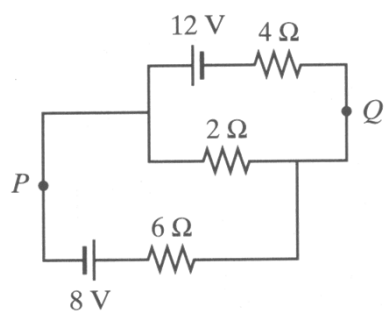
PEER INSTRUCTION

A USER'S MANUAL

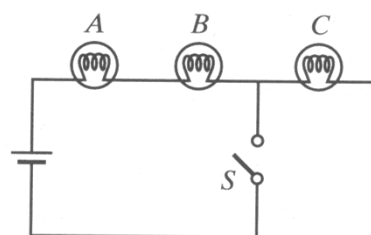
ERIC MAZUR
Harvard University

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conventional



conceptual

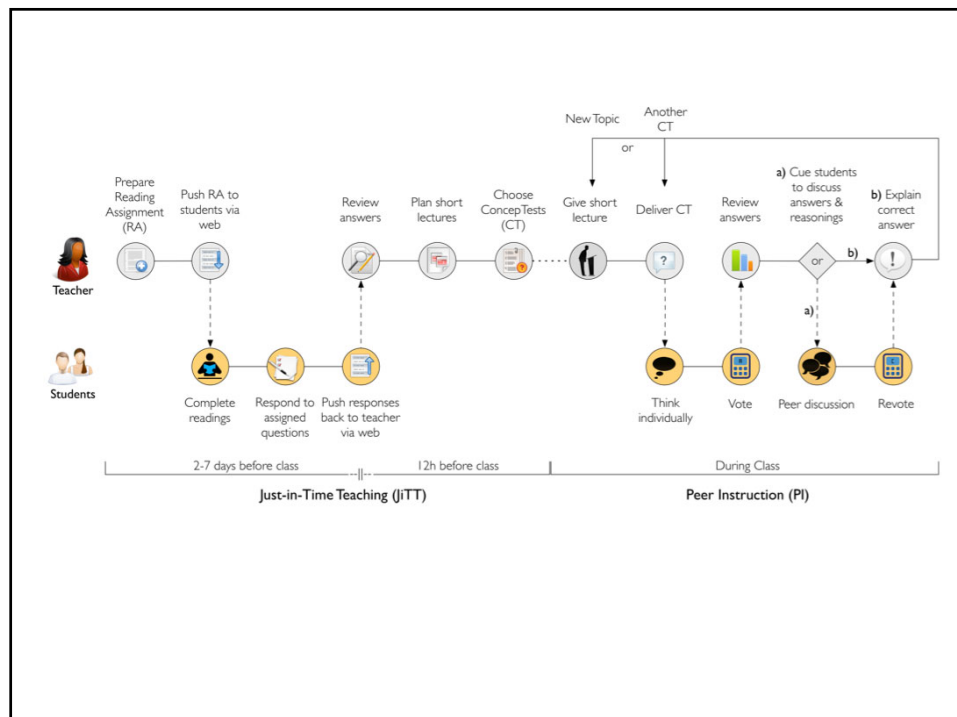


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Give students more responsibility
for gathering information...

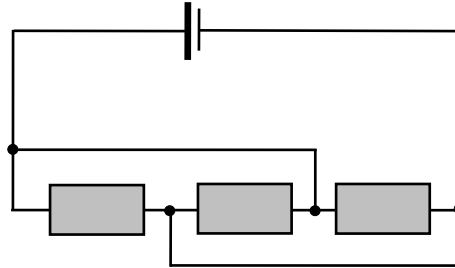
So we can better help them
assimilate it.

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Frank ontwerpt een schakeling van drie weerstanden en een voeding. Deze schakeling is een:



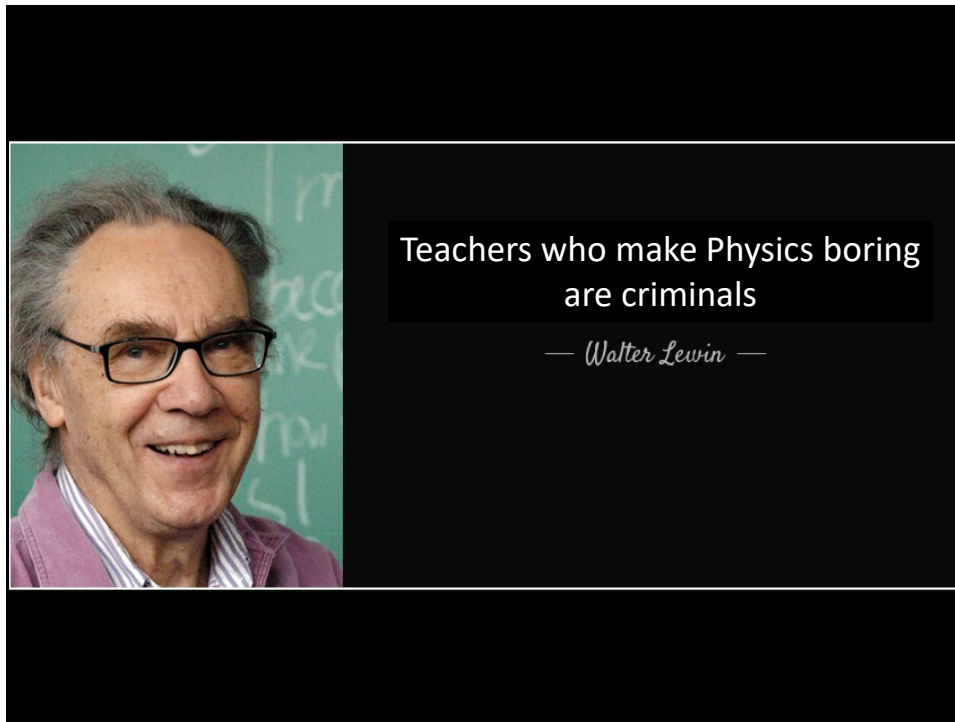
- A** Parallel schakeling
- B** Serie schakeling
- C** Een combinatie van serie en parallel

3

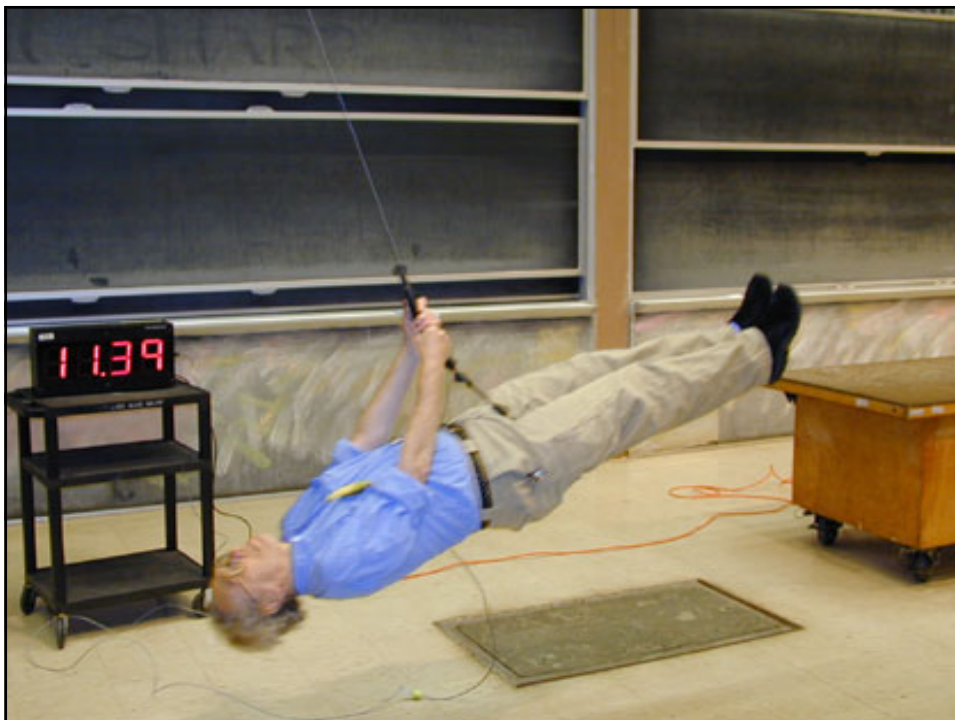
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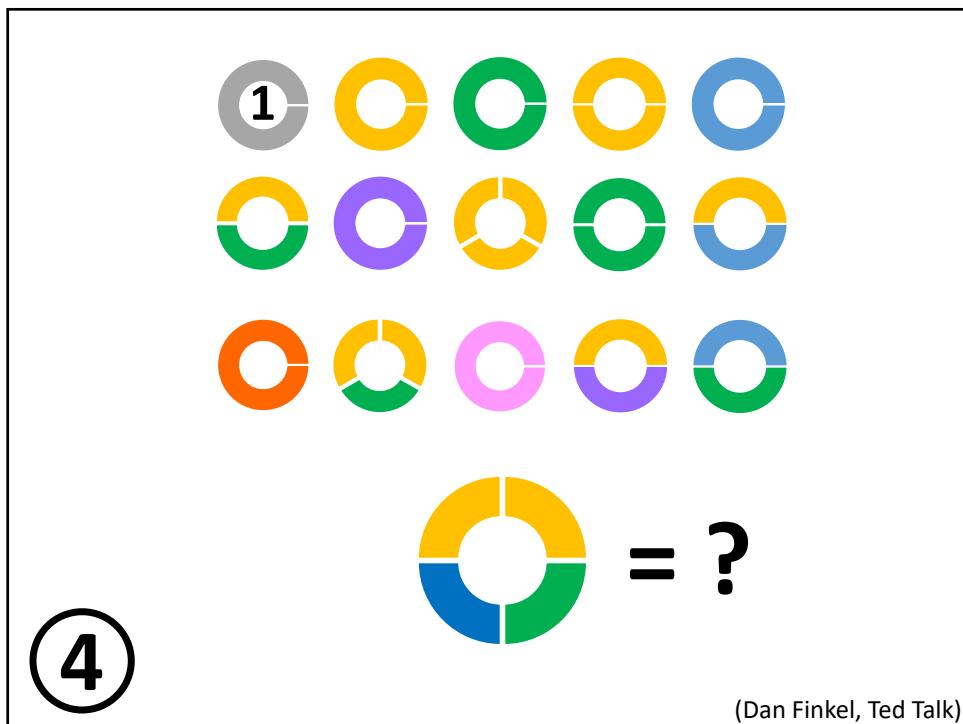
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Five Principles of Extraordinary (Math) Teaching

1. Start with a question
2. Students need time to struggle
3. You are not the answer key
4. Say YES to your students' ideas
5. PLAY!

(Dan Finkel, Ted Talk)

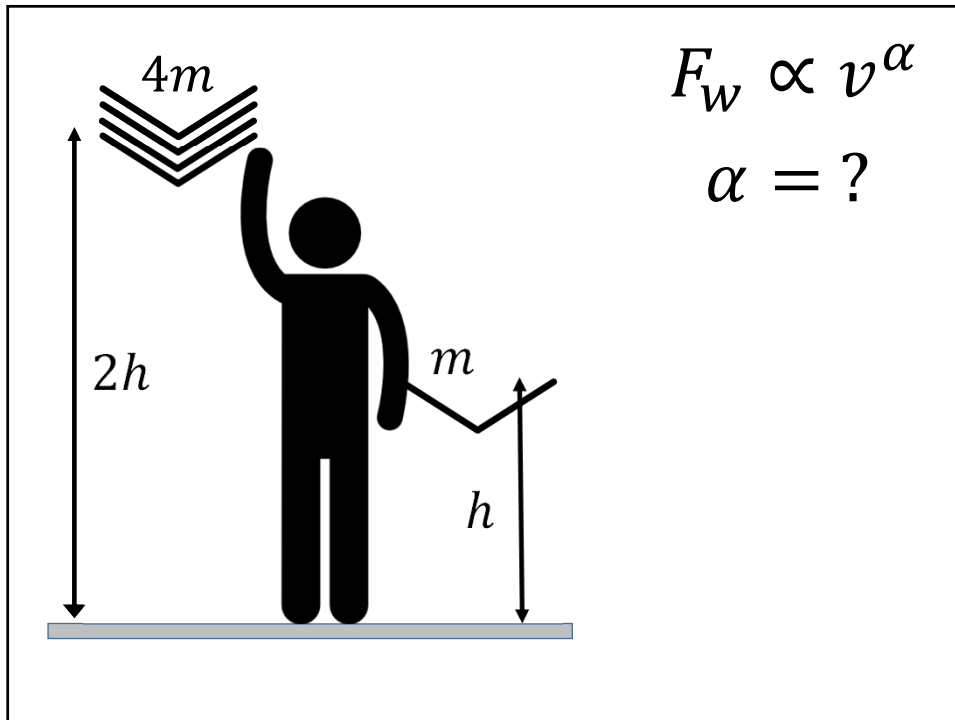
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Practical work

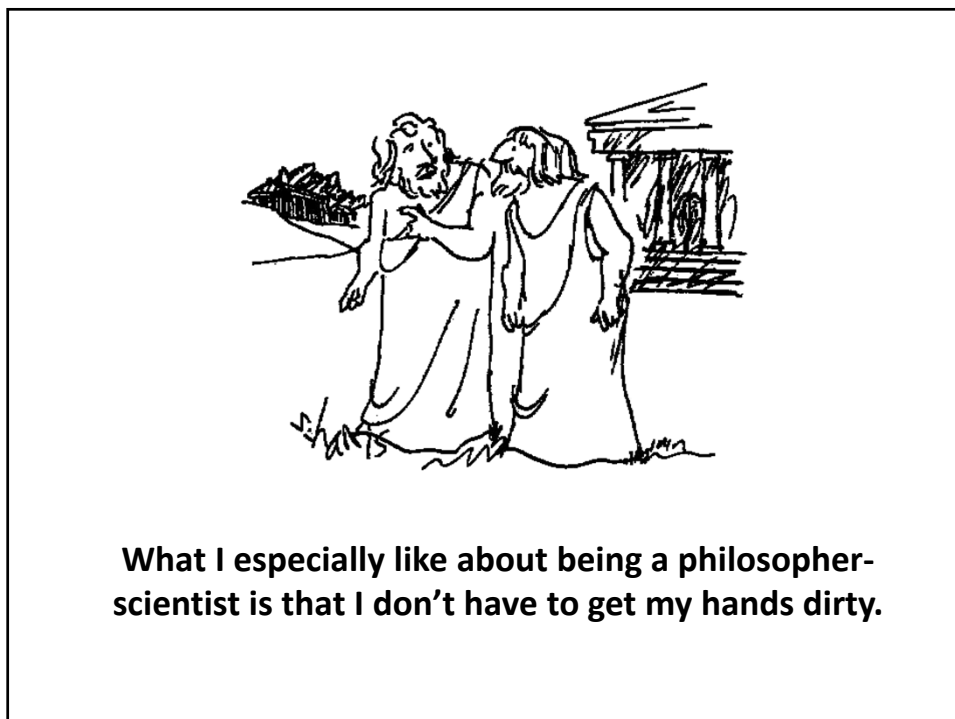
**I listen, I forget
I see, I remember
I do, I learn**

I do, and I'm even more confused

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 THE ROYAL
SOCIETY
CELEBRATING 350 YEARS



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Het is duidelijk dat eigen
ervaringen, het zelf doen der dingen
andere indrukken in de ziel
achterlaat dan het zien doen of het
horen zeggen door een ander.

(Commissie Fokker, 1928)

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Science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking.

Dewey, 1910

- A** 1910
- B** 1968
- C** 1998
- D** 2007

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Er was eens een tijd, toen men aan de kinderen de natuur leerde kennen uit tekeningetjes op het bord of in een boek: dat was de natuurkunde met krijt en spons.

Minneart, 1924

- A** 1924
- B** 1968
- C** 1998
- D** 2007

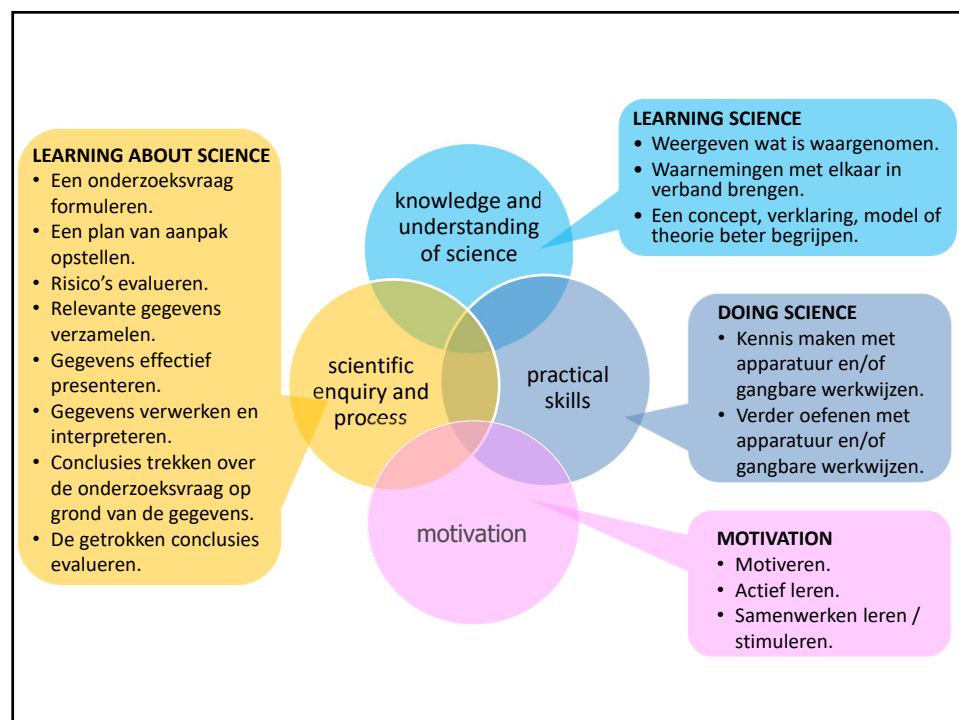
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Waarom practicum?

- **Learning science:** Uitbreiden van de theoretische kennis
- **Doing science:** Praktische onderzoeksvaardigheden bijbrengen
- **Learning about science:** Inzicht geven in de wetenschappelijke onderzoeksmethoden
- Motiveren en ontwikkelen van een wetenschappelijke houding

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Soorten praktisch werk

- **Apparaturpracticum**
Het aanleren van experimentele vaardigheden.
- **Onderzoekspracticum**
Leren onderzoeken.
- **Begripspracticum**
Ondersteuning concept ontwikkeling
- **Vaak een combinatie**

(Van den Berg, 1994)

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Praktijk

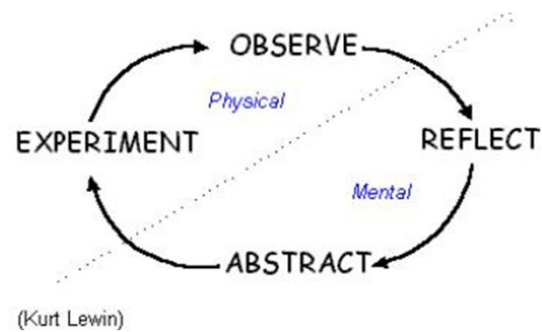
Veelal:

- 1 Alleen bevestiging theorie.
- 2 Kookboek.
- 3 Niet interessant.
- 4 Eerder slechte) demo dan (goed) praktikum.
- 5 Geïsoleerde gebeurtenissen.
- 6 Doel docent $\neq$ doel leerling. (*Just follow instruction.*)
- 7 Geen verband tussen doel en ontwerp.
- 8 Ontbrekende vaardigheden leerlingen.
- 9 Niet de beoogde resultaten. (*What is supposed to happen?*)
- 10 Geen kritische houding. (*Getting the right answer.*)

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Het idee van Nuffield

- Science: natuurkunde, scheikunde en biologie
- Discovery learning



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Kritiek op Nuffield

- Sherlock Holmes in a lab coat
- Hoeveelheid praktisch werk ontmoedigend (Abrahams 2011)
- Didactisch onverantwoord (Kirschner 2006)

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Nalatenschap

- Studenten leren het best wanneer ze geactiveerd worden
- Practicum met voorwaarden
 - Leerling heeft benodigde voorkennis
 - Leraar verschaft begeleiding tijdens practicum

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MAAR HOE DAN?

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Name: _____

PREDICT · REASON · OBSERVE · EXPLAIN

Predict

Reason

Observe

Explain

PosterMyWall.com

P(E)OE

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A $m = \dots \text{ g}$

B $m = \dots \text{ g}$

A $m_A > m_B$

B $m_A < m_B$

C $m_A = m_B$

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Getting Practical

reflective tool for a single practical activity

ACTIVITY:	What were the intended learning outcomes of this activity? (I planned that my students would be able to...)														Other intended learning outcome			
	Develop knowledge and understanding of science				Learn how to use apparatus or carry out standard procedures				Develop understanding of scientific enquiry									
	State observable features	State or use a classification system	State a relationship between variables	Show understanding of scientific theory	Identify equipment	Use equipment	Describe a standard procedure	Carry out a standard procedure	Propose a question	Plan a strategy	Evaluate risk	Collect relevant data	Present data effectively	Process data		Interpret data	State a conclusion	Evaluate a conclusion
.....																		
What were the students intended to learn?																		
What did the students do?																		
What did you do/ask?																		
What did the students learn?																		
What is your evidence for this?																		
How would you improve students' success?																		

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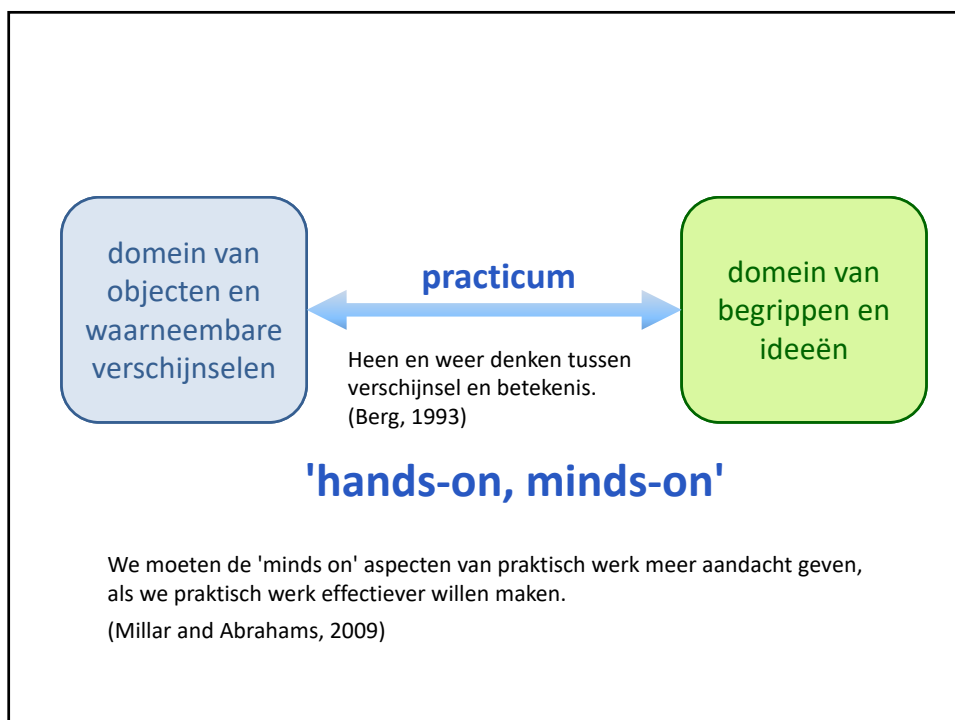


Getting Practical

practical activity review tool

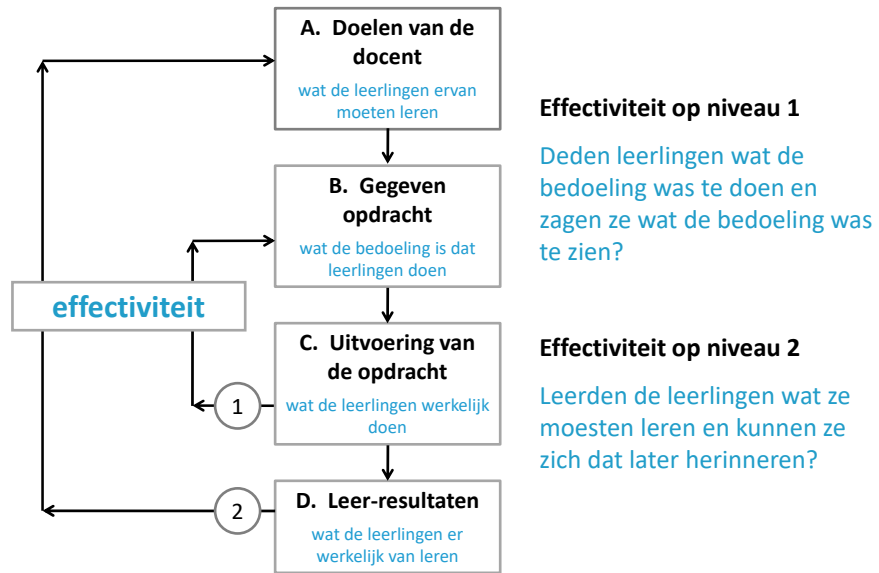
What are the intended learning outcomes of each activity? (I plan that my students will be able to...)																	
ACTIVITY	Develop knowledge and understanding of science				Learn how to use apparatus or carry out standard procedures				Develop understanding of scientific enquiry						Other intended learning outcome		
	State observable features	State or use a classification system	State a relationship between variables	Show understanding of scientific theory	Identify equipment	Use equipment	Describe a standard procedure	Carry out a standard procedure	Propose a question	Plan a strategy	Evaluate risk	Collect relevant data	Present data effectively	Process data		Interpret data	State a conclusion

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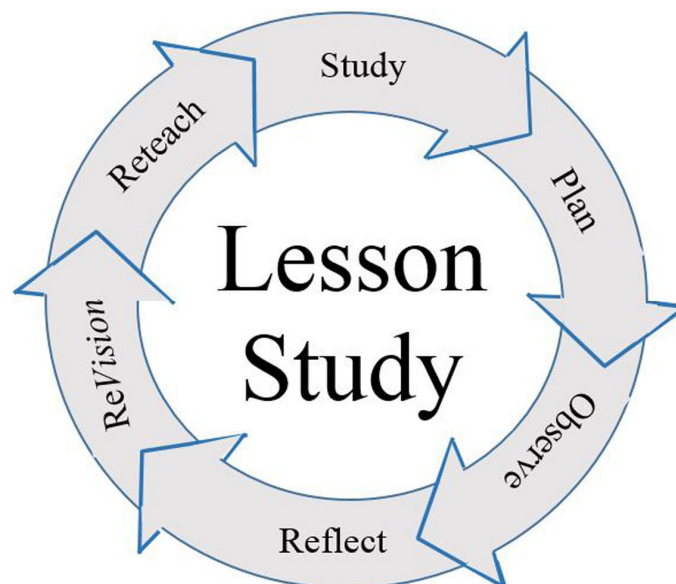
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Effectiviteit?

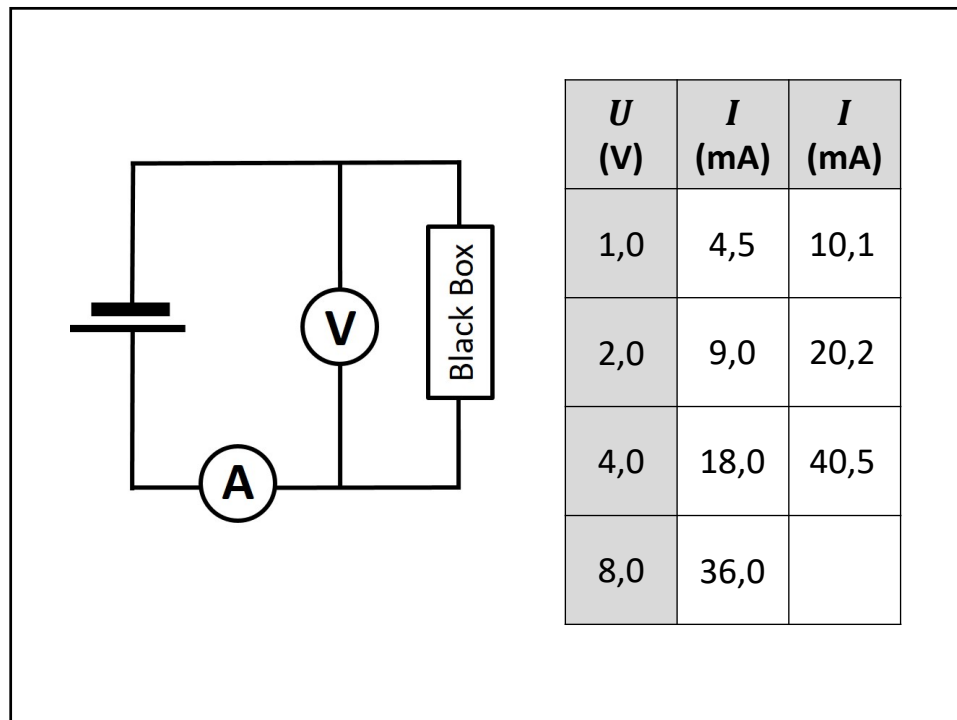


(Millar, 2002)

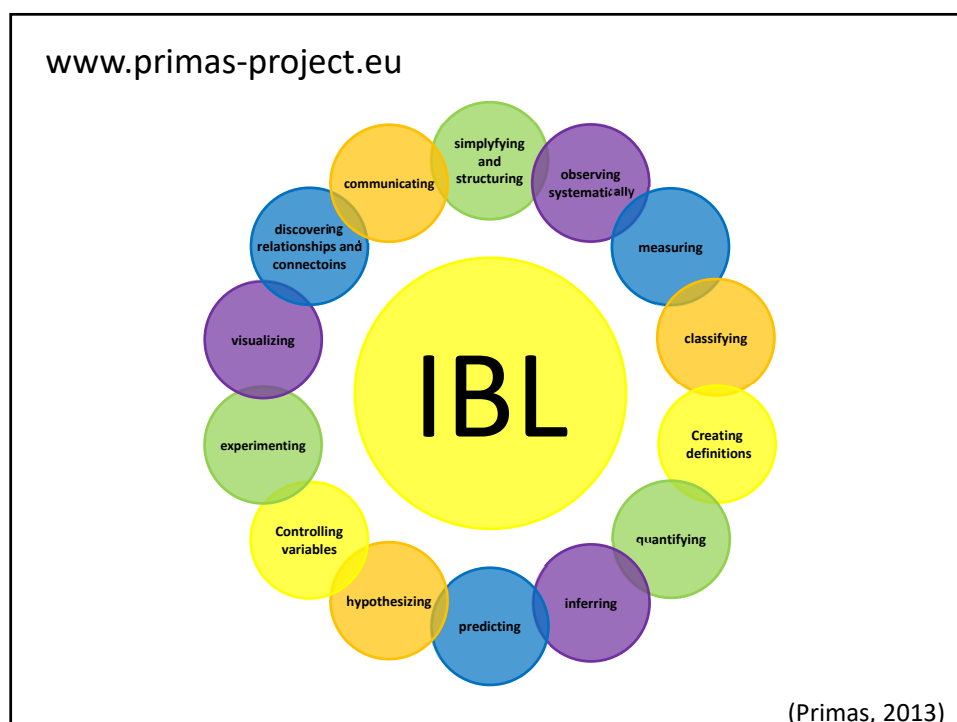
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Take home message

- Heen en weer denken
- Effectiviteit 2
- Voorbereiding begeleiding: maatwerk!

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Practicum op maat!

14 december 2019
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