A CASE STUDY ON
Light Emitting Diodes

By

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INTRODUCTION/BACKGROUND

The intervention has been focused on a vocational school in Volla (district of Naples) providing its students mainly with technical skills.
Due to the features of the school, the involved students were already skilled in electronics and such the under suggestion of their science teachers it has been chosen the lesson plan on LEDs among the other available in NTSE's Virtual Lab.
The activities has been carried out on December 9th 2013 and it involved a 11th Degree (classe terza, sezione D). As already said the class involved is characterized by the high average in level of technical skills of its 24 members.

(DEFINITIONS/NOTIONS/TERMINOLOGY)

Wavelength, light frequency and related physical quantities;
Semiconductor materials;
Electroluminescence;
Electricity (voltage, current, power and their physical quantities)

PURPOSE

The main task of the activities has been to introduce the students to the properties and the features of LEDs through IBSE methodologies. Then the student will have to work in a cooperative way to solve a problem proposed by the teacher.

OBJECTIVES

The lesson activities are designed for *students* from the 8th to the 13thgrade.
The objectives are:

- Learn about properties of Light Emitting Diodes, comparing them with other lamps
- Learn to develop hypothesis and experimentation
- Realize impact of technology in everyday things

The proposed activities allow students to:

- Describe the behavior of LED.s
- Define the concept of cold light and describe its features.
- While conducting investigations, use the science themes to develop explanations of physical and chemical interactions and energy exchanges
- Identify questions they can investigate using resources and equipment they have available

LEARNING RESULTS

- Learn about the behavior of LEDs.
- Define "electroluminescence " and describe its features.
- Describe situations in which LEDs would be useful.
- Use models and explanations to predict actions and events in the natural world

CLASSROOM MANAGEMENT & SEQUENCE OF EVENTS

Before the activity started in the classroom, students should have read on their own the text on LEDs available in the Documents Room of the Virtual Lab.
Then the activity was split in 4 steps-

Introduction and Activity 1 (VL)	**First the teacher introduced the lesson showing to the students the first clip related to the LEDs available in the Virtual Lab.** **Then she showed them the devices available in the NTSE kit produced by Doga in the framework of the project.** **Teacher started a brainstorming session by asking the following questions (Together with letting students to express their opinions/ideas, helping them to recall their previous knowledge, and motivating them to realize/see the principles, concepts, and relations):** • **You all see LEDs in your daily life. Can you list where do you see them most? Why do you call them as "LED"s?** • **Why do you think LEDs are preferred in certain applications?** • **"TV remote control"s produce light for interaction between the TV and the remote control. Why can we not see that light between them?** • **How do colors generate? What is the fact that makes them different?**

	The whole class watches the videos 1 and 2 on the Lotus effect available in the Virtual Lab. Students split into small groups (4 persons) discuss the structure of the leafs and their self-cleaning and hydrophobic properties.
Activity 2 (VL): experimenting LEDs	**Apart the device (the LEDs sytem available in NTSE kit) the students have been provided with LEDs of different colors and the materials needed to let them work (in particular materials to set electrical networks, circuits and such being the laboratories already equipped with such of kind of materials being the school vocational oriented to electronics and such).** **Then under the guidance of the teacher, the students started to carry out the experimental experiences suggested in the VL Student Guidelines**
Activity 3: group discussion	**After the experiences, the whole class had a discussion related to the subjects they just dealt. It has been also a fine toll for the teacher to evaluate how much the students related the experiences with the curricular lessons.**
Activity 4: Assessment grid	**The last step has been the filling of the assessment grid provided to the student by the teacher (see the gathered results below).**

RESOURCES

http://vlab.ntse-nanotech.eu/NanoVirtualLab/experimentroom/ac5d9f677f9b4c19a55457be2042b753

http://www.3rotaie.it/3r_Documenti/led/resistenze.htm

http://www.gaeeb.org/tek/led.htm

ASSESSMENT SUGESTIONS

It could be prepared a previous assessment grid in order to evaluate the previous knowledge of the student about the subject they have to face.

Moreover a deeper investigation through a previous common dialogue could the teacher better understand the knowledge, the interest and the expectations of the student about the activity they are going to carry out.

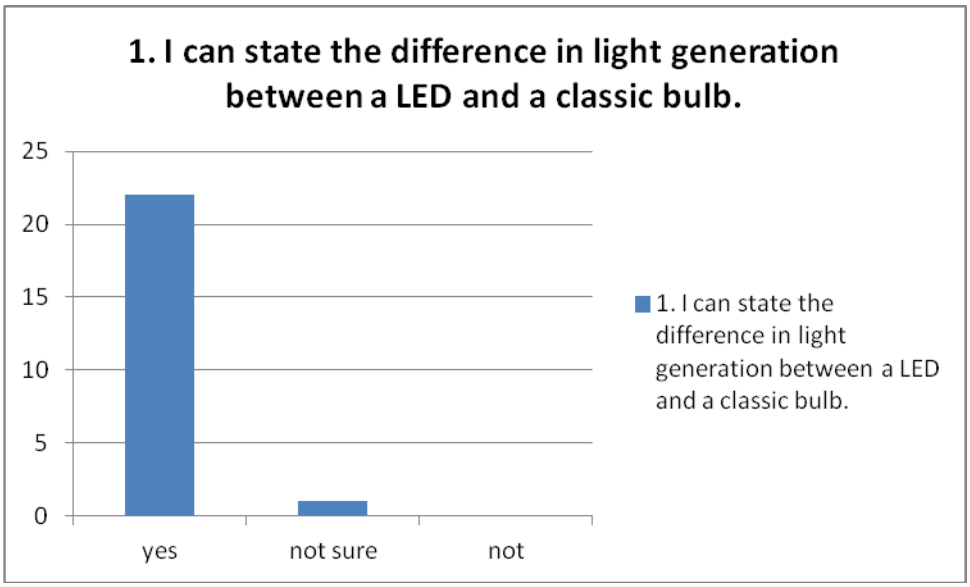
IMPACT ON STUDENTS

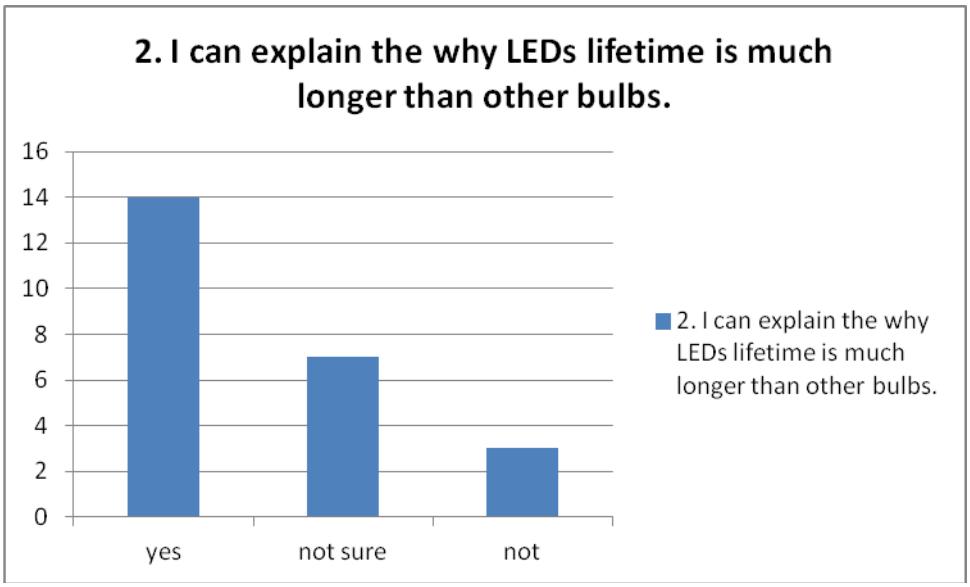
Students showed a great interest for the lesson plan even if they already dealt it topics in the curricular lessons. Anyway, practical experiences in laboratory result to be always captivating for students

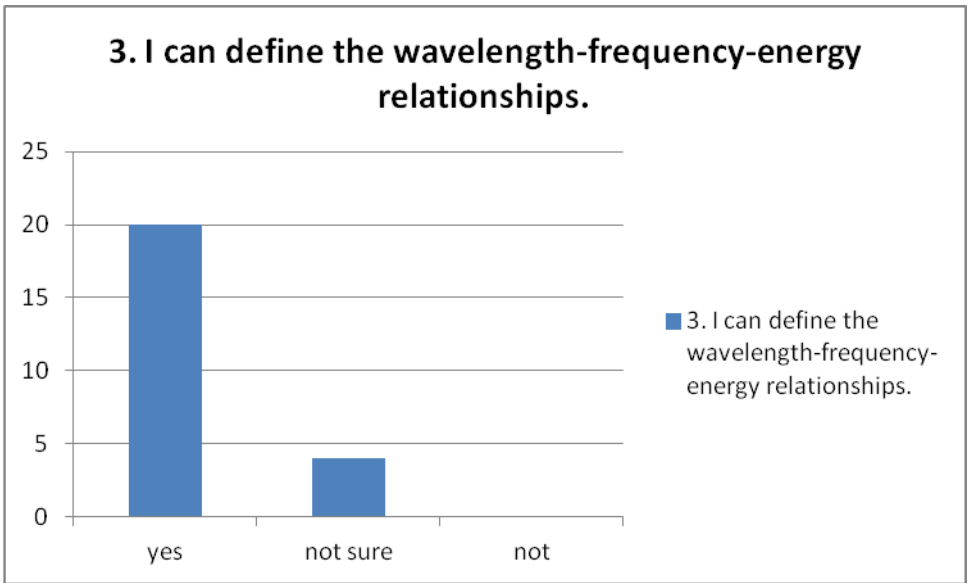
Each group of student built a macroscopic model of surface's structure of lotus leaf. A video showing the different steps of this experience has been realized.

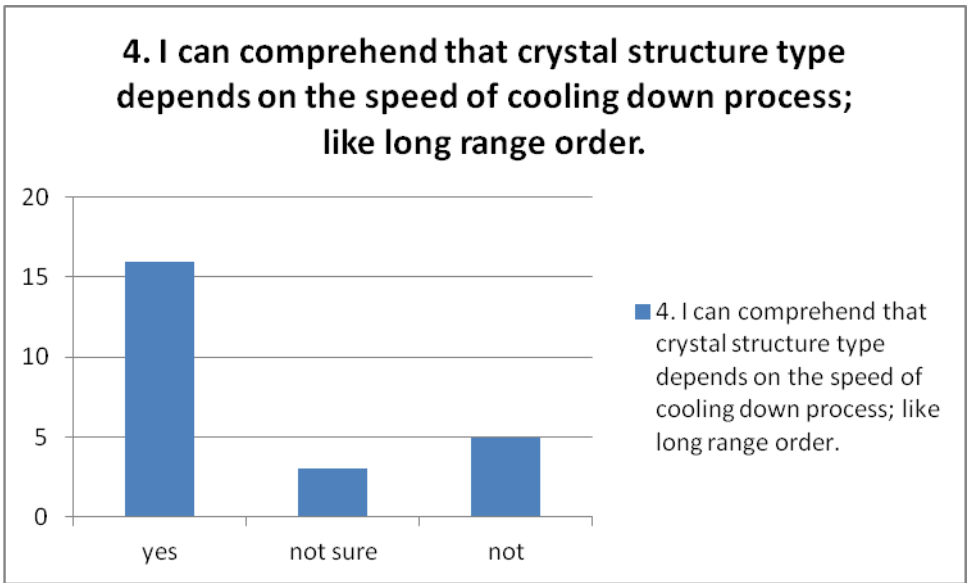
STUDENTS' FEEDBACK

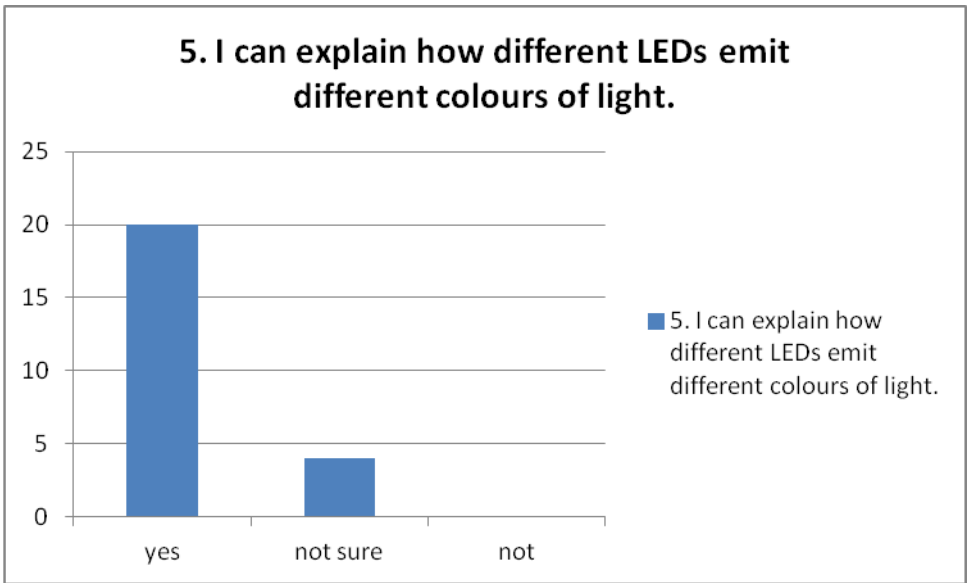
After the activity the teacher provided the students with the assessment grid to fill. The filled grill have been 24 but not every student answered to every question. Anyway, as it can be seen from the graphs below, the results seems to be largely positive with very small differences in the results among the different questions. Anyway, it is to be noticed the students were already skilled in these kind of subjects because of their curricular careers.

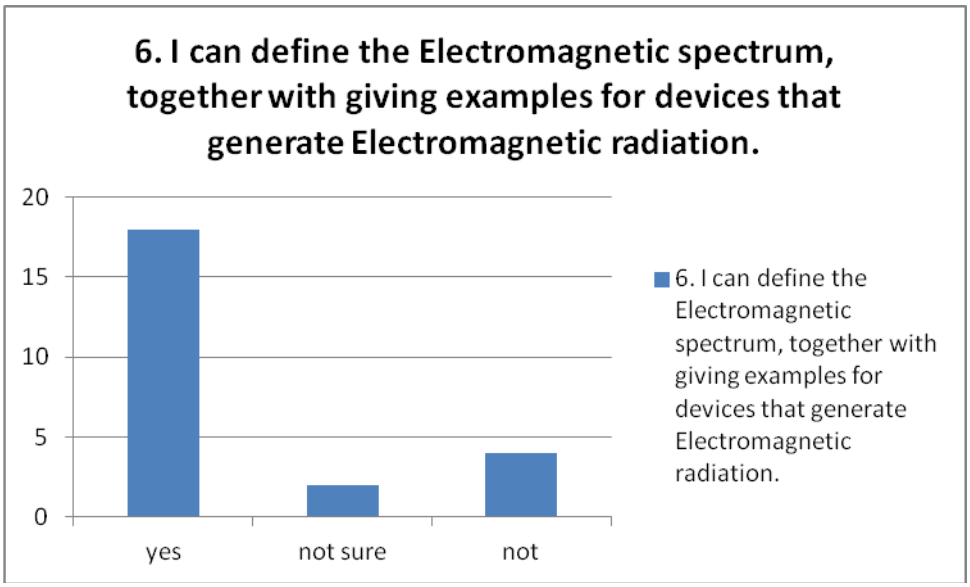



2. I can explain the why LEDs lifetime is much longer than other bulbs.
16
14
12
10
8
6
4
2
0
yes
not sure
not
2. I can explain the why LEDs lifetime is much longer than other bulbs.


3. I can define the wavelength-frequency-energy relationships.
25
20
15
10
5
0
yes
not sure
not
3. I can define the wavelength-frequency-energy relationships.


4. I can comprehend that crystal structure type depends on the speed of cooling down process; like long range order.
20
15
10
5
0
yes
not sure
not
4. I can comprehend that crystal structure type depends on the speed of cooling down process; like long range order.


5. I can explain how different LEDs emit different colours of light.
25
20
15
10
5
0
yes
not sure
not
5. I can explain how different LEDs emit different colours of light.



CONCLUSION

As already said, this lesson plan rises the interest of the students in the study and the applications of LEDs because of the laboratorial approach to the subject. It is important to remark that many of them use to spend their free time working with electronic devices like LEDs just for fun.