



A CASE STUDY ON The Lotus Effect

By

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INTRODUCTION/BACKGROUND

In the framework of the activities of the European project NTSE, on June 6th 2013 at Liceo Scientifico Statale Labriola of Naples (IT) a lesson plan was chosen among the ones available in the Virtual Lab of the project: "Lotus Effect", because the teacher considered it to be the most enjoyable, also as the one that offers experiments that can easily be suggested.

A IV class (12th grade) of the school was involved in experimentation under the guidance of the science teacher, Prof. Silvia Maria Lippo. The class involved is characterized by the high average in level of skills of its members. This was proven by several tests taken in the course of students' studies. This class is already part of an experimental learning project included in a wider national program, aimed to the development of educational paths of excellence. This project is called Brocca - from the name of one of the commission members that invented it. The project concerns extra hours of scientific and humanistic subjects. In particular, students perform many hours in different laboratories such as information technology (I.T.), physics, chemistry, biology and foreign languages. Moreover, this is a special class because it mixes several nationalities and cultural backgrounds (one student comes from Turkey, one from France, another from USA and another one took part in an intercultural project which led him to Thailand).

(DEFINITIONS/NOTIONS/TERMINOLOGY)

- Technology.- application of science to give benefits to our contemporary world
- Nanotechnology- application of Nature's technology to fabricate structure with dimensions between 1-100nm
- Biomimicry- a new science which studies nature's models and then imitates or takes inspirations from these designs and processes, to solve human problems
- Lotus effect.- very high water repellence

PURPOSE

- To realize fundamentals of nanotechnology by fun experiments, activities and simulations
- To internalize, elaborate and activate students imagination about "Nano"



OBJECTIVES

The chosen lesson was aimed at students from the 8th to the 13th grade.

The objectives were:

To carry out scientific experiments and other learning experiences. The lesson plan intended to provide the students with correct scientific information about the principles of the so called "lotus effect". This includes the perspective or actual technological applications deriving from the use of these principles.

The proposed activities allowed students to:

- To learn about the macroscopic consequences of lotus effect with basilar mechanisms
- To link them to the knowledge already learned during the physics and chemistry curricular lessons. Moreover the lesson plan emphasizes how lotus effect is a recurring phenomenon in the natural world, in particular in the plant kingdom, and how it can be used in several technological applications.

LEARNING RESULTS

As well as giving a deeper knowledge about such a particular phenomenon the lotus effect, the students have had a real view on Nano-related topics as indicated by the quotes:

- Sara, 17 years old, "Do nanotechnologies have had biomedical applications? What kind of career choices is there in order to work with nanotechnologies in biomedical environment?"
- Stefano, 18 years old: "During the experiments we saw the black carbon in a burning candle which contains nanoparticles. Do incinerators for garbage also produce such a kind of particle? Is it dangerous for public health?"
- Nicola, 18 years old: "Is waterproof clothing already available using such a kind of nanotechnologies?"
- Alessio, 17 years old: "Could I wear lotus leaves?" (it's just a joke)
- Berkay, 18 years old: "Thanks to the scientific experience I consider that even if the prefix is "Nano" these technologies could have an "enormous" influence on our life"
- Michele, 17 years old: "Are there any applications where nanotechnologies are not used yet, but could be in the future?"
- Anna, 17 years old: "I know that some particular Nano particles could be used as selective drugs that are able to destroy only pathogen cells. Is this true?"



CLASSROOM MANAGEMENT & SEQUENCE OF EVENTS

1. First the teacher gave the students the task to examine in depth the topic of lotus effect by reading at home the Students' Guidelines available in the Documents Room of the Virtual Lab.
2. The students started the lesson plan at school watching the videos about lotus effect which was available in the Experiment Room of VL.
3. The students carried out some experiments in the classroom. These were proposed both by the Guidelines and by other educational resources found online either by the students or indicated by their teacher.
4. The experiments were carried out and then discussed. The whole class together with their teacher aimed to relate them to previous knowledge

RESOURCES

- Teacher's Guidelines from Virtual Lab of NTSE project
- Student's Guidelines from Virtual Lab of NTSE project
- Assessment grid from Virtual Lab of NTSE project
- Instructions and materials of the Nanokit (project Time for Nano, <http://www.timefornano.eu>)

ASSESSMENT SUGGESTIONS

An interesting assessment tool could be represented by a common debate involving the whole class and led by the teacher. It could stimulate students to recognize connections between the experiences followed in the activity and scientific knowledge already done in the framework of formal school lessons and in an informal way in daily life. The debate could be carried out either at the end of the lesson or planned in frequent moments in the different lesson steps.

IMPACT ON STUDENTS

Students showed a real interest for the lesson and its contents

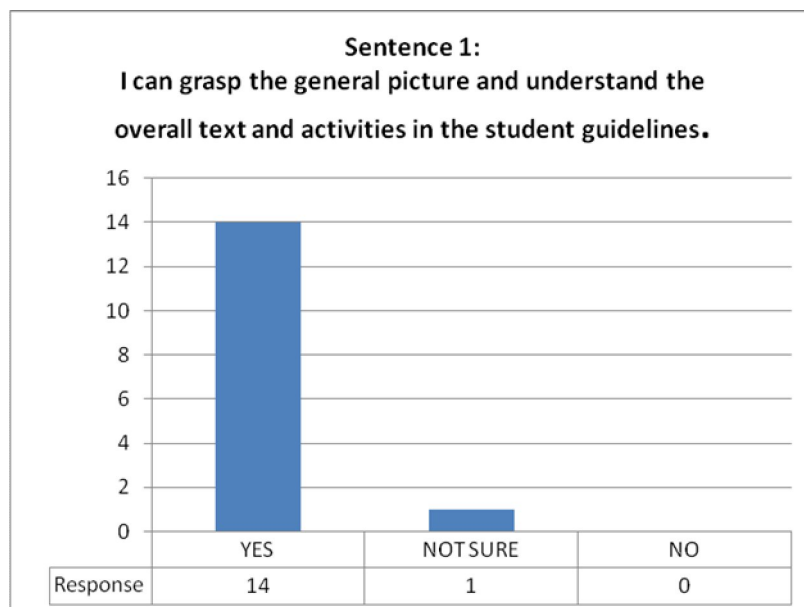


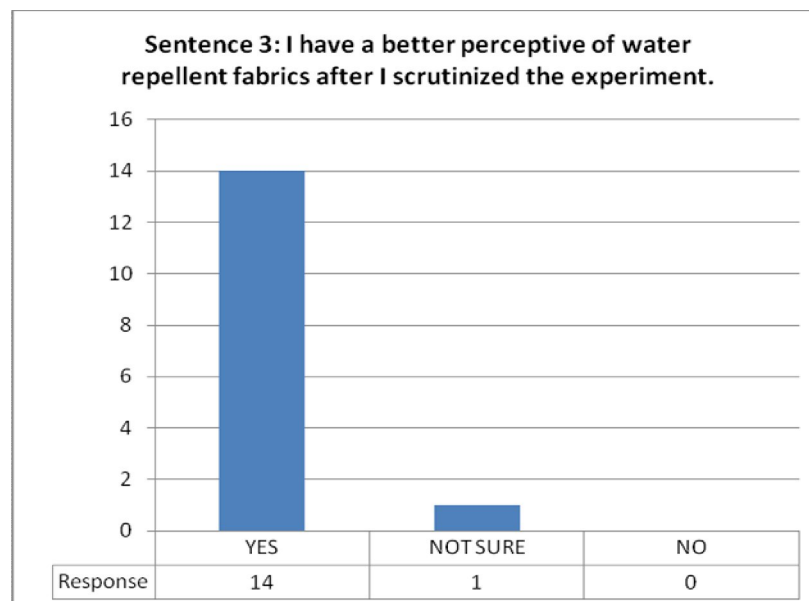
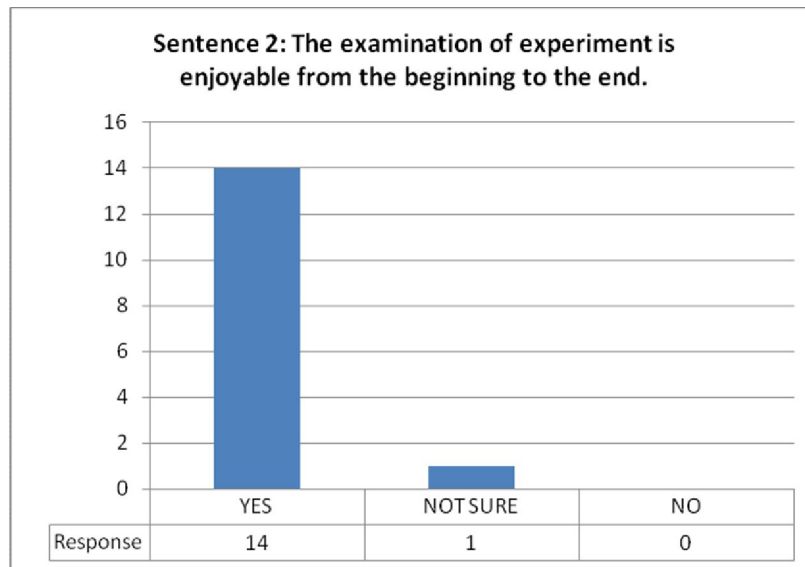
STUDENTS' FEEDBACK

Expressed feedback:

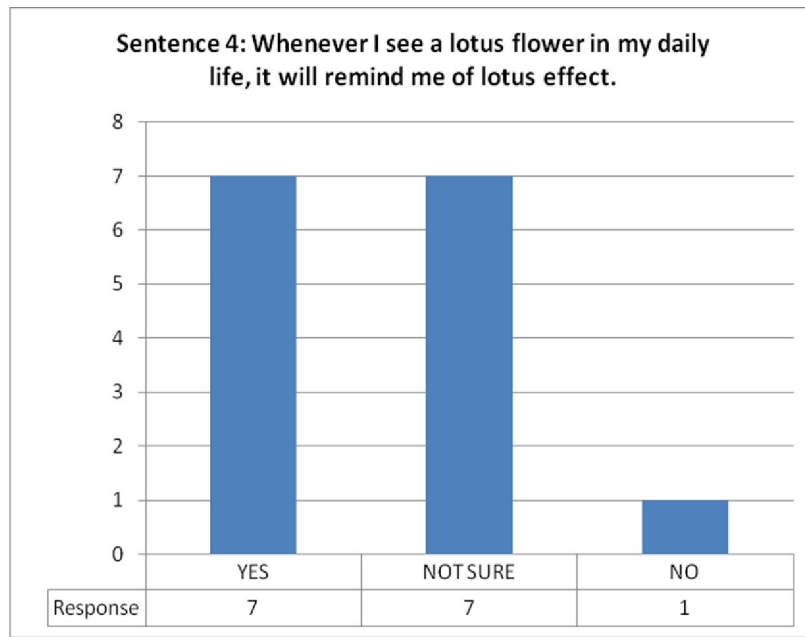
Apart from the increased students interest shown, as you can see from the quotes above, the significant feedback is shown on the assessment grid, available in the Documents Room of the VL. After the activity the teacher asked the students to fill in the assessment grid and then she received 15 completed examples. The results of the test are reported in the next paragraphs.

Processed feedback (graphical results):

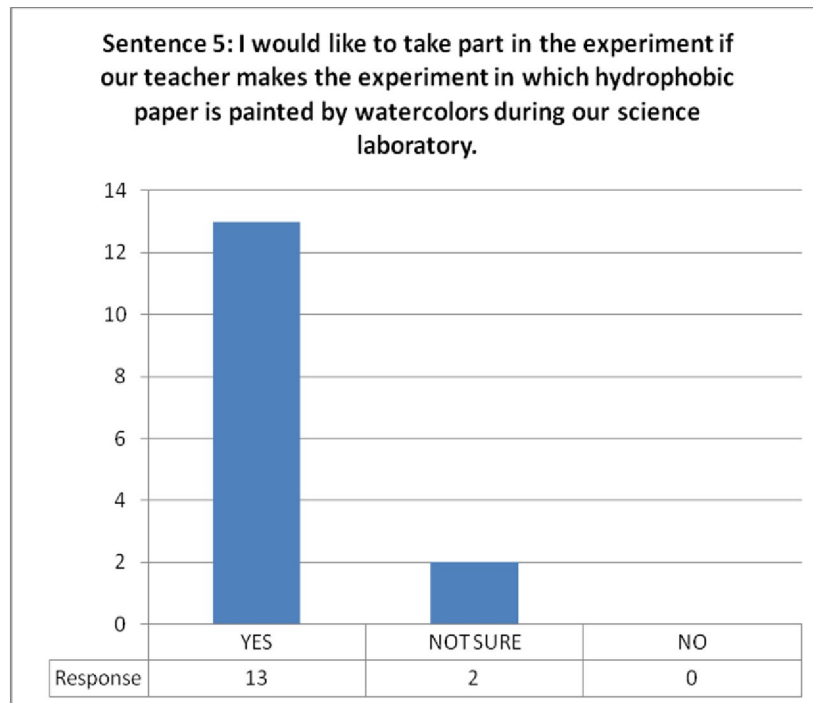




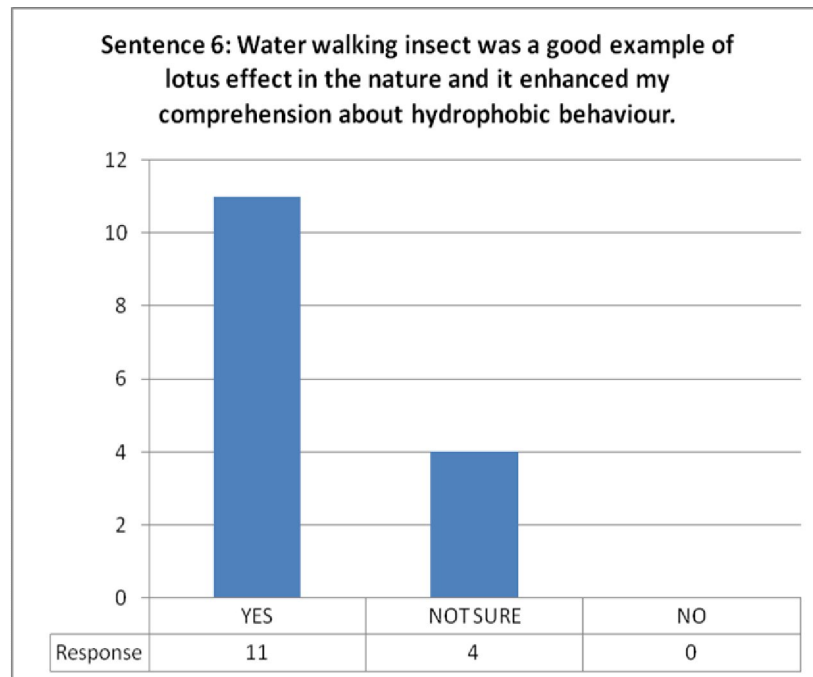
Concerning the first three sentences of the grid we had exactly the same results. The very large majority of the interviewed students (14 of 15) agreed with the related sentences. The results were predictable considering the students previous skills and their good school performances.



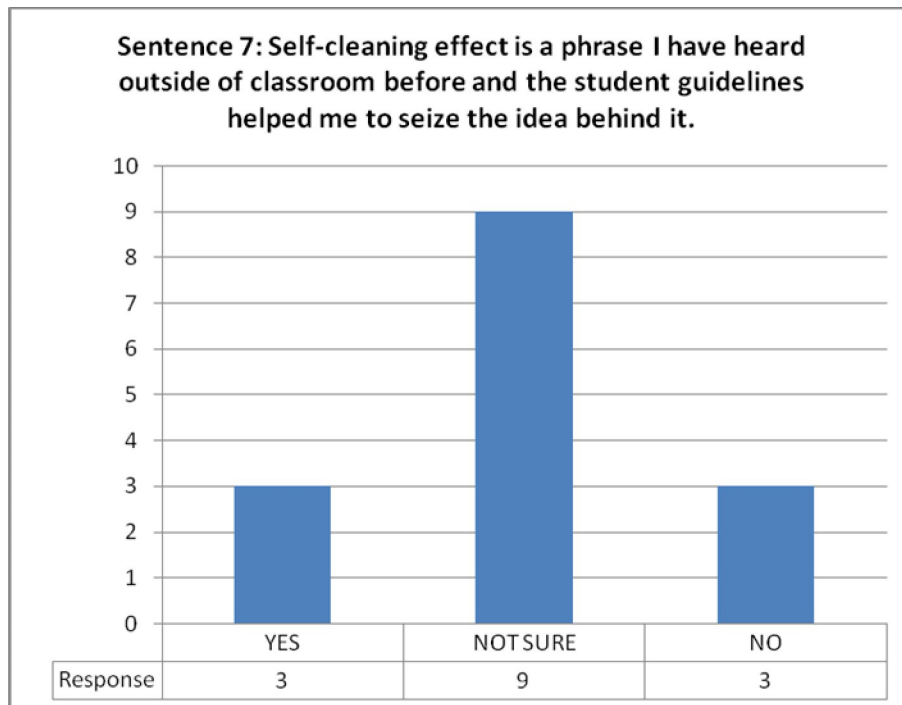
The fourth question shows a more heterogeneous response probably due to the meaning of the sentences. Half of students answered “yes”, the other half said “not sure” maybe because not all of them are sure to see a lotus plant in the future!



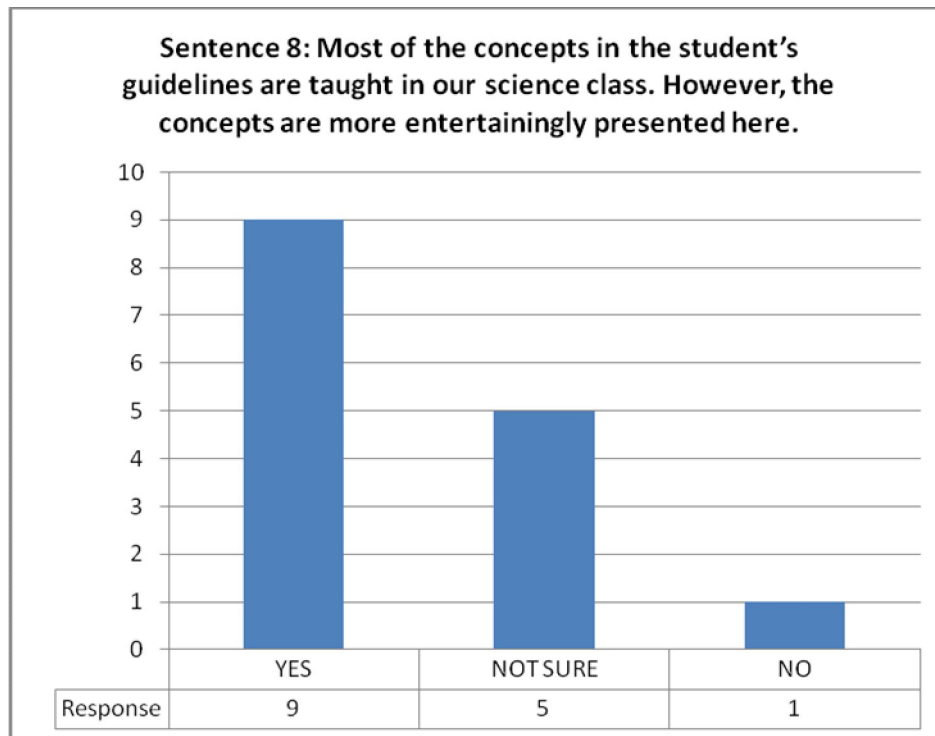
During the lesson plan the students didn't carry out the experiment mentioned in the sentence but they watched the video where the experiment is shown. The response in the grid indicates they enjoyed the video.



In this case the students didn't carry out any experiment about water insect walking apart the information they read about in the Guidelines. This could explain the four answers had as "not sure".



For this sentence we find a more remarkable amount of “not sure” and “no”. We need to note that the sentence contains two different statements. Maybe by splitting them in two different sentences we could get significantly different results.



As for the sentence 7 also this one could be split in two different statements with different meanings. Anyway the majority of the interviewed students agree with the sentence.

CONCLUSION

As mentioned before, the lesson plan "lotus effect" was chosen because it seemed to be the most enjoyable and experiments are the easiest to be followed.

This consideration seems to be confirmed by the student's statements and the images about activities, the carrying out of the lesson plan increased the participants interest both for its contents and for the other related topics.

The lesson plan and its contents might be improved or partially used depending on the leading teacher choice.



Links

<http://vlab.ntse-nanotech.eu/NanoVirtualLab/>

<http://ntse.ssai.valahia.ro/>

<http://www.timefornano.eu>

Images taken during the activity





NANO TECHNOLOGY SCIENCE EDUCATION (NTSE)
Project No: 511787-LLP-1-2010-1-TR-KA3-KA3MP









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