Nano Technology for Science Education (NTSE)

Final Expert Report
(Final meeting, Istanbul, 13.11.2013)

Gabriel Gorghiu
Valahia University Targoviste, ROMANIA

1. **The process of Implementation was / is planned to be carried in schools (involving teachers / pupils) and university (involving university students, prospective teachers & PhD researchers).**

2. **Three schools (“*Vasile Carlova*” *School Targoviste, Gimnasium School Gura-Sutii, Balasa Doamna High School*) have been involved in the implementation process so far – implementations were made in April, May and June 2013).**

3. **6 teachers, 6 university experts & 75 pupils took part in the school test-implementation phase – from VIIth, VIIIth and IXth forms.**

1. **The subjects of implementations were:**
   i. ***Nanotechnology as Future Technology*** **that included parts from** ***NANOSCALE AND NANOTECHNOLOGY*** **Teaching material.**
   ii. ***Nanotechnology and Nanobiomimicry*** ***that included Virtual Lab clips:*** ***UNDERSTANDING NANOSCALE*** ***and*** ***LOTUS EFFECT*** **and related Teaching materials.**
   iii. ***Allotropes of Carbon. Are there any Buckyballs?*** ***that included Virtual Lab clips:*** ***UNDERSTANDING NANOSCALE*** ***and*** ***MAKING ORIGAMI BUCKYBALL*** **and related Teaching materials.**

1. **University students** (from ***Faculty of Science and Arts & Faculty of Environmental Engineering and Food Science***) - in the frame of Physics-Chemistry laboratory - have been involved in the implementation process so far (April / May 2013).

2. 2 university staff (project experts) & 45 students (second year of study) took part in the **university students test-implementation phase**.

3. The subject of implementations was: ***Nanoparticles / Nanomaterials – Small Things behind a Stunning World*** which lead students to explore the ***NTSE Virtual Lab*** and consult materials from ***NTSE Repository***.

1. **PhD students / researchers (from the *Engineering Doctoral School*) have been involved in the process of implementation, trying to emphasize on the importance of Nanoscience and Nanotechnology in current researches (October 2013).**

2. **2 university staff (project experts) & 8 PhD students took part in the researchers test-implementation phase.**

3. **The subject of implementations was: *Deposition of TiO_2 Nanoparticles on Optoelectronic Materials for Achieving Dye-Sensitized Solar Cells* which lead PhD students to explore the *NTSE Virtual Lab* (teaching materials related to *Iron Nanoparticles*), but also consult scientific materials from *NTSE Repository*.**

- The role of *local experts* in the process of the test-implementation:
  - organizing the process of implementation and assuring the necessary logistic (*designing the Lesson Plans* and *collaborating with promoters (teachers, university staff, PhD students)* for realizing *4 Case Studies* so far);
  - offering support *before* and *during* the designed activities (moderating the implementation process, leading the discussions, presenting scientific information);
  - disseminating the NTSE project and emphasizing on the importance of VL implementations in the education community and local mass-media.

- Presenting the implementation process in mass-media
  - http://www.gazetadambovitei.ro/educatie/308-altele/6875-elevii-targoviteni-viitori-pionieri-in-domeniul-nanotiinelor;

Elevii târgovişteni – viitori pionieri în domeniul Nanoştiinţelor

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ANTERIOR 4 of 4 URMĂTOR

Târgovişteа participă la proiectul internaţional Nano-Tech Science Education (NTSE) care îşi propune să folosească instrumentele TIC pentru a creşte nivelul de atractivitate şi accesibilitate a cunoştinţelor predate în cadrul lecţiilor de Ştiinţe.

Universitatea Valahia Târgovişte este partener în acest proiect cu instituţii din Turcia, Grecia, Bulgaria şi Italia. "Noi dorim să facem chimia, fizica şi biologia materii mai atractive, prin punerea în evidenţă a unor aplicaţii care valorizează cunoştinţele pe care elevii le învaţă, în aşa manieră în cât să le poată folosi în rezolvarea unor probleme din viaţa de zi cu zi", explică conf. univ. dr. Laura Gorghiu, prorector al universităţii şi coordonator de proiect. Grupurile ţintă sunt elevii de gimnaziu sau de liceu, cu vârste cuprinse între 13 şi 18 ani, profesori de Ştiinţe, studenţi şi masteranzi care frecventează programe de studiu din domeniul Ştiinţelor.

Laborator virtual pentru îmbunătăţirea lecţiilor de Ştiinţe

În principal, în cadrul proiectului, se realizează un Laborator Virtual care va cuprinde o serie de experimente virtuale, ce pot fi utilizate ca şi materiale didactice auxiliare în cadrul lecţiilor de Ştiinţe. Scopul proiectului NTSE este crearea unei noi direcţii în predarea Ştiinţelor prin intermediul TIC, creşterea nivelului de atractivitate a cunoştinţelor predate în cadrul Ştiinţelor pentru elevii cu vârste cuprinse între 13 şi 18 ani, precum şi introducerea noutăţilor ştiinţifice din domeniul Nanoştiinţelor şi Nanotehnologiilor, la nivelul profesorilor şi viitorilor profesori de Ştiinţe. Laboratorul Virtual va servi drept platformă pentru orele de Ştiinţe, sub forma unei colecţii de materiale didactice, în fapt un hub care cuprinde materiale grafice ajutătoare, simulări şi experimente din domeniul Nanotehnologiilor atrăgătoare pentru învăţarea Ştiinţelor.

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- Presenting the implementation process in mass-media (Columna TV): http://www.youtube.com/watch?v=A61fnmIUT8o;

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- Presenting the implementations in social-media:
  - https://www.facebook.com/NtseNanotechScienceEducation?fref=ts;

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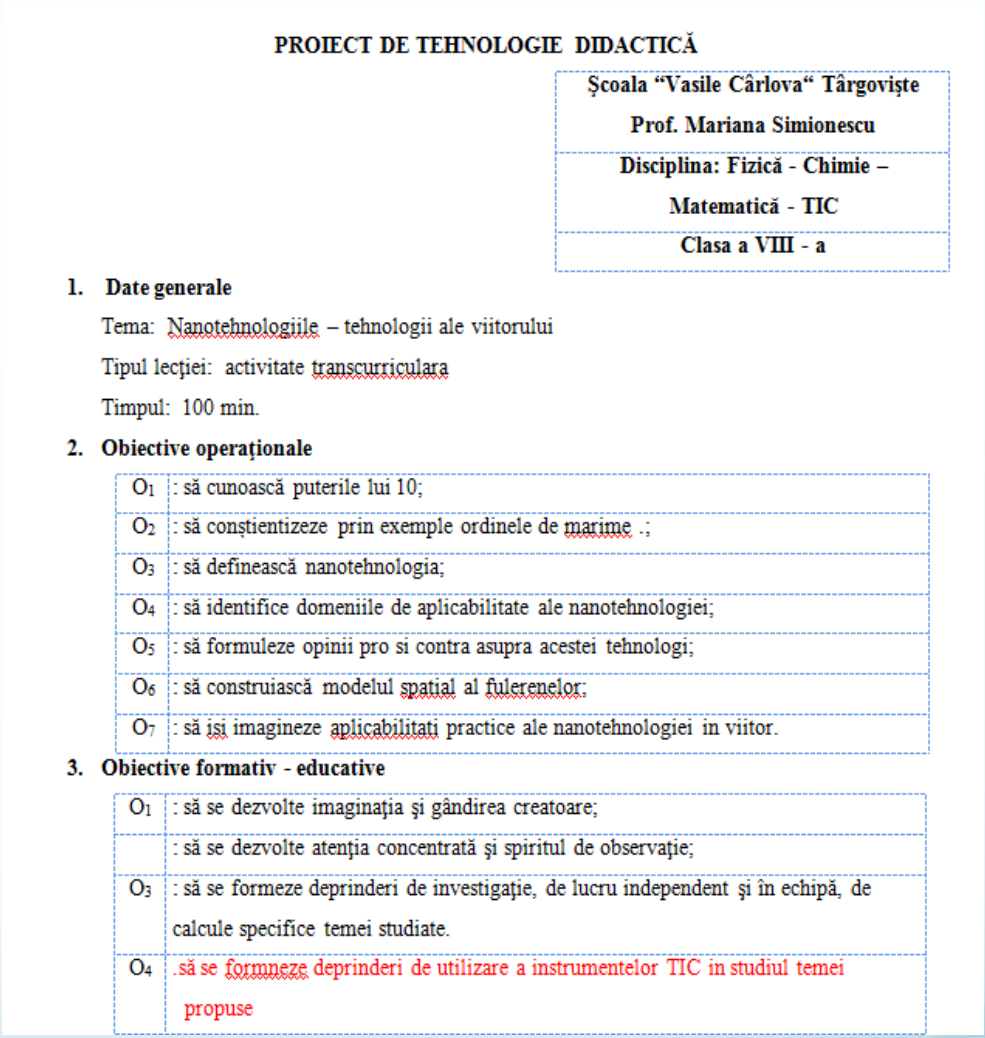
1. The process of Implementation will continue in the University involving Master students / Prospective teachers (approx. 25 Master students) in the final part of November 2013.

2. 3 university staff (2 associate professors and 1 professor) together with project experts (2), will take part in the test-implementation process.

- The role of *local experts* in the process of test-implementations organized in the University is oriented on:
  - organizing the process of implementation and assuring the necessary logistic (VL videos & repository materials, additional resources, materials for laboratory activities);
  - offering support in the developed activity (leading the discussions, presenting scientific information);
  - collaborating with master students / PhD researchers to meet their needs / requirements.

The school test-implementation *produced* three *lesson plans* – adapted according to the existed curricula which has no reference to Nanoscience and Nanotechnology.



PROIECT DE TEHNOLOGIE DIDACTICĂ

Școala "Vasile Cârlova" Târgoviște
Prof. Mariana Simionescu
Disciplina: Fizică - Chimie – Matematică - TIC
Clasa a VIII - a

1. **Date generale**

Tema: Nanotehnologiile – tehnologii ale viitorului

Tipul lecției: activitate transcurriculara

Timpul: 100 min.

2. **Obiective operaționale**

O_1	: să cunoască puterile lui 10;
O_2	: să conștientizeze prin exemple ordinele de marime .;
O_3	: să definească nanotehnologia;
O_4	: să identifice domeniile de aplicabilitate ale nanotehnologiei;
O_5	: să formuleze opinii pro si contra asupra acestei tehnologi;
O_6	: să construiască modelul spațial al fulerenelor;
O_7	: să isi imagineze aplicabilitati practice ale nanotehnologiei in viitor.

3. **Obiective formativ - educative**

O_1	: să se dezvolte imaginația și gândirea creatoare;
	: să se dezvolte atenția concentrată și spiritul de observație;
O_3	: să se formeze deprinderi de investigație, de lucru independent și în echipă, de calcule specifice temei studiate.
O_4	.să se formneze deprinderi de utilizare a instrumentelor TIC în studiul temei propuse

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Two *lesson plans* **were developed and implemented under the format of *Case Study*. Participant pupils were involved in specific activities related to the selected topics. In the end, the pupils expressed their feedback.**

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"Nature works to maximum achievement at minimum effort. We have much to learn."
(http://www.cbid.gatech.edu/univ_labs.html)

A CASE STUDY ON
NANOTECHNOLOGY AND NANOBIOMIMICRY
by
Carmen ANTONESCU, Bălaşa Doamna High School, Târgovişte, Romania

INTRODUCTION/BACKGROUND

Nanotechnology represents the study of the
Generally nanotechnology deals with structu
developing materials or devices within that s
extensions of conventional device physics, to
assembly, to developing new materials with
whether we can directly control matter on the

As a specific area, ***biomimicry*** or ***biomimetic***
systems, processes, and elements to emul
problems. The term *biomimicry* and *biomime*
mimesis, meaning to imitate. Similar terms in
Over the last 3.6 billion years, nature has gon
organisms, processes, and materials on plane
to new technologies created from biologica
nanoscale levels. Biomimetics is not a new id
both complex and simple problems through
engineering problems such as hydrophobicit
energy through the evolutionary mechanics o
The term *biomimicry* appeared as early as 19
Janine Benyus in her 1997 book *Biomimicry:*
the book as a "new science that studies natu
these designs and processes to solve huma
"Model, Measure, and Mentor" and emphasiz

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A CASE STUDY ON
ALLOTROPES OF CARBON. ARE THERE ANY BUCKYBALLS?
by
Nadia BĂDOIU, Gymnasium School, Gura-Şuţii, Romania

INTRODUCTION / BACKGROUND

Carbon (from Latin: carbo "coal") is the chemical element with symbol C and atomic number 6. As a member of group 14 on theperiodic table, it is nonmetallic and tetravalent — making four electrons available to form covalent chemical bonds. There are three naturally occurring isotopes, with ^{12}C and ^{13}C being stable, while ^{14}C is radioactive, decaying with a half-life of about 5,730 years. Carbon is one of the few elements known since antiquity.

There are several allotropes of carbon of which the best known are graphite, diamond, and amorphous carbon. The physical properties of carbon vary widely with the allotropic form. For example, diamond is highly transparent, while graphite is opaque and black. Diamond is the hardest naturally-occurring material known, while graphite is soft enough to form a streak on paper (hence its name, from the Greek word "γράφω" which means "to write"). Diamond has a very low electrical conductivity, while graphite is a very good conductor. Under normal conditions, diamond, carbon nanotube and graphene have the highest thermal conductivities ofall known materials.

All carbon allotropes are solids under normal conditions with graphite being the most thermodynamically stable form. They are chemically resistant and require high temperature to react even with oxygen. The most common oxidation state of carbon ininorganic compounds is +4, while +2 is found in carbon monoxide and other transition metal carbonyl complexes. The largest sources of inorganic carbon are limestones, dolomites and carbon dioxide, but significant quantities occur in organic deposits ofcoal, peat, oil and methane clathrates. Carbon forms more compounds than any other element, with almost ten million pure organic compounds described to date, which in turn are a tiny fraction of such compounds that are theoretically possible under standard conditions.

Carbon is the 15th most abundant element in the Earth's crust, and the fourth most abundant element in the universe by mass after hydrogen, helium, and oxygen. It is present in all known life forms, and in the human body carbon is the second most abundant element by mass (about 18.5%) after oxygen. This abundance, together with the unique diversity of organic compounds and their unusual polymer-forming ability at the temperatures commonly encountered on Earth, make this element the chemical.

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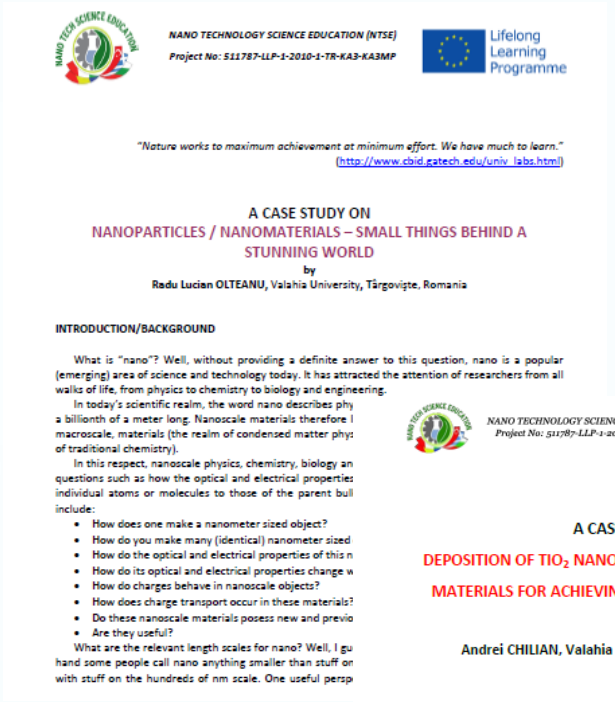
Other two *Case Studies* were developed in conjunction with the implementations with university students and PhD students / researchers. The feedback was also collected.



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A CASE STUDY ON
NANOPARTICLES / NANOMATERIALS – SMALL THINGS BEHIND A STUNNING WORLD
by
Radu Lucian OLTEANU, Valahia University, Târgoviște, Romania

INTRODUCTION/BACKGROUND

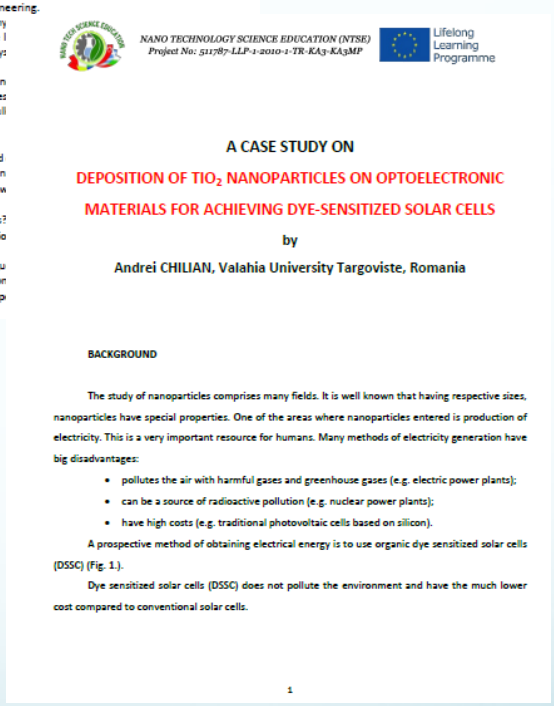
What is "nano"? Well, without providing a definite answer to this question, nano is a popular (emerging) area of science and technology today. It has attracted the attention of researchers from all walks of life, from physics to chemistry to biology and engineering.

In today's scientific realm, the word nano describes phy
a billionth of a meter long. Nanoscale materials therefore l
macroscale, materials (the realm of condensed matter phys
of traditional chemistry).

In this respect, nanoscale physics, chemistry, biology an
questions such as how the optical and electrical properties
individual atoms or molecules to those of the parent bull
include:

- How does one make a nanometer sized object?
- How do you make many (identical) nanometer sized
- How do the optical and electrical properties of this n
- How do its optical and electrical properties change w
- How do charges behave in nanoscale objects?
- How does charge transport occur in these materials?
- Do these nanoscale materials posess new and previo
- Are they useful?

What are the relevant length scales for nano? Well, I gu
hand some people call nano anything smaller than stuff or
with stuff on the hundreds of nm scale. One useful persp



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A CASE STUDY ON
DEPOSITION OF TiO_2 NANOPARTICLES ON OPTOELECTRONIC MATERIALS FOR ACHIEVING DYE-SENSITIZED SOLAR CELLS
by
Andrei CHILIAN, Valahia University Targoviste, Romania

BACKGROUND

The study of nanoparticles comprises many fields. It is well known that having respective sizes, nanoparticles have special properties. One of the areas where nanoparticles entered is production of electricity. This is a very important resource for humans. Many methods of electricity generation have big disadvantages:

- pollutes the air with harmful gases and greenhouse gases (e.g. electric power plants);
- can be a source of radioactive pollution (e.g. nuclear power plants);
- have high costs (e.g. traditional photovoltaic cells based on silicon).

A prospective method of obtaining electrical energy is to use organic dye sensitized solar cells (DSSC) (Fig. 1.).

Dye sensitized solar cells (DSSC) does not pollute the environment and have the much lower cost compared to conventional solar cells.

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- The teachers and university staff involved in the implementation process cooperated with the local experts. The collaboration was fruitful and the results of the implementations were positive;
- International cooperation through video conference were arranged for autumn 2013. University students are expected to participate in the last part of November (together with Turkey partner). At the same time, there is an intention for holding a videoconference with primary school pupils (together with the Italian partner) in the first week of December;

- Major difficulties in the test-implementation process:
  - Missing information / background related to Nanoscience and Nanotechnology in the Romanian school curricula. Just some additional resources are provided in the Physics and Chemistry manuals for pupils (most of the information provided in the test-implemented lessons was new);
  - Even the *Nano* area is well represented in the actual research priorities (national and international), few researchers / university staff are ready to work in this domain. At the same time, *Nano* high performance equipment (necessary for research) is absent from the research labs.

- Positive results from the test-implementation:
  - great interest expressed by pupils, students, PhD students / researchers;
  - understanding of the basic “Nano” concepts by using Virtual Lab resources, but also other resources;
  - enjoying the practical activity;
  - great interest for participating into discussions – emphasizing on new and original ideas;
  - Good opportunity for exploiting the multimedia resources included in the Repository.

Teachers' Feedback on the teaching materials according to the general pedagogical criteria

- Information – accurate and scientific oriented for the pupils' level, but few VL experiments match the curricula;
- Structure – feasible, but the teachers had to select only some activities, according to the actual curriculum for Physics and Chemistry;

Teachers' Feedback on the teaching materials according to the general pedagogical criteria

- Presentation & Design – pleasant, useful and easy to understand;
- Accuracy – good, in general.

5. Teachers' Feedback on the Virtual Laboratory:

- Good opportunity to be used instead of real experiments, especially where there is no specific "Nano place" (!) in the Physics and/or Chemistry School Laboratory.

THANK YOU!