EUROPEAN SCIENCE EDUCATION RESEARCH ASSOCIATION ESERA DUBLIN 17
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Conceptual understanding of scientific ideas through dialogue and experiment

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Belgium – Flanders

- *Energy: 30% of pupils reaches minimum goals*
- *Other natural sciences topics: 50% reaches minimum goals*

R. Janssen, E. Ameel , D. Van Nijlen, (2016) Achievement measurement on minimumstandards in first grade secondary science education commissioned by the Flemisch government

Pupils have preconceptions

→ Learning is inhibited

Davis, B. G. (1997). Misconceptions as barriers to understanding science. In National Research Council, Science teaching reconsidered: A hand book (pp 27-32). Washington, DC: National Academy. doi: 10.17226/5287

→ Poor performance on minimum goals

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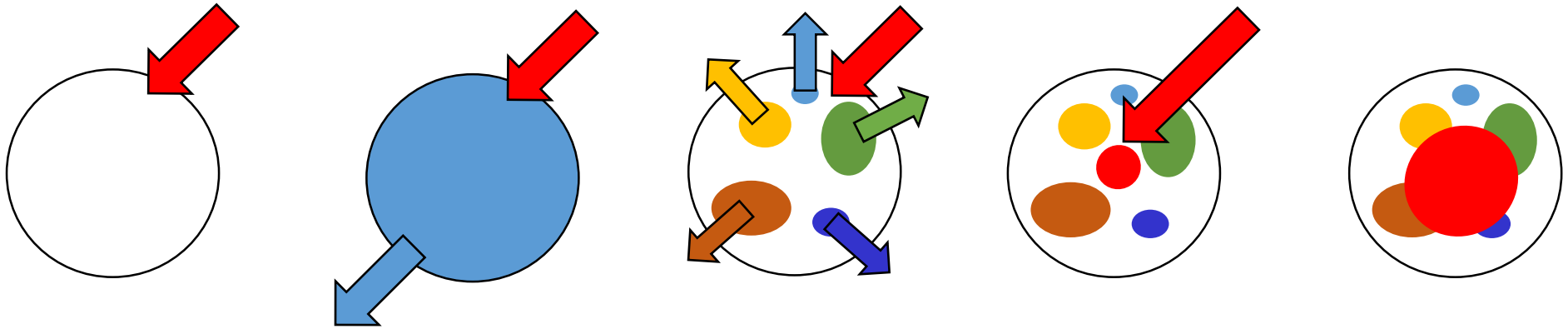
Preconceptions

"Rather than replacing the preconception by the scientific concept, a science class should introduce the scientific conceptual framework as an alternative framework that can also reside in the students' mind."

Mortimer, E. F., & El-Hani, C. N. (Eds.). (2014). *Conceptual profiles: A theory of teaching and learning scientific concepts* (Vol. 42). Springer Science & Business Media.



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→ Dialogic

"Children learn more effectively and intellectual achievements are higher when they are actively engaged in pedagogic activity, through discussion, dialogue and argumentation."

Wolfe, S., Alexander, R.J. (2008) Argumentation and dialogic teaching: alternative pedagogies for a changing world

"Transitions between dialogic and authoritative discourse to support the learning of scientific knowledge by the student."

Mortimer, E.F. (2003) Meaning making in secondary science classrooms. Maidenhead: Open University Press

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→ Experiment

'A test done in order to learn something or to discover if something works or is true'
Cambridge English Dictionary

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CONTEXTUALIZE

INTRODUCE

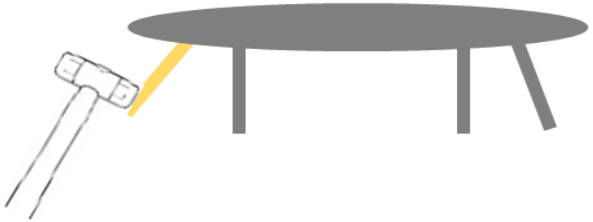
SECURE

Acknowledge their thoughts
→ time!!

WAKE UP

IDENTIFY

SHAKE



INTRODUCE

SECURE

USE

Experimental design

N = 148 (N_{exp} = 90, N_{contr} = 58)
3 schools, 9 classes, 12-13 y

N = 60 (N_{exp} = 35, N_{contr} = 25)
1 university, 3 classes, 19-21 y

N = 192 (N_{exp} = 98, N_{contr} = 94)
2 schools, 4 classes, 12-13 y

Quasi-experimental: Pre-post energy CU test
Convenience sample
4h intervention
following 6 FoI steps
4h control
'good' classical class (lecture, student experiments)

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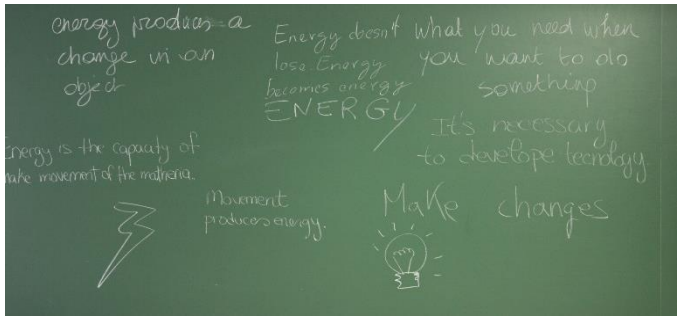
WAKE UP

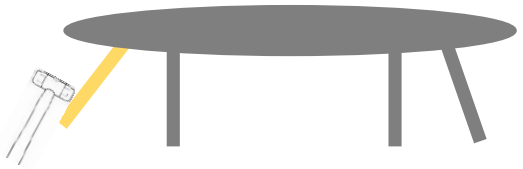
- What does … mean to you?

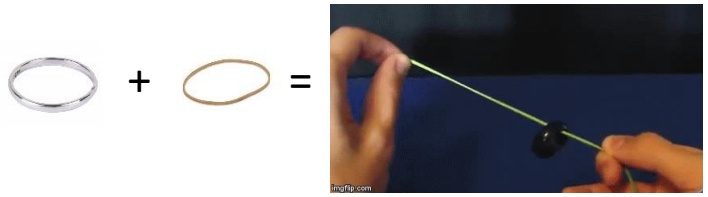


- Write/draw your idea and pass it

IDENTIFY

SHAKE





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INTRODUCE

Scientists say that …

Energy is a measure for possible change. The higher the energy, the more change than can be generated. It is a property. When you talk about energy you use the verb 'to have'. Energy cannot be created, nor destroyed. It can only be converted…

SECURE

Which properties of an object contribute to the amount of energy it has …

USE

What if

… dead things would not have energy?
… the sun would stop shining?
… we were unable to store energy?

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CL	LESSON PHASES	**CONTEXTUALIZE**		**INTRODUCE**			**SECURE**
	DISCOURSE	**AUTHORITATIVE**					
	CONTENT	Setting the mind, introducing a context for the scientific concept		Teaching the scientific concept as stipulated in the national science curriculum			Pupils apply the scientific concept in experimental setups and in given problems
TIMING							
EL	LESSON PHASES	WAKE UP	IDENTI-FY	SHAKE	**INTRODU-CE**	**SECURE**	USE
	DISCOURSE	DIALOGIC			**AUTHORI-TATIVE**	DIALOGIC	
	CONTENT	What do you think about an aspect of this concept?	What do others think of this aspect?	Discover that your idea does not always work.	Teaching the scientific concept as stipulated in the national science curriculum	Apply your ideas in experimental setups and in given basic problems. Emphasise on the difference between the intuitive idea and the scientific idea.	Discover that the scientific idea works in different contexts in experimental setups and in integrated problems.

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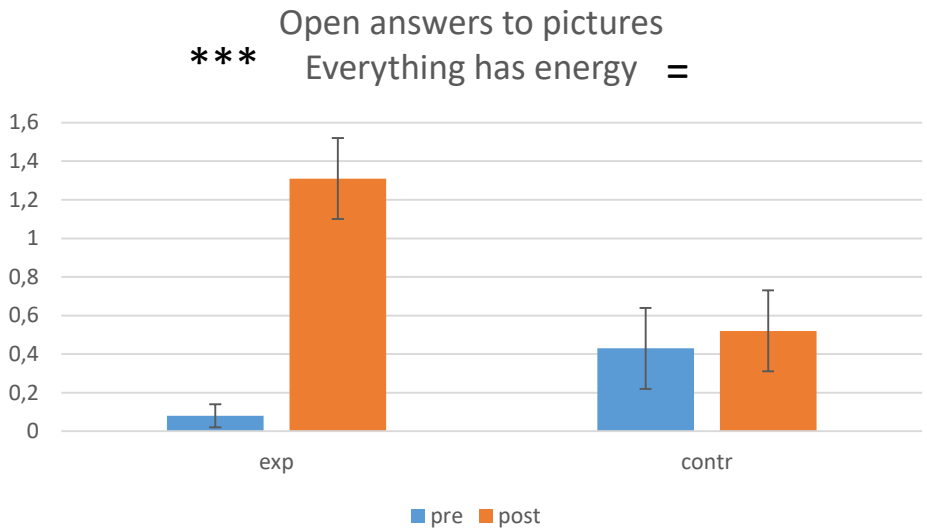
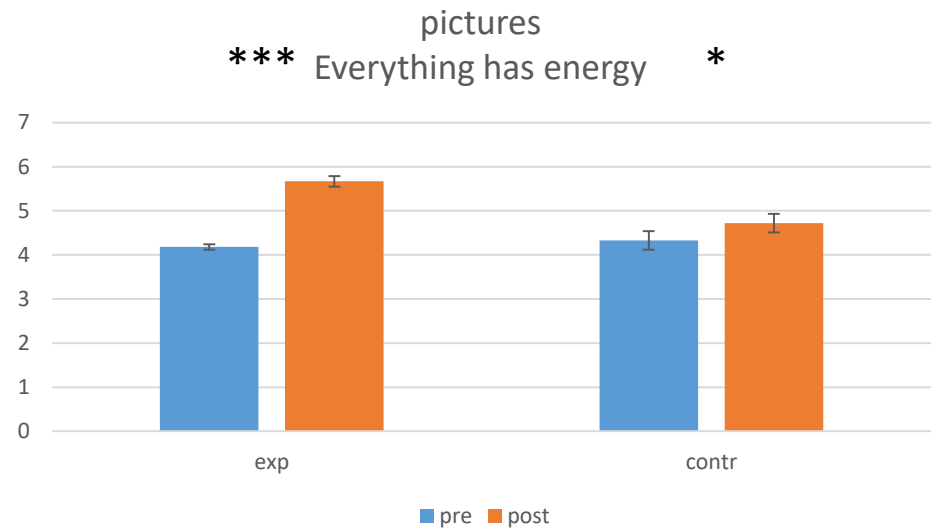
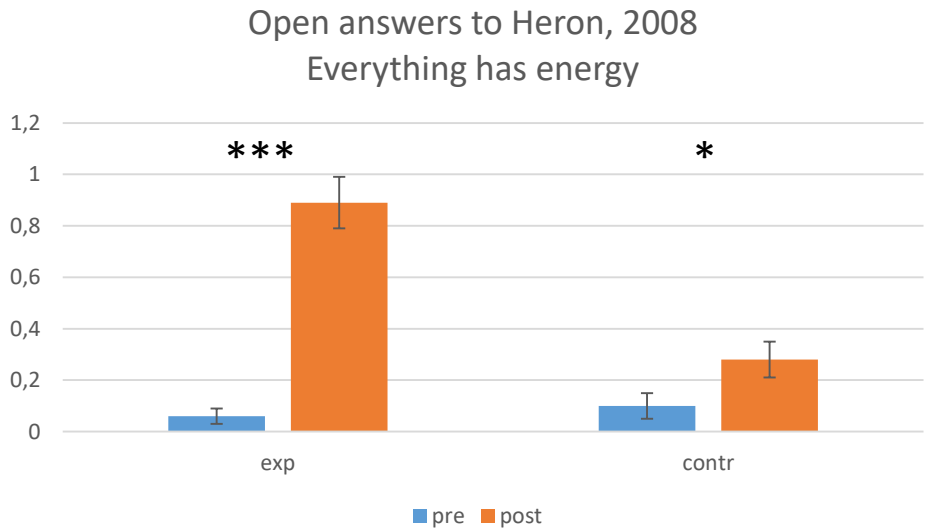
Observations

- Teachers recognize the problem, are positive about didactical approach, take ownership and give input in PLC
- Teachers are initially worried about

Unpredictability of the lesson	same preconceptions
timing	equal time needed
experiments of pupils	natural, ideas pop up
management	ownership, engagement
Socratic stance	template (what to do, say, expect) + training!







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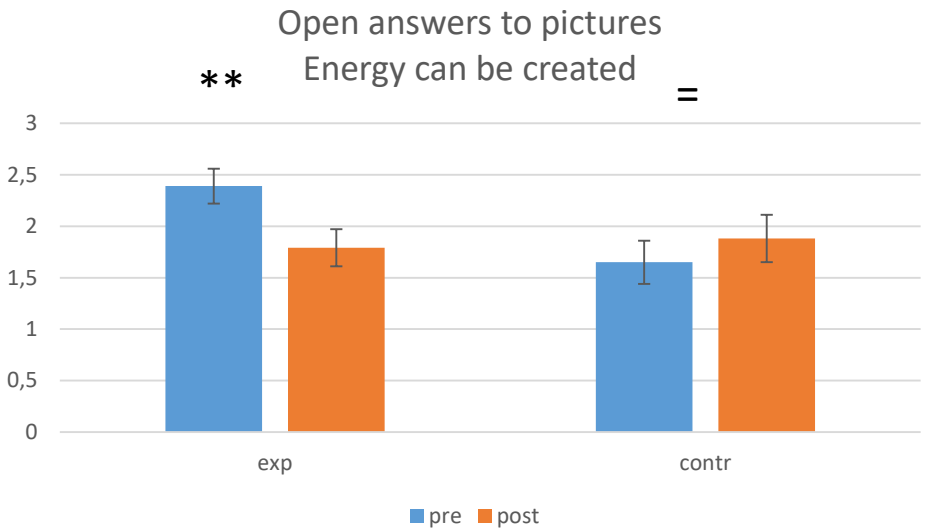

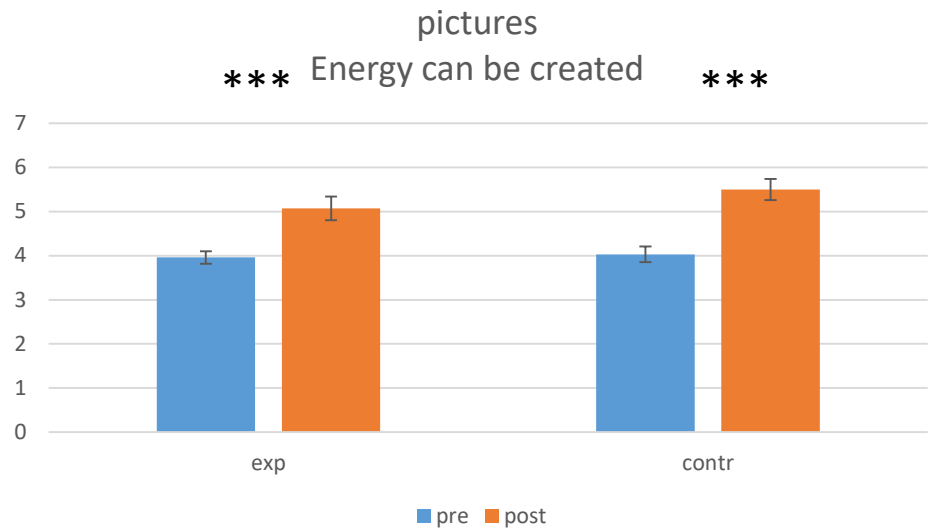

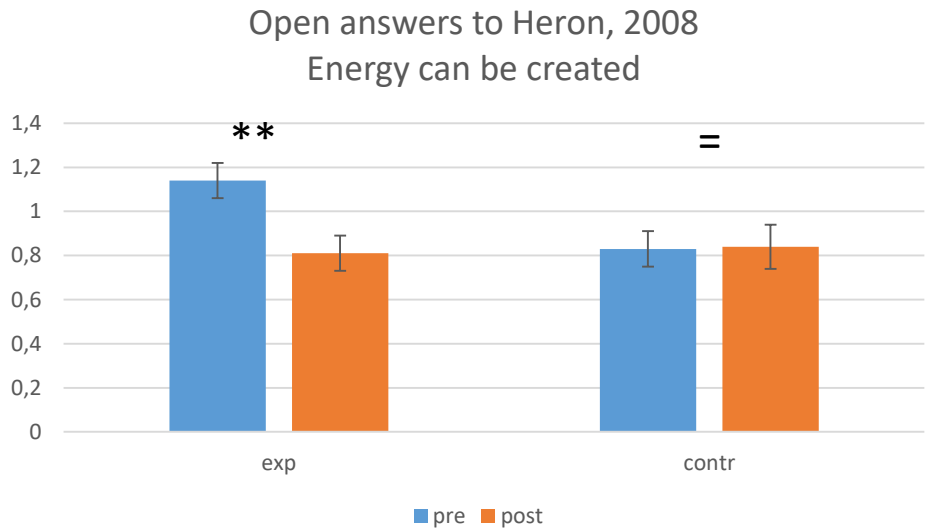

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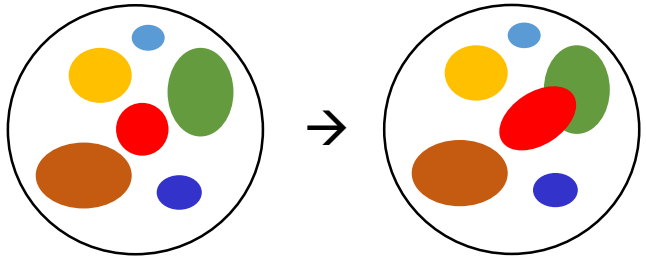
Conclusions

We developed a 6 step approach to introduce big ideas/concepts to grade 7-8 pupils, in collaboration with in-service teachers (through a DBR)

- Engaged teachers can adopt the approach (training!)
- Dialogic approach wakes up preconceptions and engages thinking
- 

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Future

- Implementation in the teacher training curriculum.
- From teachers' materials to pupils' materials.
- Expanding to more partner schools, more international partners.
- Mapping the dialogue in the class.
- Long term effect on motivation and performance?
- What if school language ≠ mother tongue?
- Gender issues?

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