Project Worksheet

Lasers & Bubbles

Teachers' details:

- **Nikolaos NERANTZIS** (TEE & EPAL Eidikis Agigis, Serres, Greece),

abc57001@gmail.com, +30 6946 08 5555

- **Sotirios MANDILIOTIS** (*Laboratory Center of Natural Science of Serres* (EKFE Serron))

sotmandili@gmail.com, +30 23210 22864

The project (max. 1000 words)

Here you can see in short the didactic frame of our project. For the further description, posters bibliography, updates, etc., please do visit *http://wp.me/p3oRiZ-h9*.

In the present project, we primarily integrate the following *Big Ideas of Science* {BIS}:

1 (*All material… is made of very small particles*) and

4 (*The total amount of energy is always the same…*)

and we argue on…

2 (*Objects can affect other objects at a distance…*),

3 (*Changing the movement of an object…*) and

5 (*The composition of the … atmosphere…*).

Since 2009 we integrate "hands-on" activities with "low-cost" materials. Activities on exploring light's behavior passing through different media (air, oils…) was carried out two years ago (2013) in classroom [Ref.1]. This year we repeat and …"elevate" those activities, visiting the *Laboratory Center of Natural Science of Serres* (EKFE Serron) with the same five students, with SEN whom also carried out the experiments two years ago.

Phase.I (pre-activities)

• Remembering 2013. Using IWB and the poster in Figure_1, we recall the experiments of 2013. We listed the core scientific concepts [Ref.2] and I emphasized and repeatedly asking my students to answer "*how light travels*" and "*is the same amount of energy 'entering' and 'exiting'* ?". {BIS4&3}.

Figure_1: Poster with experiments of the school year 2012-2013

• How light …jumps! Staying on IWB we explored "*how light travels*" passing through different media with the atom≈river analogy (Figure_2) [Ref.3]. Students had to draw how light must "jump" (like crossing a river) over the atoms (stones).

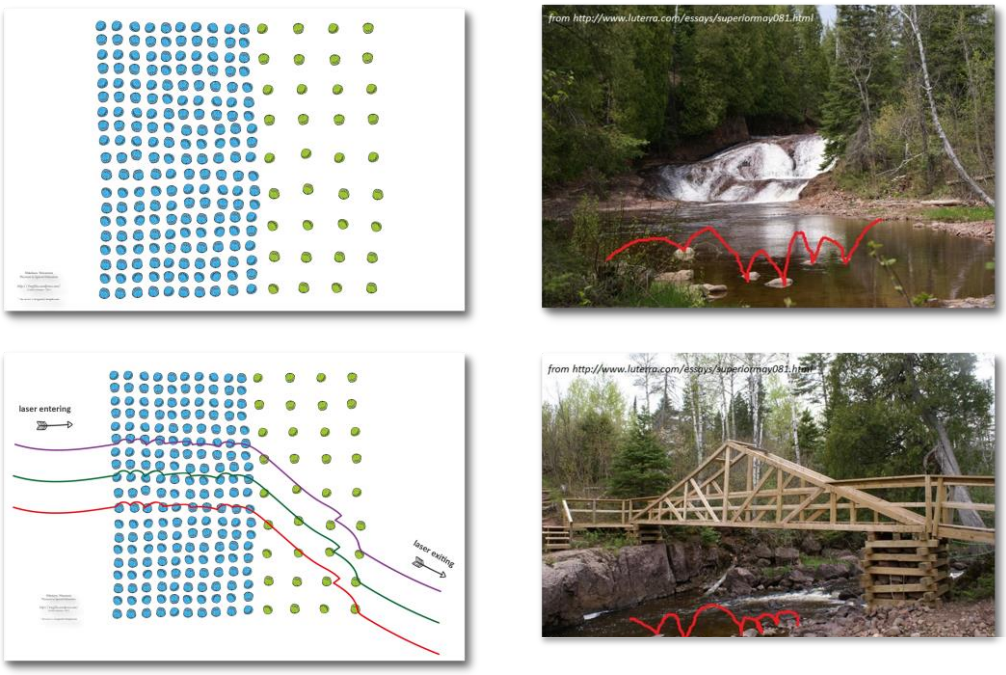

Figure_2: The atom≈river analogy

We summed up with one of the following educational objects on diffraction from photodentro.edu.gr or PhET and …enjoyed the analogy with Takeshi's Castle (at 1:41) (Figures_3a,b). {BIS1&4&3}.

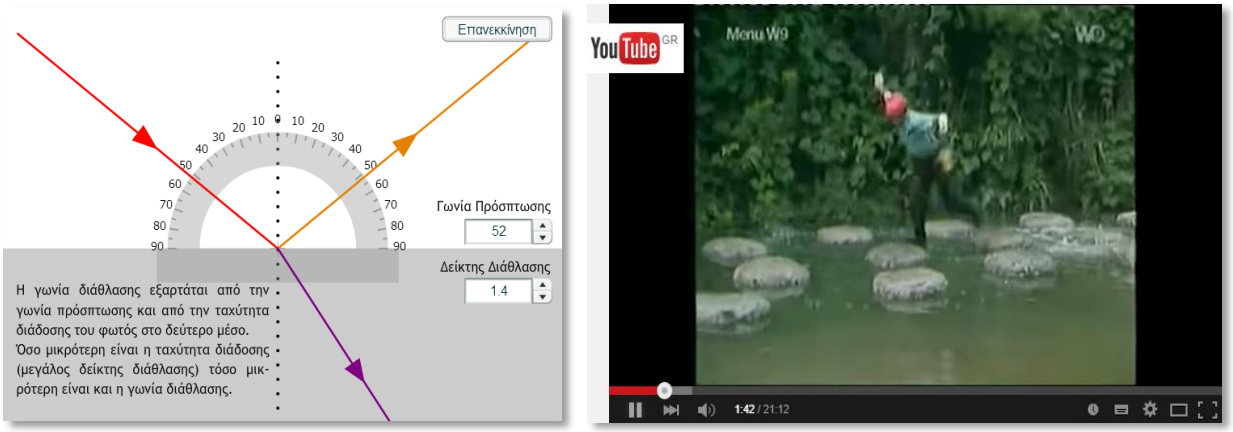

Figure_3: a. educational object from photodrntro.edu.gr, b. video https://youtu.be/ScpJSlUmA9s

• Activities at EKFE. Visiting *Laboratory Center of Natural Science of Serres*, Sotiris engaged students to a plethora of activities (Figure_4) on lasers, total reflection, fiber optics, Morse code and …bending light with sugar! {BIS1&3&4}.

Figure_4: Poster for Phase.I (*The activities on the left of this poster can be "related" to activities in the right "through" the circular pictures in the middle.*)

Phase.II (main activity)

• Experimentation-playing. After Sotiri's activities we gave the students directions about their main activity and we let them experiment/play first. Then we prepare our materials (Figure_5): light-bulbs with cooking oil and (a supersaturated) salt solution, the apparatus etc. The objective was to explore, describe, inquiry and explain light's behavior (microscopic approach) passing through different media – under teachers' very discrete guidance.

• Main activity at EKFE. In the poster at Figure_5, you can see how students manage to bend light by immersing into water the light-bulbs mentioned above and an empty cylindrical jar {BIS1&3&4}. This jar must be kept in the water by the use of weights! {BIS2}. Moreover, in the globe with the salt solution we observe a white, a red and a green …fog. {BIS5}. During the implementation students had to describe, inquiry and explain what we were observing: "*why here the light is bending left* ?" "*why this globe is …foggy* ?"

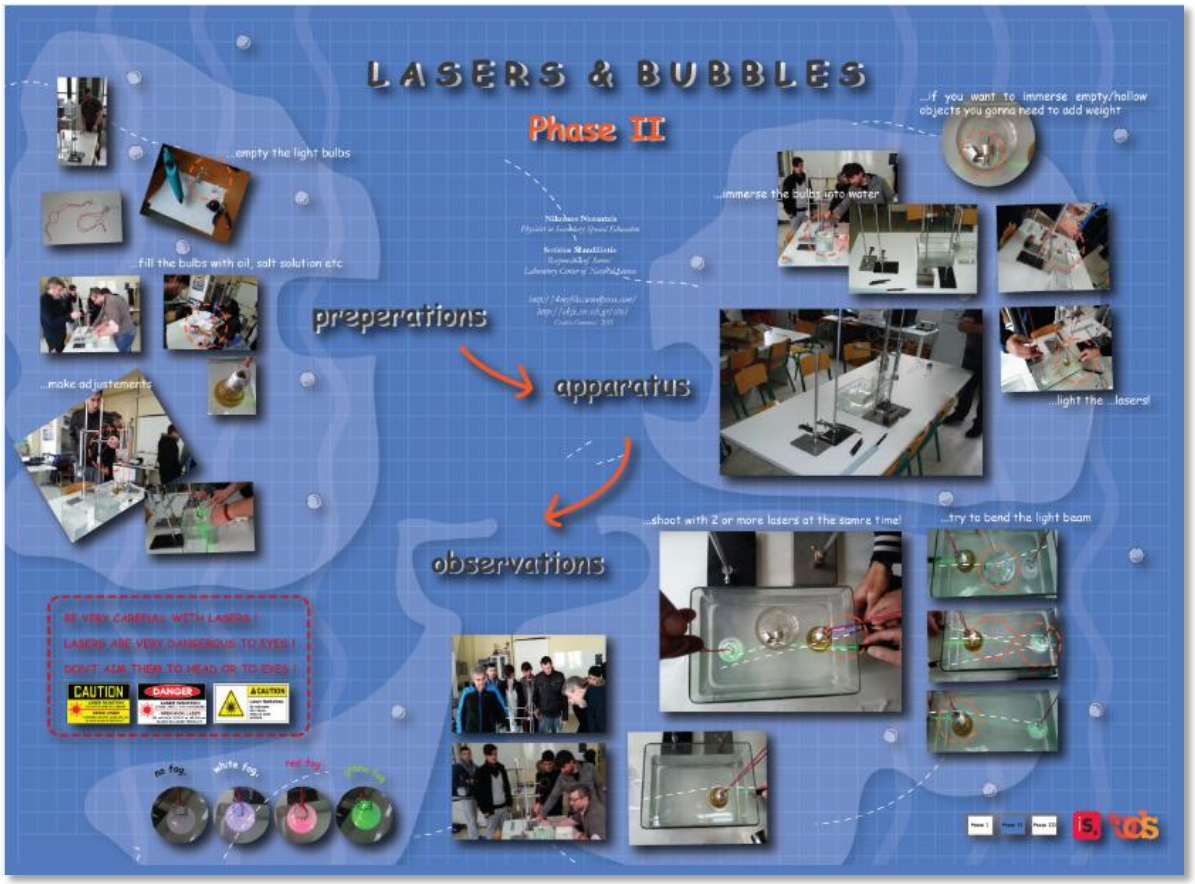

Figure_5: Poster for Phase.II

Notes

Metamemory. Prior every task, I was asking my students if the task was seemed difficult (or not) and why. After the task I was asking if the task indeed was difficult or not. The objective was to monitor the learning procedure through Ease of Learning (EOL) judgments [Ref.4].

Oscillations. During the implementation I adjusted two strings with masses and I pulled them downwards. My students asked me "*What about this strings*?" but I didn't answered them until we left EKFE! Then – when they asked me again – I told them that there are two "kinds" of oscillations: energy oscillations (like visible light) & matter oscillations (like sound). The visualization and the capability of returning to the video I took, make that knowledge more stable, since that knowledge ….. More over we can use the oscillation demonstrating in Figure_6 [Ref.5].

Posters: The importance of the posters [Ref.6] in Special Education is widely accepted. In this project, posters are not only …but also our visual note/textbook. So we sure took a lot of pictures using a camera and our smartphones.

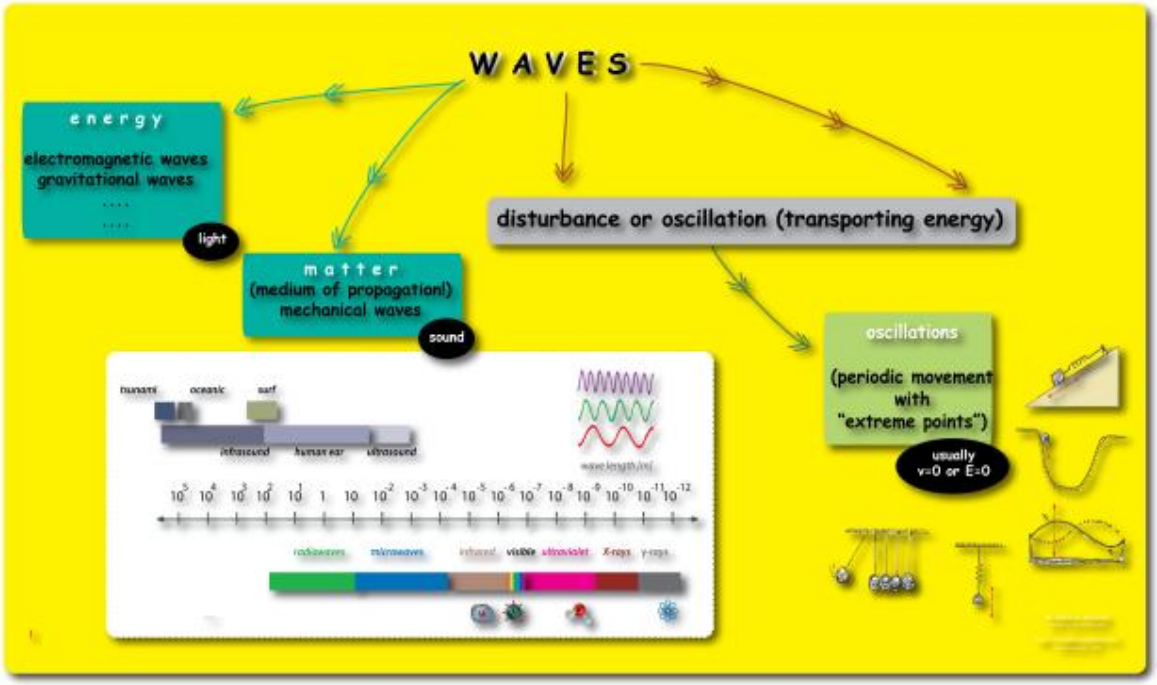

Figure_6: Poster on oscillations

Phase.III (post-activities)

• EKFE activities. At the end, Sotiris once more engage students into very interesting activities: red-cyan 3D vision & videos, eye-testing (Figure_7)

• "Heraclitus" science museum. Finally, we visit the Heraclitus science museum (in the same building with EKFE) and we saw and touched didactical experimental apparatus nearly 100 years old!. (Figure_7).

Figure_7: Poster for Phase.III

Phase.IV (discussion/conclusions/extend)

At the classroom each student present his conclusions (with his own words) and we discussed about the final results/outcomes of our project. We summary of the project, we revised and extend, connecting with everyday life through the ISE resources. Thus the Extend sub-phase [Ref.7] is a very important phase for deep scientific understanding of core ideas and the development of everyday life skills (see “The resources”).

Students worked as “one team” and “real” researchers, testing, adjusting, inquiring and exploring different aspects of a problem. Students through different activities and playing approached the same scientific concepts and gain spherical knowledge about matter(atoms), radiation(light) and their interactions: everything around us is made of (very very small) “material particles” – as protons/electrons – and “pure energy particles or radiation” – as visible light. When a beam of light finds matter, with respect of these matter’s characteristics, light’s trajectory changes.

[Ref.1] Nerantzis N., “Poster of low-cost materials experiments”, *http://wp.me/p3oRiZ-W,* 10 Apr. 2014.

[Ref.2] Staver J.R., “Teaching science”. IBE, UNESCO, Practice_17, pg.9, 2007.

[Ref.3] Περδίκης Γ., Οι Αναλογίες στη Μάθηση και τη Διδασκαλία των Φυσικών Επιστημών, ISBN 960-631-539-8, Θεσσαλονίκη 2006

[Ref.4] Karably K., Zabrucky K.M.,"Children's metamemory: A review of the literature and implications for the classroom" , International Electronic Journal of Elementary Education, Vol.2, Issue 1, Oct.2009.

[Ref.5] Nerantzis N., "A didactic proposal to introduce the concepts "energy flow", "wave", "oscillation" and "disorder"" in Greek, *http://wp.me/p3oRiZ-1R,* 10 Apr. 2014.

[Ref.6] Nerantzis N., "Posters as educational material for Secondary Special Education (Greece)", 2nd Scientix Conference, 24–26 Oct. 2014 Brussels. *http://wp.me/p3oRiZ-cc*, 10 Apr. 2014.

[Ref.7] Levy P., Lameras P., McKinney P., Ford N., PATHWAY, D2.1 The Features of Inquiry Learning: theory, research and practice, pg.22 *http://www.pathwayuk.org.uk/resources.html*, 10 Apr. 2014.

The resources (max. 200 words)

The ISE resources are widely used at the Extend sub-phase for deep scientific understanding of core ideas and the development of everyday life skills. We used…

>> the Energy Poster (http://portal.opendiscoveryspace.eu/node/822367) for the basic concepts,

>> "Information about what ancient philosophers said about the nature of light" (http://www.grouporigin.com/clients/qatarfoundation/chapter2_4.htm) and "Properties of a rainbow" (http://portal.opendiscoveryspace.eu/edu-object/properties-rainbow-419701) to connect with the history of science,

>> GoLab's remote lab The color of the light for the fog in the bulbs,

>> Eye resource (http://www.inspiring-science-education.net/sites/default/files/1_14_Eye.pdf) and "Eyes' hidden secrets" (http://portal.opendiscoveryspace.eu/el/edu-object/eyes-hidden-secrets-675434) on how dangerous laser is for our eyes,

>> Aurora Borealis (http://portal.opendiscoveryspace.eu/edu-object/aurora-borealis-13547) & Aurora Australis and their colours. {BIS1&5}

>> http://portal.discoverthecosmos.eu/node/107194 on Light pollution {BIS1,4&5}

>> Newton's mistake… (http://portal.discoverthecosmos.eu/node/132277) {BIS1,2,3&4}.

Our future work is about creating a new ILS with a new didactical approach in matter & light with the following "parameters" (for now): connecting & implementing the "The color of the light" ILS & integrate "Spectrum with Salsa_J" (http://portal.discoverthecosmos.eu/node/194903))

The challenge (max. 150 words)

Our project combined [1.]prior knowledge, [2.]visit to a scientific lab, [3.]self-motivated team-working students, exploring as researchers, describing as scientists, inquiring and explaining, [4.]visiting & interacting with a museum's apparatuses. The educational outcome is [5.]stable knowledge about the core scientific ideas of atom, radiation and the interaction between them, [6.]better relationship between teachers and students, [7.]positive self-esteem of the students and [8.]educational material.

The project's approach is not a typical/common didactic approach to Hellenic Schools. As a teacher I saw my students acting, asking questions to trying and trying again and being happy. I succeed to integrate [9.]the emotion component in learning [Ref.8], [10.]cooperation and [11.]consistency & continuity to teaching. All eleven points (superscripts) are objectives through to an effort for an inclusive education.

[Ref.8] Hinton C., Miyamoto K., Della–Chiesa B., "Brain Research, Learning and Emotions: implications for education research, policy and practice", European Journal of Education, Vol.43, No.1, 2008.