Hybrid Visual-Tutorial Instruction Model to Learn the Concept of Density

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Problem of investigation

- Most of Physical Science II students have important understanding difficulties related to the concept of density
- Future elementary teachers
- Average age: 34 years
- First exposition to physics concepts for most of students
- Female 95%

Objectives

- To design and implement a lab-visual understanding proposal of the concept of density in the contexts of solids and liquids
- To expose Physical Science II students to this proposal
- To compare the number of students from treatment and control groups answering correctly pretest and posttest questions
- To compare the corresponding gain frp boyjm groups

Context of investigation

- Treatment group N=29 students
- Control group N=20 students
- Instructor A 3 sections
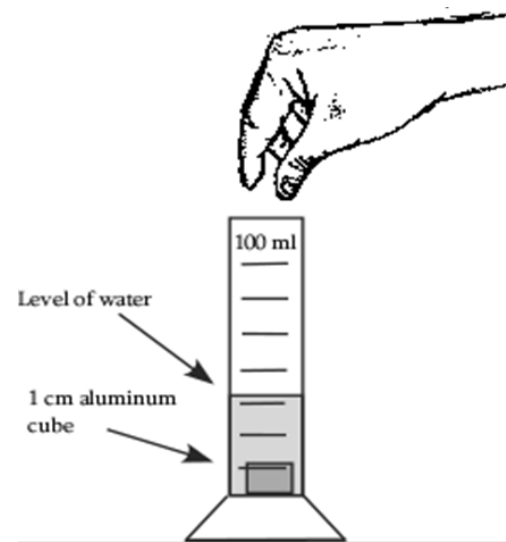- Instructor B 1 section
- Two 1 hr 50 min sessions per week

Curriculum

- A 30-min video projected at the beginning of the first session and available for students through the development of the lab (both sessions)
- A conceptual-numerical based lab
- The video shows 90% of the section of the lab
- The video also includes conceptual questions mostly related to proportional reasoning situations
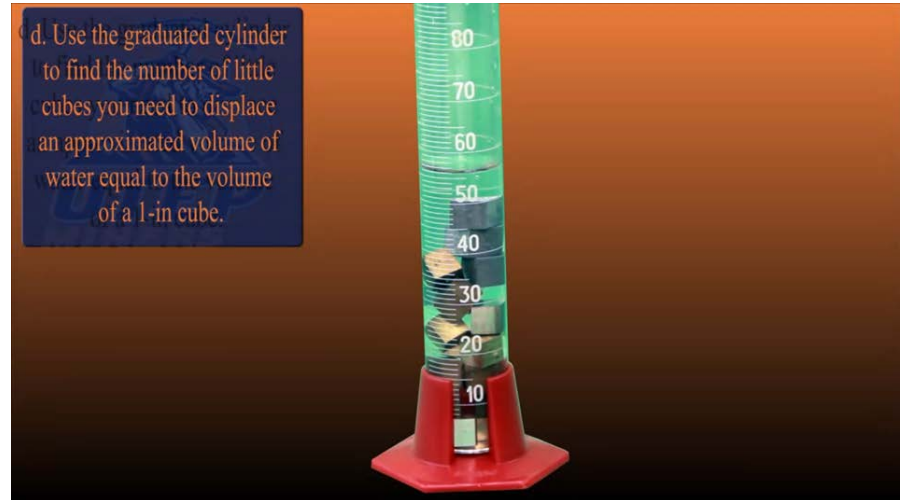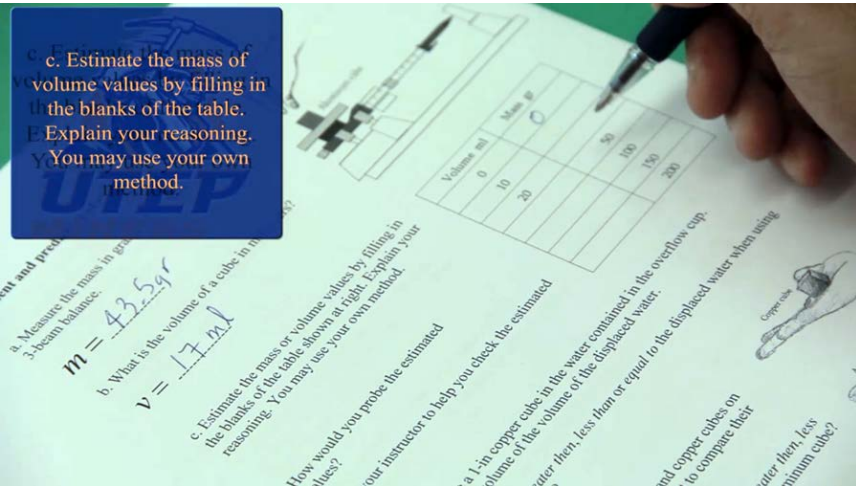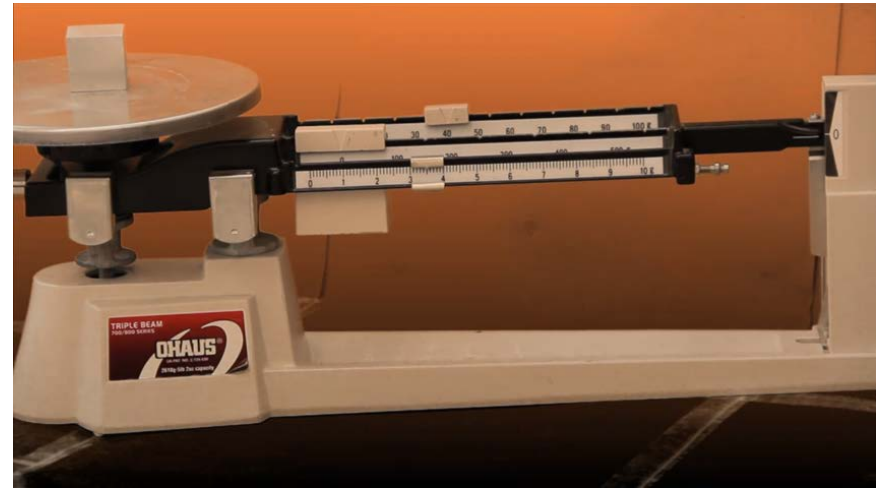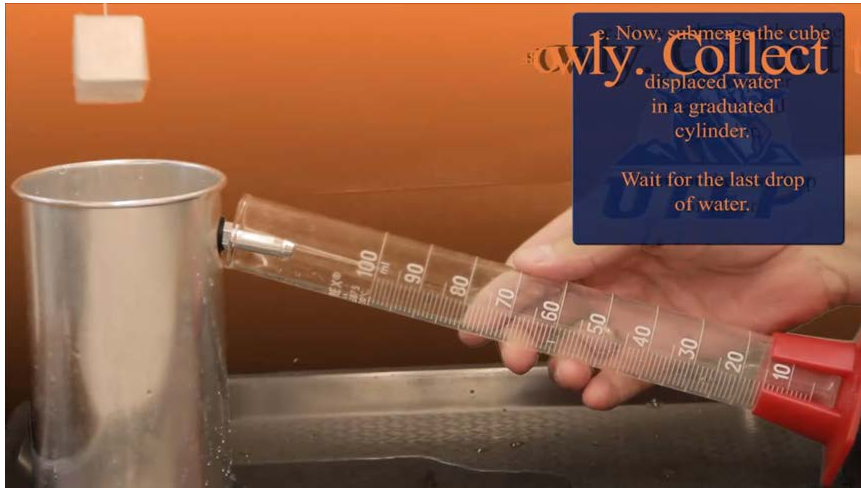- A homework
- Pretest and posttest

Lab approach

Level of water
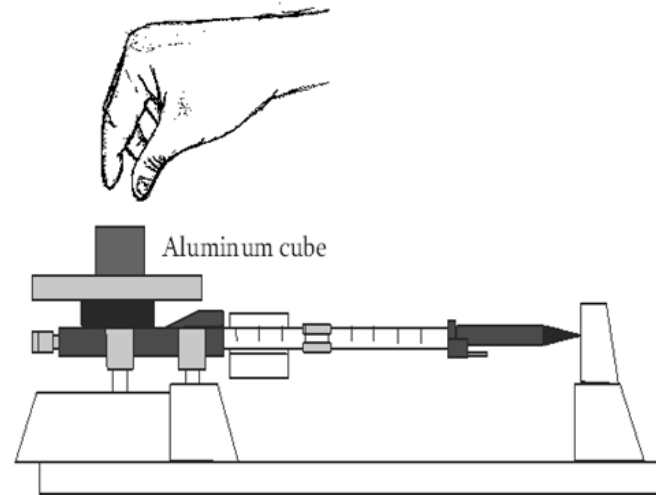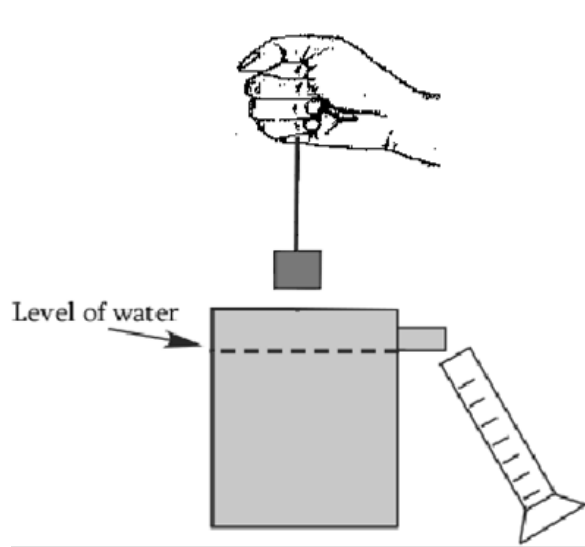
Aluminum cube

Volume ml	Mass gr
0	
10	
20	
	50
	100
	150
	200

100 ml

Level of water

1 cm aluminum cube

Video snapshots

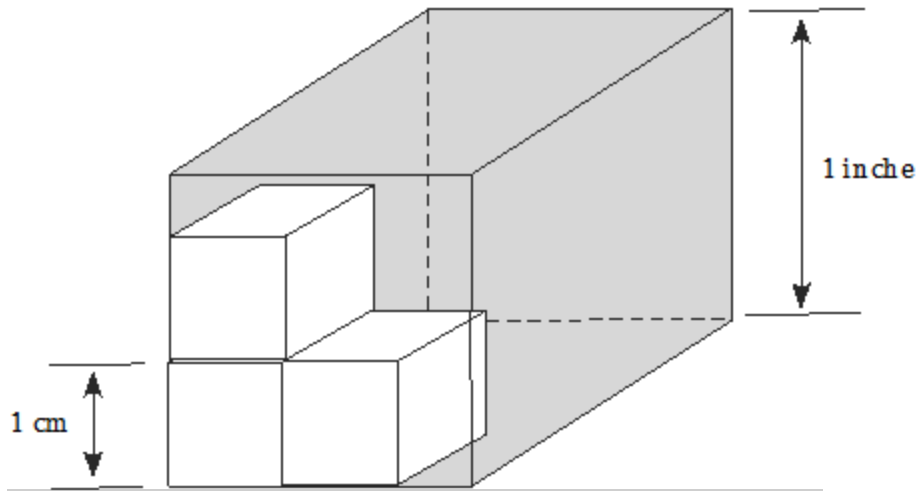# Lab approach and snapshots

Aluminum cubes

1 inche

1 cm

How many little cubes could you locate in a space equal to the volume of a 1-in cube? See the figure.

1 inch

1 cm.
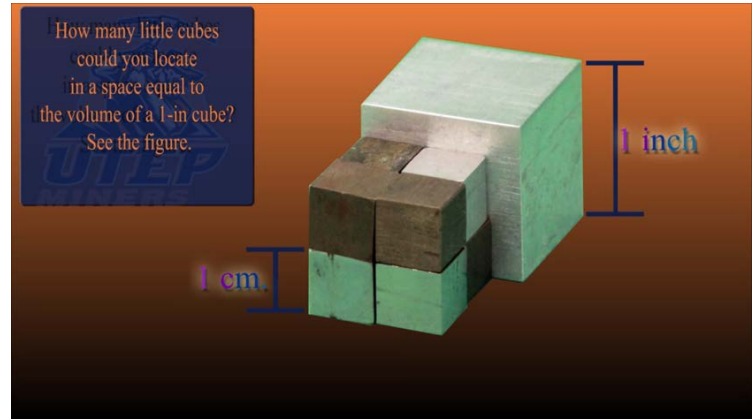
d. Calculate the slope of the straight line traced on the aluminum mass-volume graph. Remember that you have to pick any two points P1(v1,m1) and P2(v2,m2) as shown at right.

Mass (grams)

250

20 40 60 80 100 120 140 Volume (cm³)

f. ...ulate the slope of this graph.

Mass (grams)

250

200

100

20 40 60 80 100 120 140 Volume of displaced water (cm³)
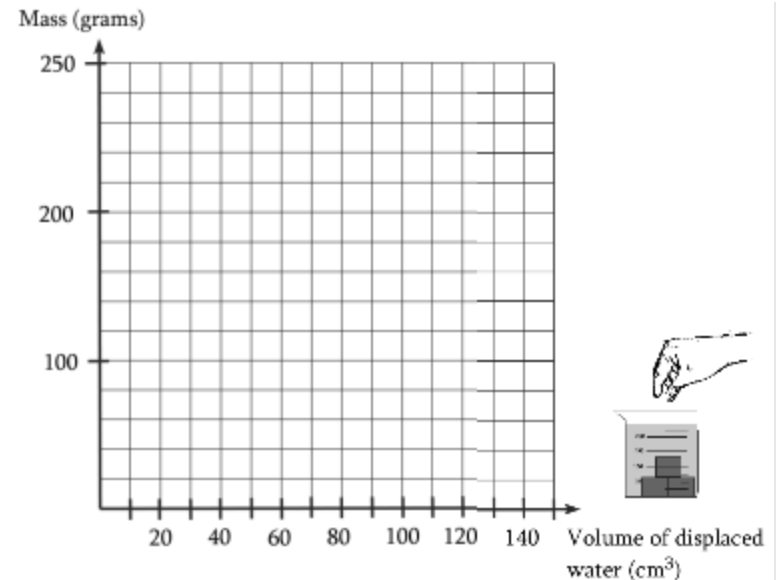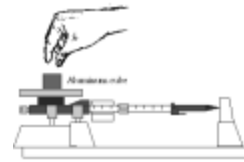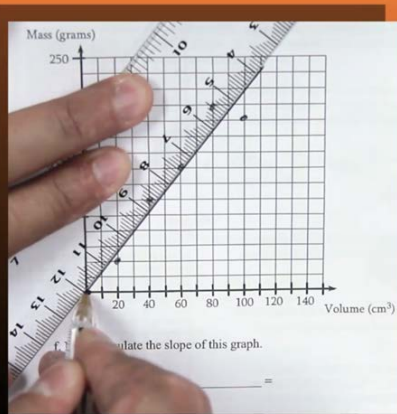
Pretest-Posttest question # 5

Figures at right show four identical buckets full of liquid. The density of liquid 1 in case 1 is twice the density of water. The density of liquid 2 in case 2 is ½ the density of water. Which of following statements is true? Explain your reasoning.

The mass of liquid 1 in case

a)   1 is twice the mass of liquid 2 in case 2.
b) The mass of liquid 1 in case 1 is 4 times the mass of liquid 2 in case 2.
c) The density of liquid 1 in case 1 is twice the density of liquid 2 in case 2.
d) None of them.

Case 1

Case 2
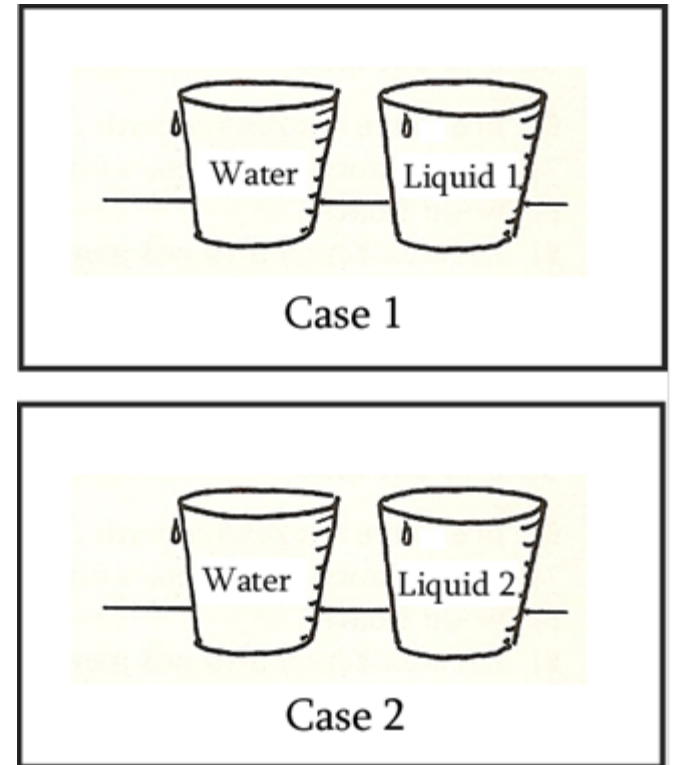
Homework question # 2

Two cork spheres are shown at right. The left sphere has twice the radius of the right sphere.
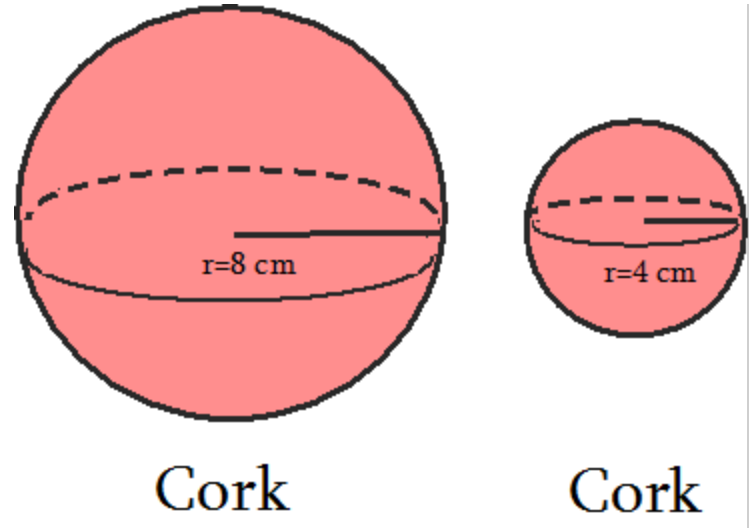Which of the following statement is correct?
a)   The mass of the left sphere
b)   is *twice* the mass
of the right sphere.
b) The mass of the left sphere is *four times* the mass of the right sphere.
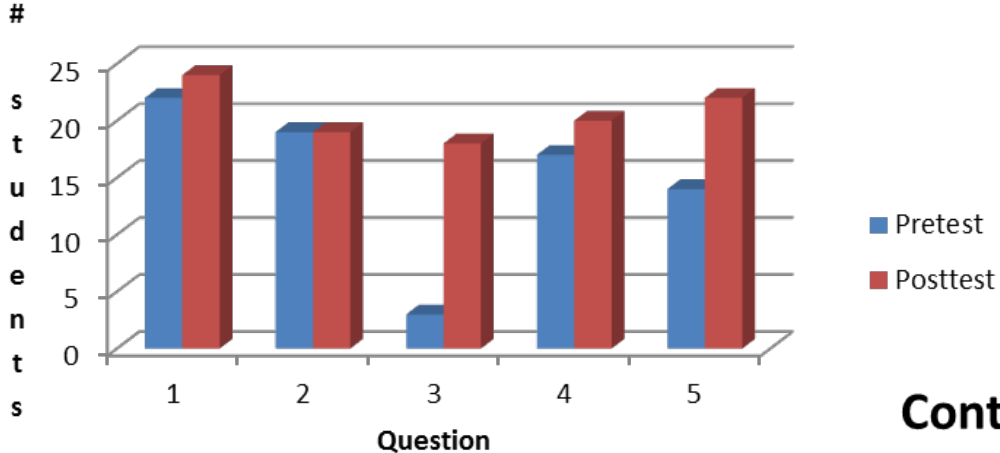c) The mass of the left sphere is *eight times* the mass of the right sphere.
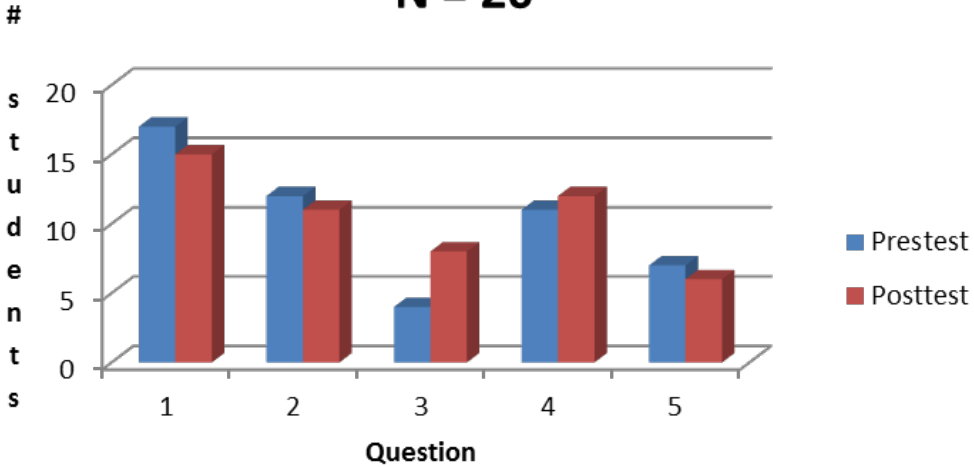d) The mass of the left sphere is *1/8* the mass of the right sphere.

r=8 cm

r=4 cm

Cork

Cork

Treatment and control groups results

Conclusions

- It seems that the video-lab combination approach is better than the lab by itself

- Students used the video through the complete lab

- Homework was too difficult for some students

- Hake's normalized gain:
  - Treatment group: 0.15
  - Control group: -0.09