Simulations in Physics class

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Subject: Physics.
Country of creation: Spain.
Countries of testing: Romania, Hungary and Slovakia.

Aims of the GP

- Use of computers in an intensive way in the teaching and learning process.
- Get a better understanding of physics concepts through computer simulations.
- Show the laws of physics in a more attractive way to students.

Teaching material

For the computer simulations:

- Computer with Internet access and JAVA installed.
- Additional plug-ins may be required in some cases.

For lab experiments:

- Several containers.
- Fluids like water, alcohol, salted water.
- A 1 N dynamometer.
- Several weights of different materials (wood, metal, clay, etc.).
- Aluminium foil for testing the dependence of buoyancy on volume.

Age of the students

14-16

Preparation and teaching time

Class time: 3 x 60 min classes.

Lesson plan

The main objective of this GP is to develop a didactic sequence in which students learn about buoyancy and sinking concepts (and the Archimedes principle) using computer simulations. The lessons consist of a combination of lab work and computer simulations.

The lesson starts with an experiment in order to provoke some reflection and to try to challenge some of the misconceptions students have.

Then students discuss the following questions and carry out some experiments to be able to answer the questions. They should consider how they might test each possible dependence:

- Is the buoyant force exerted by a liquid dependent upon the depth?
- Is the buoyant force experienced by a submerged object related to its shape?
- Does the buoyant force experienced by a submerged object depend on its orientation?
- Is the buoyant force experienced by a submerged object related to its volume?
- Is the buoyant force exerted on a body dependent upon the weight of the object?
- From what you've seen, does the buoyant force depend upon the density of an object?
- Is the buoyant force exerted by a fluid dependent upon the density of the liquid?

As the steps of this inquiry lesson are carried out, the teacher makes certain that proper experimental protocols are observed, such as the control of variables. This will require some of the above experiments to be conducted in proper relative order.

Once the factors that significantly affect buoyancy are identified, students will design and carry out an inquiry lab to determine the actual relationships between buoyancy and those factors empirically shown to be related to the buoyant force – the density of the immersing liquid and the volume of the object immersed.

Questionnaire

When an object is placed in a container half full of water, and the object is then completely covered with water, the change in water level depends on

Mass only.
Mass only, but when the volume is very large depends also on volume.
Volume only, but when the mass is very large depends also on mass.
Volume only.
Shape only.
Mass and volume.
Mass and shape.
Volume and shape.
Mass, volume and shape.

The buoyant force acting on an object equals

The mass of the fluid displaced by the object.
The weight of the object displaced by the fluid.
The weight of the fluid displaced by the object.
The force that holds the object afloat.

Does it take more force to keep a plastic inflatable beach ball submerged at the bottom of a six-foot-deep pool or at the top?

It takes more at the top.
It takes more at the bottom.
It's the same either way.

The density of a fluid and buoyancy are related. As the density of a fluid…

Increases, the buoyant force decreases.
Decreases, the buoyant force increases.
Increases, the buoyant force remains the same.
Decreases, the buoyant force decreases.

Which one of the following statements concerning the buoyant force on an object submerged in a liquid is true?

The buoyant force depends on the mass of the object.
The buoyant force depends on the weight of the object.
The buoyant force is independent of the density of the liquid.
The buoyant force depends on the volume of the liquid displaced.

The water level in a small aquarium reaches up to a mark A. After a large ice cube is dropped into the water, the cube floats and the water level rises to a new mark B. What will happen to the water level as the ice melts? (Don't take into account thermal effects).

Water stays at the same level / Water level increases / Water level decreases

Teacher reviews

The teachers who implemented this GP were happy with the results of their students due to the combination of hands-on experiments and simulations, which allowed the students to compare the results obtained by both methods and gain a better knowledge of Physics concepts. For instance, the Slovakian teacher mentioned that the students were "highly motivated, they joined in the work actively and also improved their study results in the given tasks".

The SPICE project

SPICE was a two-year project (December 2009 – November 2011) carried out by **European Schoolnet** (http://europeanschoonet.org) together with **Direção Geral de Inovação e Desenvolvimento Curricular** (http://sitio.dgidc.min-edu.pt/Paginas/default.aspx) from Portugal and **Dum Zahranicnich Sluzeb MSMT** (http://www.dzs.cz/) from the Czech Republic.

The primary objective of the SPICE project was to collect, analyse, validate and share innovative pedagogical practices, particularly those using inquiry-based learning, whilst enhancing pupils' interest in the sciences. SPICE supported this objective by singling out, analysing and validating good practice pedagogies and practices in maths, science and technology (mostly ICT-based) and disseminating them across Europe. SPICE involved 24 teachers from 16 different educational systems (from 15 different countries). This teachers' panel helped the SPICE partners in defining good practices that were then tested in classes by 41 teachers during the school year 2010-2011.

For more information see: **http://spice.eun.org**

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