Activating the student´s prior knowledge in the learning of third Newton law trough a P.O.E. (“Predict-Observe-Explain”) strategy.

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Laboratory hand-on

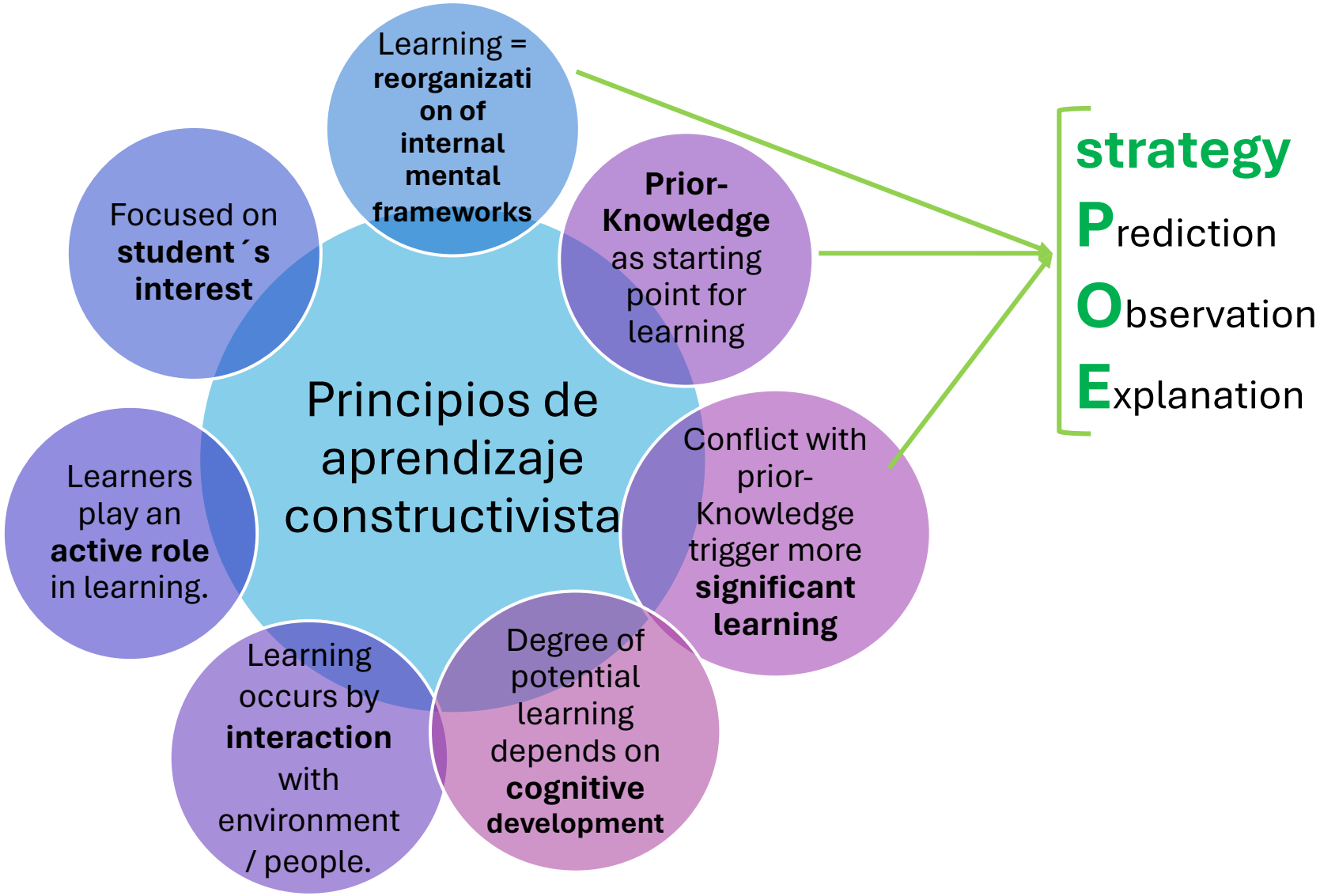
activities are traditionally used in secondary education as:

VERIFICATION

of the new knowledge
learned in the theory class

Theory → Exercises → Lab

Rethinking lab activities from the constructivism perspective



Flip the order: lab activities first

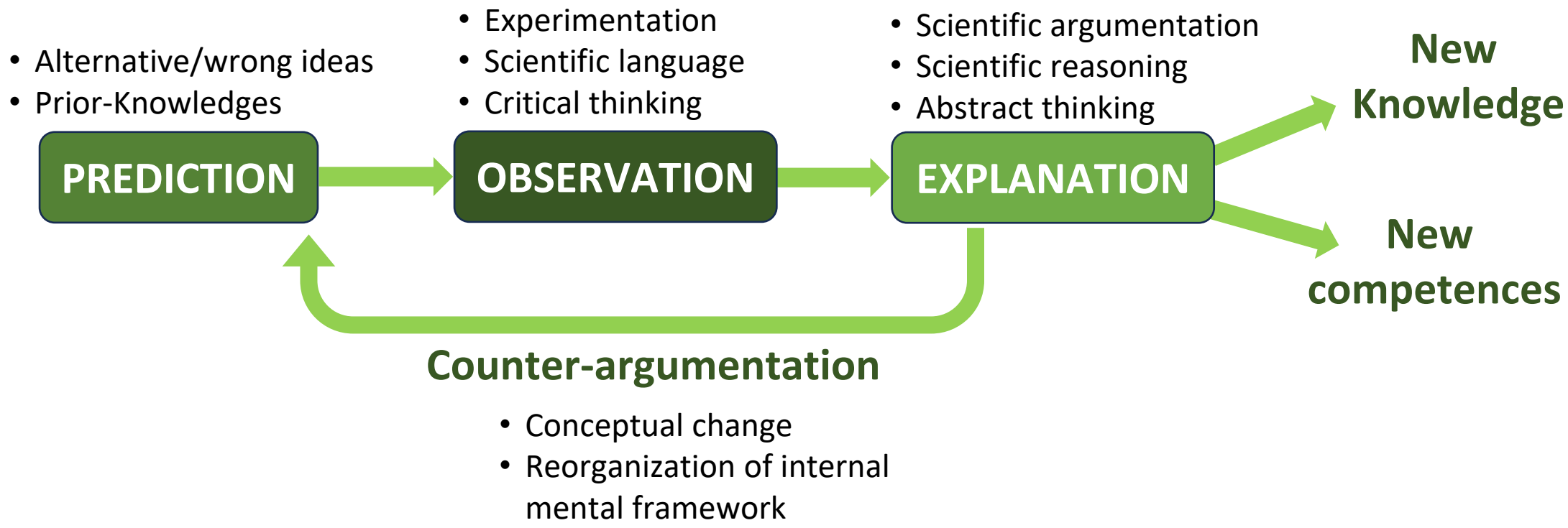
Use the lab hand-on activities to introduce new scientific concepts may improve:

- **Activation of prior-knowledge**
- **Abstract thinking**
- **Scientific argumentation**

to enhance

significant learning

Steps of the P.O.E. strategy



But… **not all experiments work** to introduce new scientific concepts to the students

It is necessary to rethink hand-on lab experiences to use the P.O.E. strategy

Courter-intuitive experiments work better

As more **counterintuitive** the experiment is

higher conflict with the prior knowledge

more internal menta rearrangement

More **abstract thinking** & scientific **argumentation** are needed

Higher significant learning

Newton's Laws of Motion

1st Law

A body in motion remains in motion or a body at rest remains at rest, unless acted upon by a force.

2nd Law

Force equals mass times acceleration: F = m*a

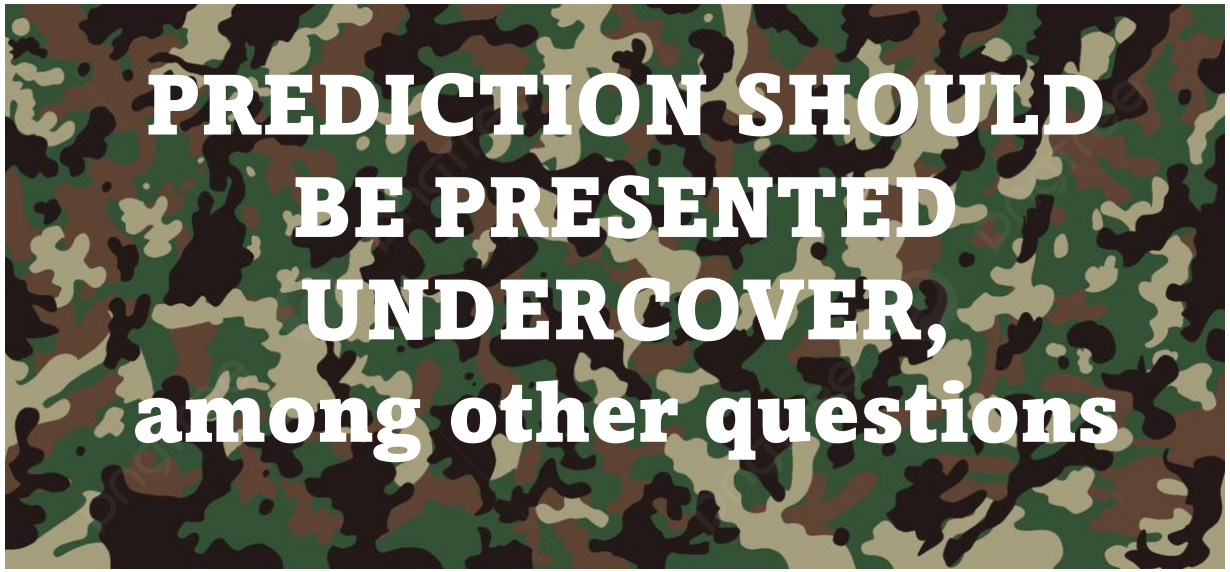
3rd Law

For every action, there is an equal and opposite reaction.

sciencenotes.org

On the teaching of **Newton´s Laws** using a P.O.E. strategy

PREDICTION step in the POE strategy



The goal is to detect alternative ideas and misconceptions in the Prior Knowledge of students

PREDICTION step in the teaching of Newton´s law

Predictions related with experiment 1	
1	Does the scale show the same, more, or less weight if you step on it with one foot compared to stepping on it with both?
2	If you step on the scale on the Moon, would it indicate more, less, or the same weight?
3	Would your mass on the Moon be the same, more, or less than on Earth?
4	Does the scale show the same, more, or less weight if you lean on a friend?
5	If you stand on tiptoes on the scale, does it always show the same weight?

This is the question to cover the important prediction

This is the important question

PREDICTION step in the teaching of Newton´s law

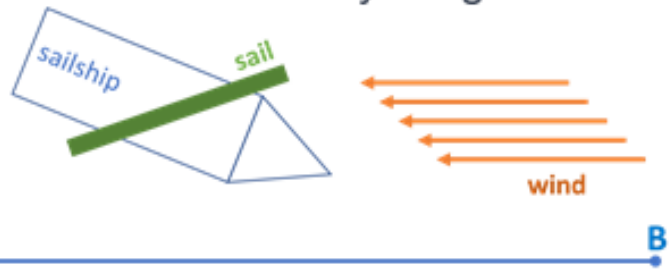
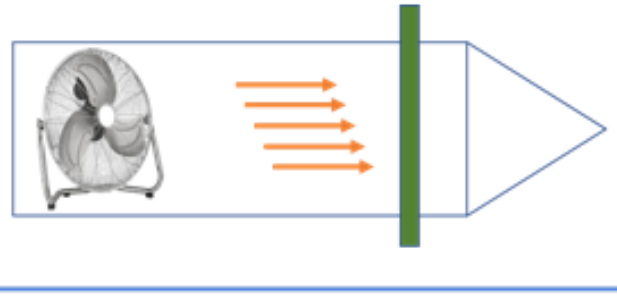
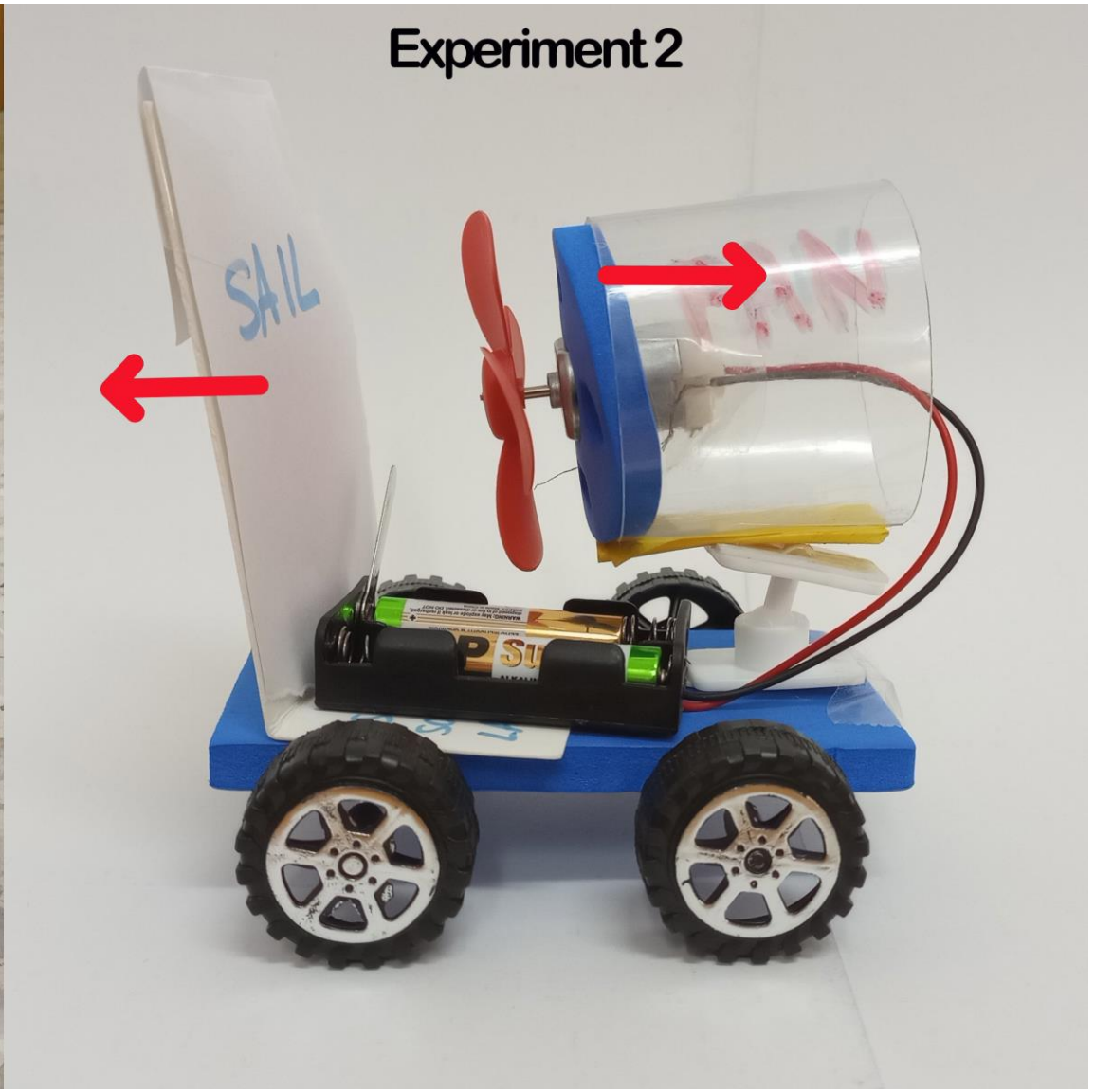
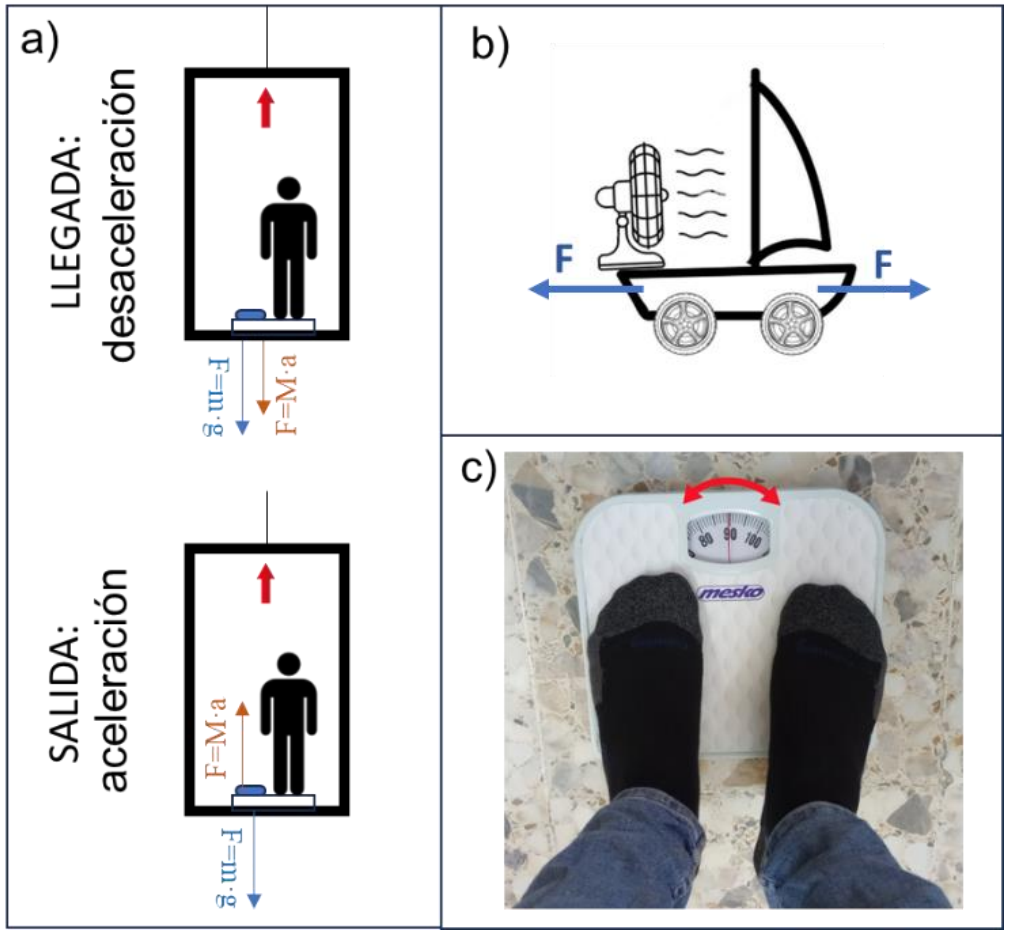
Predictions related with experiment 2	
1	Which way would a sailboat move with the wind against it if the sail is positioned as shown by the green line?  a)It would approach point B b) It would approach point A c) None of the above
2	**If on a day with little wind, a giant fan located at the back of the boat is turned on, sending air towards the sail, how does the boat move?**  a)It would approach point B b) It would approach point A c) None of the above

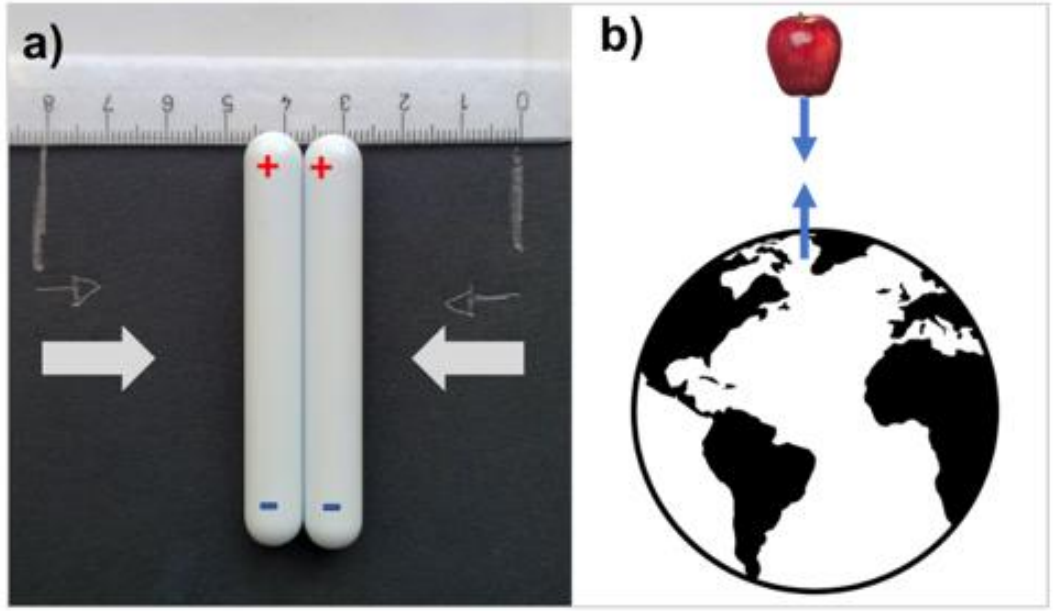
Table 2. *Questions related with experiment 2. Question #2 was the relevant question to test through P.O.E. strategy.*

OBSERVATION step in the teaching of Newton´s law



EXPLANATION step in the teaching of Newton ´s law

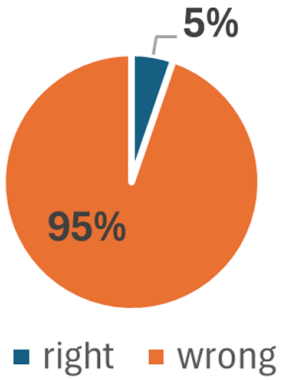




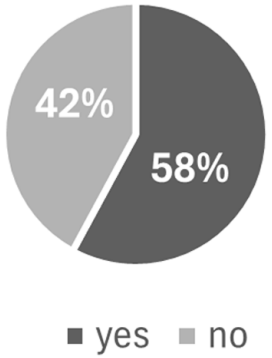
RESULTS OF A PILOT EXPERIENCE with MASTER´s students

Experiment 1

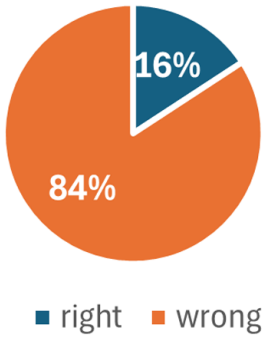
Did the students predict correctly the experiemnts 1?

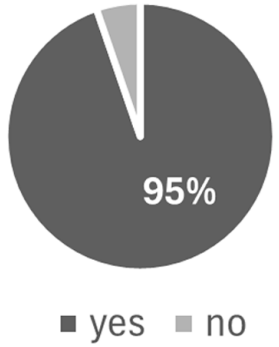


Did the students find useful experiemnt to learn Newton´s laws?

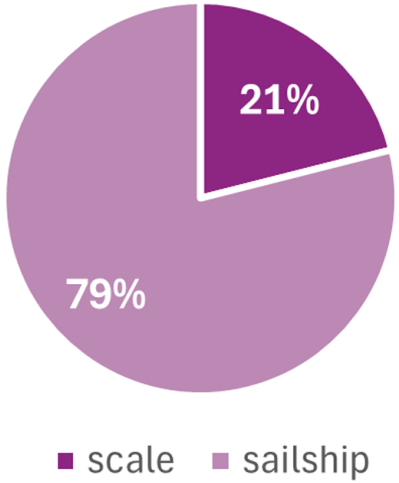


Experiment 2





Which experiments do students consider to produce a more significant learning of teh Newton´s laws?



Future Work

1. Test the P.O.E. with secondary students and large statistics.

2. Design new counter-intuitive experiments to introduce other scientific concepts in the curriculum (center of mass, inertia momentum, flotability…).

1. Introduce the use of visual argumentation tools as “Gowin´s uve” and test their efficiency to enhance scientific reasoning in secondary students.

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Thank you for your attention

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