



## **NTSE: Nano-Tech in Science Education**

Project number: **511787-LLP-1-2010-1-TR-KA3-KA3MP**

### **Project Exploitation Report**

#### **WP8 – Exploitation of Project results**

**December 2013**

#### **1. Preliminaries**

The process of *Exploitation of NTSE Project Results* has in view to widely make known the project results and good practices during and after the funding period. In this respect, the project partnership took into consideration two relevant Exploitation actions:

- *Mainstreaming* - by transferring the successful project results to educational stakeholders and decision-makers in each country, at local, regional and national levels;
- *Multiplication* - by engaging individual end-users to adopt / apply the best project results.

In the case of *NTSE Project*, the *Exploitation Work Package* has started in Month 17 (May 2012), with a partners' discussion held during the 4<sup>th</sup> *Transnational Coordination Meeting*, in Sinaia, Romania, as a first *Exploitation Session* which had as main topic how to guarantee the transfer of the project results in-time and beyond its life. In this respect, an *Exploitation Strategy* has been designed and agreed, taking into account the guidelines stipulated in the *Project Proposal*.



In the following *Transnational Coordination Meetings*, the partners discussed, analyzed and planned in details, several key-issues related to how to exploit the project results optimally, and offered solutions and implementations, according to:

- *Expectations* related to *exploitation of project results* and *NTSE issues* which should be transferred, adopted or applied;
- *Educational stakeholders* or *other actors* interested to proceed to use the *NTSE project results*;
- *Limits* and *barriers* that could appear in the process of *exploitation of NTSE project results*;
- *Related time-frame* associated with the process of *exploitation of NTSE project results*.

## **2. Exploitation strategy and specific Exploitation channels provided by the NTSE Project**

The *Exploitation strategy* took into consideration the following aspects:

- a) *measures* for exploitation of results during and beyond the lifetime of the project;
- b) *timing*;
- c) *target groups* (final end-users).

The *Strategy* clearly stipulated also that it was defined and carried out in a very close relation with the *Dissemination activities*, and in this respect, the exploitation results must be seen in a deeply correlation with the *Evaluation and Dissemination process*. More, the *Mainstreaming* and the *Multiplication actions* play an important role for further development of the project outputs and offer a real guarantee that the benefits of the project will endure beyond the lifetime of the project.



*The main channel for exploitation of project results* - as indicated in the Project proposal (page 102) - was/is offered by *the use of the NTSE Virtual Laboratory* (designed and set up in the frame of the project), as an *educational testing environment*, in-time but also beyond the lifetime of the project. Practically, beginning with the second half of the project, the *Virtual Laboratory* was introduced to the educational stakeholders and decision-makers in the frame of various seminars or through mass-media. More, the *NTSE Virtual Laboratory Guidelines Book* makes broadly known the *NTSE Virtual Laboratory* to the educational environment.

But first, the NTSE Project partners had as an important task to exploit the *Virtual Laboratory* in their own institution, within the existed *teaching programs*, planned *workshops* and/or *Science events*. More, the NTSE Project partners made efforts to encourage educational institutions / organizations and/or individual learners to apply the *Virtual Laboratory* in different educational settings.

*The other important channel for exploitation of project results* is represented by the *Nano-Tech Annual for Nano-Tech Readers* - a printed volume that records, highlights and illustrates the main results of the project, including also the main project facts and several statistics. The volume (printed in English version) is sent and dispatched to schools, directorates, public libraries, teacher training centers and research institutions. A special launching and presentation of the project (and of the volume) will be organized with the occasion of the *4<sup>th</sup> International Advances in Applied Physics and Materials Science Congress & Exhibition (APMAS 2014)* and *1<sup>st</sup> International Congress & Exhibition on Current Trends on Science Technology Education (SCITEED 2014)*, both of them being held on April 24<sup>th</sup>-27<sup>th</sup>, 2014 in Fethiye, Muğla, Turkey, and proposing special sections dedicated to *Nanoscience* and *Nanotechnology*.



As a clear *NTSE Exploitation Event*, it has to be mentioned that in the frame of the *1<sup>st</sup> International Congress & Exhibition on Current Trends on Science Technology Education (SCITEED 2014)*, a special *Workshop* dedicated to *Nanotechnology* will be organized: *1<sup>st</sup> Workshop on Nanotechnology in Everyday Life*. The workshop welcomes submissions covering aspects of using *Nanotechnology* in various areas relative to our everyday life (as below), but not limited just to those ones:

- *Nanotechnology in Medicine*
- *Nanotechnology in Food Preparation and Refrigeration*
- *Nanotechnology in Cosmetics and Skin Care*
- *Nanotechnology in Clothes and Related Accessories*
- *Nanotechnology in Computer Equipment*
- *Nanotechnology in Electronic Devices*
- *Nanotechnology in Photography and Film*
- *Nanotechnology in Renewable Energy*
- *Nanotechnology in the Treatment of Surfaces*
- *Nanotechnology in the Renewable Energy Area*
- *Nanotechnology in Robotics*
- *Nanotechnology Issues in Education*
- *Miscellaneous*

At the same time, the *Workshop Scientific Committee* is defined as the same one that supervised the *International Nano-Tech Science Education Congress (INT-NTSE)*, held on November 15<sup>th</sup>-16<sup>th</sup> 2013, in Avclar, Istanbul, being formed by active participants and members of NTSE project.



The project partnership intention is to make permanent the *Workshop on Nanotechnology in Everyday Life*, future editions being proposed to be organized in conjunction with important Conferences or Congresses.

A very successful NTSE project action and event was the *Nano Science Camp* (July 2013), hosted at “*The White Lagoon*”, Balchik, Bulgaria, between July 1<sup>st</sup>-6<sup>th</sup> 2013, where 25 teachers / experts from partner countries (Bulgaria, Greece, Italy, Romania and Turkey) and 45 secondary school students participated to *Nano* presentations, demonstrations, implementations, hands-on activities and cultural tours, including interactive sessions using the *NTSE Virtual Laboratory*. It is also in the intention of the project partnership to organize the *Nano Science Camp* yearly, by exploiting the NTSE project results (especially the *NTSE Virtual Laboratory*), after the end of the project. In this sense, two proposals for its organization have been already expressed (one from Turkish partner - DOGA, and one from Bulgarian partner - CCTA).

Beside the *Nano Science Camp*, another successful event was represented by the *Nano Poster Competition* for the students between 14 and 18 years old, having as main theme: *Nanoscience and Nanotechnology*. The competition was held in the countries participating in the NTSE project: Bulgaria, Greece, Italy, Romania and Turkey, and the winners were selected by an *international jury* at the 3<sup>rd</sup> *International Advances in Applied Physics and Materials Science Congress & Exhibition (APMAS 2013)*, in Antalya, Turkey. The NTSE project partnership express the willingness to exploit the success of this competition and to continue to organize another edition of the *Nano Poster Competition*, in order to encourage the young students to extend their knowledge and to meditate on the topic related to *Nanoscience and Nanotechnology*, by imaging different *Nano-applications* in various areas. Local winners from each country will be rewarded with the opportunity to participate in the *International Nano Science Camp*, in 2014.



A remarkable project result, with *a huge potential of exploitation on a large scale*, is offered by the realization and production of the *NTSE Nano Kit*, designed by *DOĞA* experts. The *NTSE Nano Kit* comprises of nine experiments similar to those ones included in the *NTSE Virtual Laboratory* that serves for *hands-on activities* related to *Nanoscience* and *Nanotechnology* and Science teaching. With the help of the materials provided in the *NTSE Nano Kit*, activities concerning *Nanoscale*, *Buckyball*, *Lotus Effect*, *Nanocrystals*, *Ferrofluids* and *Leds* can be taught to students. Thousands of young students (from *NTSE* project partner countries, but not only!) will benefit of *NTSE Nano Kit*, during the scholar activities, in the following years. The *NTSE Nano Kit* can be easier implemented in the Science curricula and offers sufficient strong points to be adopted by the Science teachers for practicing and developing *Nano* experiments in the classrooms.

*An important channel for exploitation of NTSE project results* is offered by the participation of project team-members to various national / international conferences, seminars, workshops which have *Nanoscience* and *Nanotechnology* as topic. Representatives from each partner country will participate and present the main results and outcomes of the project: *NTSE Virtual Laboratory*, *NTSE Virtual Laboratory Guidelines Book*, *Nano-Tech Annual for Nano-Tech Readers*, *Nano Poster Competition*, *Nano Science Camp*, *NTSE Case Studies Results* etc. One of the main objectives for participating to national / international conferences is to increase the impact of the project, to ensure the project sustainability and to create awareness related to the *NTSE* project within the scholar and academic actors, researchers, but also general public.

A clear result comes especially on continuing the *NTSE project activities* and exploiting them by *setting up of a new proposal*. In this respect, preliminary discussions with some European partners have been already established with the occasion of *IOSTE Eurasia Regional Symposium & Brokerage Event Horizon 2020 - EU Framework Programme for Research and Innovation* (October 30<sup>th</sup>-November 1<sup>st</sup> 2013, Antalya, Turkey), where the *NTSE - Nano-Tech in Science*



Education project was presented (*Nano-Tech Science Education - A European KA3-ICT Project that Promotes Science Education through Virtual Experimentation* – authors: Gabriel Gorghiu, Laura Monica Gorghiu, Mihai Bîzoi and Zuhail Yilmaz Dogan).

Last but not least, the *Exploitation of the NTSE project results* takes into account the on-line channels, being concretized in practice by the *NTSE project website* (<http://ntse-nanotech.eu/>). The website represents the mirror of the project which people can visit it and consult it for having a project overview, but also to use the project results. The website ensures the NTSE project sustainability and includes also the main events, even after the project ending.

### 3. Specific Exploitation results from NTSE project partners

The main results obtained in the frame of the *exploitation activities*, carried out by the *NTSE project partnership*, have been registered as follows:

- **UVT** was the partner institution which coordinated and monitored the *Exploitation Work Package* and reported its results.

As results, the *NTSE Virtual Laboratory* was integrated in specific training activities for 50 *Chemistry* students (Year I and III of studies) and *Physics* students (Year II of study), in the frame of disciplines: *Physical Chemistry, Colloidal Chemistry, Inorganic Chemistry, Organic Chemistry and Didactic of Chemistry/Physics*. During the disciplines laboratory/seminar activities, there have been exploited *teaching materials, multimedia features and resources (articles)* from the *NTSE Virtual Laboratory / Repository* related to: synthesis of nanoparticles, specific properties of nanoparticles, application of nanoparticles in different areas. Different topics have been



approached and discussed such as: physical and chemical methods for obtaining nanoparticles (*Nanocrystal Fabrication* materials), structure and properties of nanomaterials (*Making Origami Buckyball* and *Lotus Effect* materials), magnetic properties of magnetite (*Iron Nanoparticles and Ferro-fluids* and *Waves and Dancing Ferrofluid* materials).

At the same time, master students / prospective Science teachers - 30 Master students from *Physico-Chemical Methods of Analysis for Life and Environment Quality* specialization - studied specific properties of nano-fibers and nanotubes (using *Carbon Nanotubes* and *Waveguide Fabrication by Sol-Gel* materials from the *NTSE Virtual Laboratory / Repository*).

In addition, 25 students from the *Faculty of Electrical Engineering, Electronics and Information Technology* (Year III of study) were involved in analyzing the way of making the simulations and producing the movies included in the *NTSE Virtual Laboratory interactions: Nanocrystal Fabrication* and *Iron Nanoparticles and Ferro-fluids*).

Future teachers were also familiarized with the modelling and simulation concepts designed for educational purposes. In the actual education, the role of modelling and simulation in understanding dynamic processes is extended to secondary education. Computer modelling and simulation have an important potential to improve the quality, especially of the secondary Science education. In this respect, 35 students enrolled in the related studies proposed by the *Teacher Training Department* have been trained concerning the use of *NTSE Virtual Laboratory / Repository* in teaching and learning. *Movies, Interactions, Repository* and *Documents (Student's Guide, Teacher's Guide and Assessment Grids)* sub-sections were presented and debated as important issues that embrace and complete the *simulation concept*. As examples, the *Romanian Case Studies* were also introduced and explained.

All the presented results will be multiplied in the following university years. In addition, the *Nano Kit* was presented during the Seminars held with Science teachers, those ones being very interested to use the *Nano Kit* with the secondary students, in the classrooms.



UVT has also planned to exploit the *NTSE Virtual Laboratory Platform* and the *NTSE Virtual Laboratory Guidelines Book* in the frame of the meetings with Romanian Science teachers. In this sense, half-yearly meetings are foreseen to be organized with the occasion of the traditional Science teachers' methodological meetings, in which particular outcomes of the NTSE project (*Classroom implementations, Video-conference implementation sessions and Case Studies conclusions*) will be analyzed. In addition, the *Nano-Tech Annual for Nano-Tech Readers* - distributed to more than 250 Romanian educational actors - has the role to make known the NTSE project and its results, but also to increase the importance of *Nanoscience* and *Nanotechnology* in the formation of young students.

- **DOĞA** - the NTSE project coordinator - exploited the NTSE project results in several various national and international events (*Workshops and Webinars*), by organizing them to provide basic information on how to effectively use the *NTSE Virtual Laboratory* in the classroom for Science and Prospective Science teachers.

Created initially as a *Dissemination event*, the first edition of the *Webinar* provided an important exploitation feature, through *mainstreaming* - several educational stakeholders (Science teachers, students, master students, university staff) participating to the event ([www.ntse-nanotech.eu/webinar](http://www.ntse-nanotech.eu/webinar)). Within *Doğa Schools*, 131 Science teachers from secondary schools and 60 Physics, 48 Chemistry and 48 Biology teachers from high schools participated in the *Webinar*. During the first session of the *Webinar* (December, the 9<sup>th</sup> 2013), the NTSE project was presented, but also the basic information about Nanotechnology was provided to participants. More, during the second session of the *Webinar* (December, the 16<sup>th</sup> 2013), the *NTSE Virtual Laboratory* was presented and how it should be used and exploited, but also the *NTSE Nano Kit* was introduced and discussed.



The *European School Net* ([www.europeanschoolnet.org](http://www.europeanschoolnet.org)) supports the dissemination of the *Webinar* in order to be able to maximize the number of participants. In this sense, more on-line sessions are planned for the following period, after the ending of the project, in order to address over 100 Science teachers in Europe.

Having a big exploitation potential, the *NTSE Nano Kit* and the related 9 experiments provided by the *NTSE Virtual Laboratory* will be included in next years' Science curriculum, in *Doğa Schools*, starting from the lower secondary education level and expanding to other levels, gradually. It is estimated that during the *2014-2015 school year*, the *NTSE Nano Kit* and the *NTSE Virtual Laboratory* will be used by 4000 students from lower secondary and 3700 students from upper secondary schools.

As NTSE project coordinator, *Doğa* presented the project in Berlin, at *Online Educa 2013*, December 4<sup>th</sup>-6<sup>th</sup>, 2013, a three-days *International conference on technology supported learning & training*. The NTSE project and its outputs were presented during the event organized by *EACEA* within the main conference. It must be specified that proposed by *EACEA*, the NTSE project has been chosen to be included in the publication that includes project descriptions and outcomes of several KA3 projects from the period 2007-2011. The publication gathers the information related to coordinating organization, consortium and grant details and relevant pictures from the project activities, a paragraph describing the project and a part that introducing the project outcomes.

- **FONDAZIONE** exploited the project results and its specific steps in several meetings and events with teachers and educators. Since *Fondazione* had a Science Centre (for half of the length of the project), the section devoted to Nanoscience and Nanotechnology was the place where educators and teachers could experiment and received updated information related to the *NTSE* project, but not only. Apart the annual event for schools - *Smart Education and*



*Technology days*: 10-12 October 2012 and 9-11 October 2013 - in which thousands of teachers were informed about the project, being familiarized with some experiments from the *Virtual Laboratory*, other smaller events for teachers were held during the project's time span.

Since the burning of the Science Centre, the *Nanotechnology section* was also the place where the explainers (educators who deal with the school students and the general public) were trained every month and informed about the available virtual and real tools, and also on how to use them with the public. *NTSE Virtual Lab* was one of the selected topics and 35 educators attended to the training courses held in October 2012.

In February 2012, a special training course for science teachers (primary and secondary schools) was held at *Città della Scienza*, in cooperation with the *Italian Ministry for University and Research (MIUR)*. 25 teachers from all over Italy attended the course, and one of the lessons was about *Nanotechnology*, related to the use of the *Virtual Lab*. A similar course will be held in February 2014.

In March 2013 (8<sup>th</sup> and 15<sup>th</sup>), two special training courses with science teachers of secondary schools were held by Mr. Guglielmo Maglio (13 teachers and 8 teachers respectively attended the meetings), having the NTSE project issues as central information, but also things concerning how to apply for the Nano Poster Competition. Other meetings in 9 secondary schools of Naples were held by the staff of the Project to clarify the rules of the poster competition and to invite students to use the *Virtual Lab*.

Finally, it is estimated that the *Nano-Tech Annual for Nano-Tech readers* will be distributed to 30 Policy Makers and Managers, responsible for Local School Authorities and 50 selected teachers.

- **FORTH** undertakes to exploit the NTSE project results of: *NTSE Virtual Laboratory Platform*, *NTSE Virtual Laboratory Guidelines Book* and *Nano-Tech Annual for Nano-Tech Readers*.



It is foreseen that the *NTSE Virtual Laboratory Guidelines Book* was/is about to be distributed (in electronic format) to approx. 5000 Science teachers, in the context of Greece. This is to be achieved via *FORTH's* collaboration with the *Hellenic Institute of Educational Policy* (<http://www.iep.edu.gr/site/index.php/en>) which is the responsible Agency for curriculum development.

A *Workshop* entitled “*Teaching Nanoscience in Secondary Education*” will be organized during March 2014 in Heraklion, Crete, addressing Science teachers from the region of Crete. The *Workshop* will be supported by the local educational authorities and its main goal will be to integrate experiments from *NTSE Virtual Laboratory* into the curriculum and introduce the students to the new field of *Nanoscience*, but also exciting them about Science, in general.

In addition, the regional inspectors / consultants of Science Education in the fields of Physics, Chemistry and Biology will support the engagement of teachers in the *NTSE Virtual Laboratory*. A minimum of 300 teachers will participate in this task. The results of the *NTSE Virtual Laboratory* implementations will be conveyed to the regional inspectors and through a dedicated *Workshop* jointly organized between *FORTH* and the *Institution of Educational Policy (IEP)* - the *NTSE “messages”* will be conveyed to the *policy level*.

Finally, the *Nano-Tech Annual for Nano-Tech Readers* is distributed to a not less than 120 policy makers (approx. 100 inspectors and 20 curriculum development specialists of the *IEP*).

- **SIRMA** planned to exploit actively the NTSE project results of: *NTSE Virtual Laboratory Platform*, *NTSE Virtual Laboratory Guidelines Book* and *Nano-Tech Annual for Nano-Tech Readers*. The Bulgarian institution has already placed an *advertise banner* of the NTSE project on the *National Educational Web-Portal of the Ministry of Education* (<http://resursi.e-edu.bg>). This portal is being visited by several thousand people daily (teachers, students, MoE administrators and representatives of the regional inspectorates of education). This banner will



bring serious traffic to the *NTSE Virtual Laboratory* and hopefully the majority of the visitors will start returning to the *Virtual Lab* occasionally. This will greatly enhance the future exploitation and direct implementation of the *NTSE Virtual Laboratory* experiments and materials, in the everyday learning activities.

*Sirma Media* is acting as *Regional Training Agency* under the *Intel Teach* program for Bulgaria. Among *Sirma Media*, main responsibilities are the coordination of the senior and master trainers under the program, and the provisioning of useful examples of good educational practices that can be shared with the teachers during the training sessions. With all this in mind, *Sirma Media* plans to represent the *NTSE Virtual Laboratory* as useful tool for Science based lessons, especially with the following *Intel Teach* courses: *Project-based approaches*, *Inquiry based learning in the Science classroom*.

It is also planned that the *NTSE Virtual Laboratory Guidelines Book* will be distributed (in electronic format) to approx. 500 educational institutions across Bulgaria. This is to be achieved via *Sirma Media network* of active partners/clients.

In addition, the *Regional inspectors of education* and especially the *Science education experts* (covering the disciplines: Physics, Chemistry and Biology) will support the direct implementation of the *NTSE Virtual Laboratory* experiments and materials by the Science teachers, across the country. It is envisaged the inclusion of approximately 280-300 teachers from the 28 *Regional Inspectorates* in the country.

Finally, it is estimated that the *Nano-Tech Annual for Nano-Tech Readers* is distributed to approx. 30 policy makers, but also to educational NGO activists, young scientists and prospective teachers.



- **CCTA** exploited and plans to exploit the project results at different levels, as follows:

a) Exploitation of the project results in the frame of the *Nano Science Camp Event*:

CCTA is committed to have the *Nano Science Camp* as an annual event, beyond the project lifetime. CCTA had organized the *NTSE Nanocamp* in Balchik, Bulgaria, and up to early 2014 is planning the second edition of the *Nanocamp*, taking part in Kyustendul, Bulgaria, with the support of the Kyustendil Municipality. The Bulgarian *Nanocamp* team leaders and scientists had committed contribution for the second edition in 2014.

The *Nanocamp* is presented as science-camp, taking part in Bulgaria, open for any national or international team of participants from EU or partner countries. Every team participates on tuition basis, for every participant, as the cost of the team-leader (teacher) is covered by CCTA.

b) Exploitation by adding the NTSE activities to the general curriculum, at local level:

The *Sofia-city Regional Inspectorate of Education* is supporting four schools in Sofia City to freely experiment the integration of the NTSE activities in the general curriculum:

- 2<sup>nd</sup> English Language School “Thomas Jefferson”;
- 2 Comprehensive School “Acad. Emiliyan Stanev”;
- “John Atanassov” VET High School of Electronics;
- National VET school of precise equipment, electronics and optics “M.B. Lomonosov”.

All above-mentioned schools had taken part in all the project stages, starting with the questionnaires to teachers, up to the NTSE Congress in Istanbul, in November 2013. Videos of the recorded lessons are available in the *NTSE Virtual Lab - Podcasting Room*.

The curriculum integration is not time-limited result, since the involved teachers teach

c) Exploitation by involving the Bulgarian Academy of Sciences and the Technical University of Sofia, through participating in the Annual Nanotechnology conference:



CCTA participated in the 15<sup>th</sup> International Workshop on Nanoscience & Nanotechnology, where a special section was dedicated for illustrating the NTSE findings and results. In this respect, the CCTA team was invited to share the *Virtual Lab* learning materials to the conference organizers and audience.

d) Exploitation via the *FP7 Scientix 2* project:

CCTA had reached an agreement with the *Scientix project team*, in order to integrate the NTSE *Virtual Lab* activities in the *Scientix* database, and therefore to make it available to *more than 2000 registered members*, all *STEM* teachers from *EU28* and partner countries, *and* to add the NTSE Project in the *SCIENTIX project community* funded STEM-related projects, making so NTSE accessible via the *Scientix search engine*. By that way, the users will enter directly to the *NTSE Website* and *Virtual Lab*, redirected by the *Scientix* portal.

#### 4. Conclusions

Generally, through *Exploitation process*, the NTSE project outputs are available so that they become replicable and usable by others. From the partnership point of view, it is considered that the exploitation results lead to a qualitative process of ensuring the project sustainability and answer to the expectations proposed in the exploitation strategy. In this respect, the project partnership will make continuously efforts to promote the NTSE project results and outputs through different educational, professional, and school / academic networks of which the partners are members.



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