Executive summary:

The purpose of this report is to inform about the FP7 NANOYOU (Communicating NANOtechnology to European YOUth) project, funded under the EC contract ? 233433.

NANOYOU designs and undertakes a communication and outreach program in nanotechnology (NT) aimed at European youth. The project aimed to reach 11-18 year olds through school programs to take place in at least 20 EU Member States and Associated States. Additional programs aimed at young adults aged 19-25 offered in science centres. According to the initial plan the school programs planned to involve at least 400 schools and reach more than 25,000 students, and the science centres program is expected to reach an initial 4,000 young adults during NANOYOU and many more subsequently as more science centres adopt the program.

The report will represent a summary of project context and objectives, describe the main results, achievements, dissemination activities and project impact.

Project Context and Objectives:

The aim of NANOYOU is to undertake a well-designed communication and outreach program that:

- -Informs young people in most EU Member States and Associated States about nanotechnology.
- -Encourages their participation in dialogues about the ethical, legal and societal aspects (ELSA) of NT.

NANOYOU combines temporary exhibitions, innovative computer games, experiments and other online content, and workshops aimed at making participants aware of NT risks and benefits. Educationally, a key goal was to promote a dialogue. NANOYOU's content is balanced and up-to-date, and teacher training materials prepared to equip science teachers and other personnel to present the NANOYOU programs.
NANOYOU main goals:

- -NANOYOU project's main goal was to design and undertake a communication and outreach program in nanotechnology (NT) aimed at European youth.
- -NANOYOU project was addressing the target audience of "children and younger people". The project was tailored to the separate educational needs and capabilities of the 11-13, 14-18, and 19-25 year old age groups.
- -NANOYOU was focused on the three sub-areas of medicine, energy and the environment, and information and communication technology.
- -The communication plan provided information and increased knowledge and understanding of nanotechnology.
- -The communication plan encouraged young people's participation in dialogues about the ethical, legal and societal aspects (ELSA) of NT.
- -Outreach activities in schools were planned to involve at least 400 schools and reach more than 25,000 students in at least 20 countries.
- -Outreach activities in science centres were expected to reach an initial 4,000 young adults during NANOYOU and many more subsequently as more science centres adopt the program.

NANOYOU technical objectives:

- -To create tools and activities that will increase young people's basic understanding of nanotechnology and nanosciences, by providing scientifically accurate information through a set of virtual tools and face-to-face activities.
- -To create tools and activities for engaging young people in dialogue about the social, ethical and legal implications of NT, touching directly on applications and products that influence young people's daily life with their associated risks and opportunities.
- -To develop teacher training materials that will build on the capacity of teachers to educate, motivate and inspire young people about nanotechnology and its applications.
- -Organize outreach programs in approximately 400 schools situated in at least 20 Member States and/or Associate States.
- -Organize outreach program in science centres to engage young adults (19-25) with NT.
- -Organize evaluation of communication tools and activities developed during the project and assessment of the project's impact on the three target age groups.

All the above mentioned goals and technical objectives were fully achieved during the project.

Project Results:

NANOYOU project is divided into following work packages:

- Project Management - The main objectives of this work package are to set-up the management infrastructure, to provide technical and administrative assistance to coordinator and partners, to provide financial and contractual management of the consortium, to ensure execution of the project in conformity with the Commission contract and the Consortium Agreement, to negotiate any necessary changes to these agreements during the project, and to manage risk and perform contingency planning.
- Survey and requirement analysis - the main objectives of which are to survey young people's initial attitudes, concerns and expectations about NT and to ascertain and assess the educational needs and capabilities of the various age subgroups.
- Development of NT knowledge tools and activities - development of tools and activities that will show, explain and simplify both general NT knowledge as well as specific knowledge pertaining to the three sub-areas of medicine, energy and environment, and ICT.
- Development of dialogue related tools and activities - development of tools and activities designed to explore some of the ethical, legal and social aspects of NT applications, especially those related to the three chosen sub-areas. The tools and activities will help participants to be able to think about the benefits and risks of NT and to contribute to dialogues on NT policy issues.
- Development of teacher training materials - development and test of teacher training materials that will enable science teachers in schools to educate, motivate and inspire young people about nanotechnology and its applications.
- Outreach in schools - The main objective of this work package is to engage a critical mass of schools on the topic of nanotechnology and to support schools in the organisation of local events on nanotechnology.
- Outreach in science centres - The main objective is to engage young adults (19-25) and public at large in a serious dialogue with NT and ICT experts through a "bottom-up" methodology.
- Evaluation - The evaluation and validation of the tools/ programs/ training kits/ tests developed in the project frame as communication aids and evaluation of the project impact in informing children and younger people about NT and encouraging their participation in discussions about the topic.
- Dissemination and exploitation - Implementation of an ambitious dissemination of information about NANOYOU to a wide range of relevant stake- holders and to the public at large and development of a detailed plan for exploiting the tools and activities developed by NANOYOU for widespread implementation throughout Europe after the project is complete.

The purpose of the following section is to provide a summary of project results and achievements with regard to each work package activities.

Survey and requirements analysis

Work on survey and requirements analysis, had been finalised with the final report "report on the analysis of survey responses". This is based firstly on an exemplary literature review in the fields of nanotechnology and science communication. Secondly, it is based on empirical work carried out between June and November 2009 in several European countries and Israel. Empirical work included focus group discussions with young people in three age groups, expert interviews of different related fields, e.g. teachers and science communication experts, national context questionnaires - filled in by representatives of five countries, and a comprehensive online questionnaire, which was carried out in eight European languages and was filled in by 2.397 respondents.

It has to be considered that the open structure of the survey obviously attracted students via interested teachers. According to the size of the middle group and their education level, it is also obvious that our sample predominantly consists of students of senior classes. Furthermore, the sample is very much characterized by Austrian respondents who build the biggest part of the analysis. Nevertheless, the following generalised results were cross checked with focus groups results and expert opinions.

Knowledge

In general, young people at least have heard about "nano", but mostly they do not have a deep understanding. Their knowledge about NT is predominantly related to specific NT products. They can name different products and applications, but cannot give explanations of the technology behind. In answering the quiz they gained average results, they could answer half of the questions correctly. However, the interest for NT is bigger than the knowledge, and young people would like to know more about it in the future. Reaching out for young people with the topic of NT is related to interest, either by teachers or youths themselves.

On basis of the data at hand - although the sample sizes are not very big - no tendencies can be seen, that the area of living is decisive for knowledge about NT.

Sources of knowledge

School, TV and radio, movies and internet are the most important sources for information about NT for young people. The internet as source of knowledge is very attractive, because it allows for appealing designs. But as it is a pull rather than a push medium, information about NT doesn't happen coincidentally like in TV. Thus, youth have to be led to information about nanotechnology topic on the internet. In general, the elder group was more attracted by the internet. Young people wish to learn more at science centers and museums, at events and in seminars, courses and workshops, more than they do up to now. Seemingly, they want to gain more thorough information about NT. To attract interest of students, preliminary teachers' interest has to be attracted.

For the future, students still name school as an important source of knowledge about NT.

Interests

In general, young people of our sample showed a medium to high interest in science and technology. In any case their interest is higher than in other topics like for instance the field of politics which is consistently on the last position. Attracting and keeping the interest of the youth is a key factor. The interest is predominantly connected to products and their opportunities and development. Examples should be related to their daily life. The design is decisive. Furthermore interest relate to gender and age in terms of products and examples. Any practical information is preferred to theoretically. Answers in the questionnaire relating to the practical examples give a hint that young people are still very open to every kind of information given on NT and its applications.

Attitudes and expectations

In general, young people think that NT will improve our lives in future. They are mostly optimistic up to euphoric, but at the same time believe in risks and are aware of negative impact as well. For some of them nanotechnology products open infinite opportunities and future possibilities. Youths are aware of its big potential, but they do also have considerations and ask for information and control. The findings point out that information of young people in NT should also address possible risks and problems.

Communication

To provide basic information about nanotechnologies school could be an appropriate source of knowledge. Information has to be well balanced. These days the relevant subjects are chemistry and physics. The remaining question is what else could be related school subjects, who are the teachers and how to train them?

Most challenging for further material and activities is the matter of nanotechnology and its possible risks for environment and health, as the items used were too difficult for about a fifth of the participating people although they were seen as fascinating. Additionally there must be some extra example that makes social dilemmas more clear.

Raising young people's interest in nanotechnologies should be accompanied with the relevance for their future. This is a crucial point especially when considering the less social or educational encouragement of

females. Strengthen young women's interest in technology and especially in nanotechnology could work by relating the communication on nanotechnologies to their daily lives and interests.

Education materials development
Knowledge tools

A number of knowledge tools were developed in the frame of NANOYOU project, with the major aim to show, to explain and to simplify both general NT knowledge as well as specific knowledge pertaining to the three sub-areas of medicine, energy and environment, and ICT. The developed knowledge tools are:

- -The video, presentation and posters for introducing nanotechnologies
- -The virtual experiments
- -The NT time machine virtual game
- -The "What is NT?" workshop

The video, presentation and posters for introducing nanotechnologies:

A short video providing a general introduction to nanotechnologies and nanosciences, introducing NT as a new phase of technology exploiting nanoscale effects, and presenting specific fields of application was produced by University of Cambridge (UCAM) team after several weeks of extensive research including reading, interviews with Professor Welland and other nanoscientists in Cambridge.

The video was uploaded to the University of Cambridge Youtube channel where it will have received 100,000 hits by the end of this project.

The video was entered by UCAM, at its own expense as this was outside the remit of the project as a whole, into several science film festivals. These festivals were carefully selected to provide the best chance of being shown during the respective events. One was the Scinema film festival in Australia. It was awarded the prize for BEST SHORT FILM.

Another was the Goethe-Institut 6th Science Film Festival Thailand 2010. The film was chosen from 173 films submitted by 22 countries and was synchronised into Thai on receipt of a Beta SP tape from UCAM. This was enabling it to outreach to pupils, students and the general public in Thailand. In fact the video was then shown across Thailand, Indonesia and the Philippines.

Following a request from the project officer Matteo Bonazzi UCAM couriered copies of the DVD to the EC to enable the video to be shown at a meeting of the Cabinet. This presentation was a huge success and as a result the PO requested permission to upload it to the EC website and asked UCAM to supply the appropriate wording/caption. UCAM liaised with the EC Communication office and gave permission for the upload and agreed appropriate/legal wording.

On request, an international master version sent to an Italian schoolteacher who will translate the transcript into Italian and add Italian narration. International master versions of the video podcasts also sent to Krisztina Szakolczai of the Research Institute for Technical Physics and Materials Sciences (MFA) Hungarian National Technology Platform for Integrated Micro/Nanosystems (IMNTP) for use in a moving exhibition to be held at the EuroNanoForum 2011 to be held in Budapest, Hungary.

A DVD of the video was sent to Gene Bertrand for use in a moving exhibition assembled by the Discovery Center Continium in the Netherlands. The exhibition was to be displayed in 7 public venues across the southern Netherlands to raise awareness in Nanotechnology.

The video has been disseminated to most of the continents eg Europe, North America, Asia, Australasia. Beyond the end of the project it will continue to be accessible via the University of Cambridge Youtube channel.

NB: many of the hits to the Nanoyou portal have come from countries in these continents which are probably as a result of the video being shown there. The video has proved to be an excellent marketing tool.

In addition to the video 2 presentations, covering major aspects of NT and 4 posters, conveying information (textual and graphics) about nanotechnology and the three sub-areas, and their related risks and benefits were produced by UCAM.

One of the presentations entitled "the secrets of the nanoworld" and the other "Nanotechnology: benefits and risks to developing countries". Both are uploaded to the Nanoyou portal.

Hard copies of the posters were printed off at A0 size and used at various University of Cambridge outreach events including Physics at Work and the University of Cambridge Science Festivals. Soft copies were sent to Krisztina Szakolczai of the Research Institute for Technical Physics and Materials Sciences (MFA) Hungarian National Technology Platform for Integrated Micro/Nanosystems (IMNTP) for use in a moving exhibition to be held at the EuroNanoForum 2011 to be held in Budapest, Hungary.

All the developed materials are uploaded to the Nanoyou portal.

Virtual experiments

The aim of this task was the development of virtual experiments which will demonstrate the chosen sub-areas of NT and will be developed in two levels of difficulty and abstraction according to the two school age groups. They will present more concrete and simpler issues for the 11-13 age group and more abstract issues for the 14-18, according to their cognitive and emotional abilities.

One of the experiments was designed and developed by Barcelona Science Park (PCB) in two high and low versions and uploaded to the Nanoyou portal in January 2011.

UCAM had been in process of developing a script for a second virtual experiment in the ICT. This experiment was uploaded to the Nanoscience Centre website and linked to the Nanoyou portal at http://www.nanoscience.cam.ac.uk/images/stories/videos/virtual-experiment-final-007.swf

NB: there is a strong link to another EU (science) project called NABAB as this experiment is used as part of the NABAB project research in Cambridge. The virtual experiment will be mentioned in the final report of NABAB, this research project finished 31.03.11.

The NT time machine virtual game

The time machine virtual game enables the students to "travel in time" while investigating applications and products such as communication and energy solutions. Students can navigate back and forth to points in the past and the future. This voyage enables them to get acquainted with various solutions, which evolved through the years, to fulfil the communication and lighting needs. The game includes textual information as well as visual and dynamic elements produced as flashes. The information relates to the specific human needs from different periods of time. The flash animations demonstrate how each of the telecommunication or light products works. Throughout their voyage, students carry out interactions in which they receive immediate and meaningful feedback. Finally the students have to fill out an "e-portfolio" in which they compare between different solutions in relation to material, knowledge, scale and energy aspects of each solution

The time machine was designed at two levels suited to the target age groups and was used by schools participating both in class lessons and during the one-day program.

The NT work shop

The NT workshop includes various games which expose the students to different Nanotechnology concepts and applications. The Nano memory game consists of different sets of cards. Each set addresses a different Nano knowledge aspect (medicine, energy and environment, and ICT), the different sections of the game are:

1. Nano Terms and definitions - introducing basic terms and definitions of nano science and nano technology

2. Nano scale and Nano science -introducing visual elements representing scale, dimension and scientific elements
3. Nano applications Nano applications that serve as solutions to human needs
4. Nano Questions and Answers -Questions and answers related to general knowledge of Nanotechnology
5. The jigsaw puzzle card game consists of cards which describe different characteristics of materials at the nano scale and applications (products) based on these characteristics

The games were played in groups and offered an opportunity for students to discuss and understand the different terms and applications

ELSA tools

Another main objective of the Nanoyou project was to create tools and activities for engaging young people in dialogue about the societal implications of NT. The tools and activities that were developed introduce the ethical, social and legal aspects of NT, while dealing with applications and products that could influence young people's daily life. Each tool includes dilemmas presenting different NT solutions associated with risks and opportunities. These dilemmas are presented using different methods to generate dialogue, such as a role play workshop, web-based activities and contests presenting Nanothechnology applications.

The Role play work shop

The role play game presents dilemmas dealing with complex issues about policy, governance, and values concerning Nanotechnology. The games expose students to diverse stakeholders' perspectives in a learning environment that enables them to be active and share their opinion. This environment offers an opportunity for students to learn how to cope with decision making related to various social matters.

The dilemmas are represented by sets of cards. Each set includes the following:

- One page introducing a case study dealing with a specific nanotechnology product (either commercial or prototype)
- 4-5 cards representing different stake holders roles related to the same matter, explaining basic knowledge as well as their motivation for expressing certain opinions.

The dilemmas were tailored for two school age groups (11-13, 14-18). The Role play games took place in small groups. At the end of the lesson, each group presented a summary of its role play in front of the class for general discussion of the dilemma.

The virtual dilemmas

The Virtual dilemmas are presented as animations expressing the impacts of using nanotechnology in different matters.
Each animation demonstrates three aspects:

- A specific problem or a human need;
- A solution enabled by nanotechnology, referred to as a "Nano solution" problem which points out the benefits of nanotechnology;
- The possible effects of the solution that stresses out the risks that might occur;

At the end of the animation the students are presented with a dilemma that arises from the conflict between the benefits and the risks. The students are requested to relate to the dilemma expressing their opinion in a dialogue box. All responses are uploaded the NANOYOU portal allowing students to interact with each other.

ELSA Tools - Science Centre workshops

One of the main features of the NANOYOU project was to target young adults, aged from 19 to 25, through science centres activities. Indeed, science centres are focussing on informal education with great attention to public participation and engagement in science & society topics. Science centres develop both interactive exhibitions and participative workshops, involving scientists from the field concerned, but also social scientists, designers, artists and other stakeholders (NGOs, industries, local authorities, etc.). The 3 workshops designed for NANOYOU were all based on engaging young adults making things: filming future scenarios, taking pictures, debating with the public. More than just classical "learning-by-doing" activities, these 3 workshops were less focused on science education than on science communication and science representation. This fitted with the idea of the weight of imagination in the process of adoption of technology. This idea has been developed by Haddon (2003) in the framework known as the "domestication approach" which points out that "to adopt a technology, one needs to be able to imagine the use of that technology, appropriate it for one's own, and incorporate it into one's habits or practices" . This explains why the topic of usage has been so central in the science centres' work. Furthermore, these 3 workshops have been designed before the designing of the exhibition in order to take their outcomes into account for the writing of the exhibition scenario.

NT Daily environment investigation - renamed SITU afterwards

This workshop has been turned into a photo contest. Young participants were asked to take picture illustrating the following topic: "my intelligent environment". Youngsters were invited to portrait how nanotechnologies are becoming part of our lives and to discuss which could be the possible benefits and risks, in the particular field of nanotechnology and ICT. All pictures had to be documented by means of a dedicated form, making participants think about ELSA issues.

The jury selected 3 pictures according to the following criteria:

- Relevance with which the theme was addressed, the originality and the lucidity of the mise-en-scène of the intelligent environment;
- Consideration of scientific and technological trends;
- Consideration of ethical, social and legal risks and opportunities associated with the use of intelligent environments and which influence daily life directly;
- Artistic and creative quality.

All participants uploaded their photos and comments on the NANOYOU web portal.

Real sized NT experiment - renamed FUTU afterwards

The FUTU workshop has been turned into a video contest and a barcamp-like session. By "barcamp", science centres mean that participants are the main actors of the event (see more information on http://www.barcamp.org). This workshop ideally took place during a weekend in a small village, far from big cities and their agitation. Participants were asked to gather in team of three to design a future scenario on the theme of "Living a 2.0 city".

Participants worked day and night to transform their innovative storyboards into 3 minute videos. The youngsters were challenged to participate with interactive experiments, providing real-life experience with sensors and chips: "What does it feel like to be tracked in real time?" "What does it feel like to interact with a computer, using a motion pod instead of a mouse?"

Scientists involved in this workshop gave talk and resources on the following topics:

- What do we call "smart devices" and "intelligent environment";
- Master narratives about relationships with technology;
- How to design a future scenario.

The main objective of this workshop was not to draw new science-fiction stories but to design sound science based future users' scenario from the viewpoint of youngsters aged from 19 to 25. All videos then have been uploaded on the NANOYOU web portal.

This workshop was well tailored to fit with graduate schools expectations such as the Grenoble School of Architecture (ENSAG) or the National School of Design (ENSAD).

NT users' conference - renamed DITU afterwards

This workshop consisted of the animation of a public debate on the basis of the projection of the videos created in the FUTU workshops. The objective was to engage youngsters aged from 19 to 25 in a debate about likely uses (or misuses) of nanotechnologies and ICT in the near future. The debate has been prepared with a group of youngsters, already involved in the video workshop, and focused on their core values - that is to say freedom; personal relationships; sustainability; hacking and fun; art and culture versus productivity.

The workshop was structured around the projection of 3 series of videos followed by a vote of the audience for the best video and a discussion with invited experts (a philosopher, a scientist, an architect and a designer) and the public. At the end, viewpoints of youngsters are challenged with public opinions and experts comments.

NANOYOU Teachers training kit & experiments

The NANOYOU project has developed a comprehensive Teachers Training Kit in Nanotechnologies, a tool developed specifically for secondary school science teachers and students. The training kit aims at supporting teachers in gaining the fundamental knowledge required to successfully run the NANOYOU outreach program in their schools. Moreover, it aims to provide them with a lasting tool they can use for their school teaching to integrate nanoscience and nanotechnologies concepts in their teaching curricula, and as a resource for educators at large involved in nanotechnology communication. The NANOYOU Teacher Training Kit in Nanotechnologies has been extremely successful among teachers who used it, in particular its Experiments, and will soon be converted in an EC Publication.

The kit is composed of three Modules:

Module 1: this model covers Fundamental concepts in nanosciences and nanotechnologies, and is made of seven chapters. The aim of this module is to provide teachers with the fundamental background knowledge on nanoscience (including definitions), nanomaterials, fundamental "nano-effects", nano-fabrication and nano-characterization tools. The first module also covers fundamental concepts of Ethical, Legal and Social Aspects (ELSA) related to nanotechnologies, as well as some key Environmental, Safety and Health (EHS) issues, and provides ideas on how to bring those topics in class.

Module 2: this module covers the Applications of Nanotechnologies in three main theme areas: Medicine, Energy & Environment, and ICT (spread over four chapters). The second module provides concrete examples of commercial nanotechnology applications, as well as cutting-edge research in numerous application fields of nanotechnologies. Throughout Module 2, issues of ELSA and EHS are also highlighted, connected to specific applications.

Experiment Module: This module describes four laboratory experiments that teachers and students can perform in their school laboratory to see with their own eyes some interesting properties of nanomaterials. Each experiment exemplifies some concepts of Module 1 or Module 2. Each experiment includes several documents: teacher background resources (background reading, protocol, etc.), student background reading, student laboratory worksheet and Student synthesis procedures. All student documents, for each experiment, are translated in 12 languages. Some videos of these experiments are provided as well. The experiments cover fundamental concepts of nanoscience (Experiment A and B) and applications of nanotechnologies (C and D). Experiment A is very simple, and shows that we have many natural nanomaterials around us. In this experiment students learn how two very common materials, milk and gelatine, are indeed two of these. Experiment B investigates liquid crystals, an example of self-assembled molecules that are sensitive to external factors, such as temperature, and that change their assembly as a consequence of variations in these factors. Self-assembly is a fundamental concept of Nanoscience. In the third experiment, Experiment C, students investigate nanoparticles of gold and learn that their properties are very different from "conventional" gold and can have useful applications in medicine. In the last experiment, Experiment D,

students analyse some innovative materials that are highly water repellent, stain-resistant and require less cleaning thanks to their surface nano-engineering. Those materials have been developed using nature as an inspiration. The property students analyse is the superhydrophobic effect found in some leaves, such as the lotus leaf.

The experiments are available for two age groups, 11-13 years and 14-18 years. The version for the 11-13 years old is a simplified version of the one for the older age group, and has been developed to encourage young students to solve small problems and perform simple experiments; tips and teaching strategies are provided.

In addition to the three Modules, the kit includes also a list of references and further reading suggestions. All the NANOYOU Teachers Training Kit is licensed as Creative Commons Non-Commercial Share-Alike 3.0 (except for images that have copyright, clearly marked in the text). All the information, documents and supporting videos can be found online under the "Nano Lab" section of the nanoyou.eu website.

Outreach in schools and science centres
Nano-days and lesson modules in schools

During the first year of the project the following outreach activities took:

- Training meeting for 24 teachers took place in Brussels 28-29 January 2010. The training days in Brussels were a success and received very positive feedback from the teachers. A follow up of the face to face meeting is being carried out by virtual meetings between the NANOYOU partners and the teachers, using the illuminate platform.
- Blog has been set up to store teachers videos results and recommendations on the tools http://blog.eun.org/NANOYOU/. The blog is currently being linked to http://www.nanoyou.eu.
- Monthly online meetings have been performed with all the pilot schools since the training meeting at the end of January.
- Pilot schools have been implementing the project via the experiments, videos, games, etc with their students according to the schedule detailed in their NANOYOU plans.
- Pilot schools have been actively promoting NANOYOU among their peer schools, newsletters, local and national media.
- Teachers were invited to participate in a NANOYOU workshop in Brussels during e-Skills Week closing event 5 March.
- Second call for pilot schools has been launched.
- Announcements to register as a non pilot school have been placed in all EUN newsletters and in the NANOYOU.eu website
- In addition to work carried out by EUN UCAM has promoted the programme to its school contacts. UCAM has hosted a work experience school age pupil for one week and hosted a visit from local schools who were involved in an Art project organised by the UCAM Community Affairs department and the Wysing Art Centre called "What the future holds".
- UCAM took part in the "Physics at work" event which was 3 days of "Open days" held in September 2009. School age children of between 14-16 years were introduced to the world of Nanotechnology and information on the NANOYOU project was disseminated.
- In addition to the above tasks, CCSTI and EUN collaborated to develop a workshop concept for teaching and learning about Nano-ICT, targeting upper secondary school students, teachers and others interested in the future of ICT. It was based on the ELSA topics and dialogue approaches developed in other activities of the project and more specifically the workshops developed during the first year. The workshop was held on 5 March 2010 as part of Go Digital! the e-Skills Week Closing event. The workshop was run by CCSTI.

Teachers' training, Nanotechnology day at the Faculty of Education, University of Cambridge
21st January 2011

20 chemistry graduates who are novice teachers took part in a one day training event organised by Nanoyou in conjunction with the Nanoscience Centre, University of Cambridge. Dr James Bendall from the Cambridge centre introduced the research being done in Cambridge in this area. James gave each new

teachers a copy of the DVD Nano; The strange new world of Nanoscience to introduce the ideas to secondary school students.

Dr. Luisa Filipponi, Scientific coordinator at the Interdisciplinary Nanoscience Center (iNANO) at Aarhus University introduced the excellent practical activities in the Nanoyou teacher's guide.

New teachers using the card sort activity.

The new teachers are now using the ideas in schools. Faculty of Education technical staff have put together a practical kit which each student can use with students in their practicum schools. Furthermore two of the new teachers have chosen to use these materials as the context for their extended classroom based research project.

Elaine Wilson, Faculty of Education, University of Cambridge
Ew208@cam.a.cuk

The Barcelona Science Park has organised two teachers' training sessions within the context of the NANOYOU project, one that took place on the 12th of February and another one that took place on the 14th of July. More training sessions will be organised in the future and in fact one has already economical support to take place during next autumn.

Training session of the 12th of February at PCB

The session of the 12th of February was organised in collaboration with Luisa from iNANO. The head of the Nanotechnology Platform from the PCB, Alvaro Mata, participated giving an introduction to nanotechnologies and their applications and the part devoted to ELSA aspects was dynamised in collaboration with the ORT team (Yoel, Vered and Nira). The pilot school from Catalonia also participated in the session by sharing with the teachers their experience within the project and a moodle plataform they have created.

Around 40 teachers from all over Catalonia participated in the session; that is the capacity of the Open Lab where the session was carried out. However, there was a waiting list of teachers that expressed their interest in participating in future sessions.

Training session of the 14th of July at PCB

The training session of the 14th of July was organised in collaboration with the CDEC, a science learning centre belonging to the department of education of the Catalan government. Researchers of the PCB also participated in the introductory talk on nanotechnologies and leading the Lab activities.

Around 40 teachers from all over Catalonia participated in this session as well and like the previous time there was a waiting list of teacher interested in participating and that requested to participate in future sessions.

One of the distinguishing aspects of NANOYOU has been the organization of teacher training events around Europe, to disseminate the project and to train a large number of teachers on using the NANOYOU tools. The efforts made during the lifetime of the project to reach schools have been highly successful as at least 958 schools; 1,005 teachers; 1,238 classes and 35,825 students were reached through the various dissemination and outreach activities.

Workshops and exhibitions in science centres

In the following of the participative workshops (SITU, FUTU, DITU) CCSTI La Casemate designed an exhibition on the convergence between nanotechnology and information & communication technology (ICT) from the viewpoint of users. Entitled "Everyone connected", this exhibition took the visitor on a journey to discover micro and nanotechnologies, the motors of innovation in enterprises or in alternative spaces, and the history of the mobile phone, which stands as the symbol of our connected society. Many questions

punctuated this visit, designed as a survey in which experts and visitors could interact through video and hands-on activities.

The exhibition was divided in 5 sections:

1. The marketplace: focus on objects including nanoelectronics or based upon nanotechnology fabrication process. What already exist and is available on the market for European consumers? This section introduces the question of data property in the booming age of the mobile phone.
2. The motors of innovation: focus on new processes of industrial and technological innovation (open innovation) through the example of "the internet of things". This section introduces the question of intellectual property in open innovation processes and if open source could be a new economic model.
3. At the frontiers of research: focus on tomorrow's electronics beyond silicon and Moores'law (spintronics, photonics, molecular electronics). This section introduces the many ways of doing research at the nanoscale.
4. Challenges for society: focus on societal and environmental impacts of the high development of nanoelectronics. The section introduces the question of traceability and surveillance in our society, and the perspective of a more sustainable electronics.
5. Did someone say cyberculture? Focus on generational features regarding the use of nanoelectronics and new ICT; is "digital natives" meaningful? This section particularly relies upon the videos produced by young adults during the FUTU workshop sessions; it introduces also the pictures taken by young adults for the SITU photo contest.

Dissemination of the "Everyone connected" exhibition

The exhibition has been presented from October 2010 to March 2011 in La Casemate, Grenoble, where it has been visited by 4.800 people. Then, the exhibition moved to Paris, in La Cité des sciences, where it will be presented until April 2012. Around 200.000 visitors are expected there. In the same time, all the panels and videos of the "Everyone connected" exhibition have been integrated and "remixed" in an exhibition on Digital World in Cap Science, the Science centre in Bordeaux. 15.000 visitors are expected there from April to December 2011.

In addition, all digital contents of the exhibition have been put on a DVD. 500 copies of this DVD are available for dissemination. All contents are translated in 3 European languages (French, English, and Spanish). All files on the DVD are ready-to-use to make an exhibition (panels, press file and teacher guide are ready-to-print, videos are ready-to-broadcast, multimedia games are ready-to-implement). This DVD is sent for free under creative commons attribution, non-commercial and share alike licence.

Evaluation results

As mentioned above, NANOYOU has undertaken a tremendous range of activities addressing students and teachers in 20 countries with different languages, school types, structures of curricular and experiences with teaching nanotechnologies. In a very short period of time, tools had been developed by the project members and then implemented by the teachers in their classes. The development of NANOYOU tools and activities was based on previous findings from the student surveys and literature about knowledge, attitudes and interests of the students. A comprehensive survey was undertaken at the beginning of the project and after each stage of outreach an evaluation phase was conducted. Based on survey and evaluation results (Deliverable 7.3 and 7.4.) many coordination and balancing activities were undertaken in order to meet the needs of the target group.

Young people from 11 to 25 years took part in NANOUYOU outreach activities, the two younger groups foremost at school, the elder group through activities at science centres. The aim was to raise their interest in the realm of nanotechnologies and improve their knowledge about nanotechnology.

Outreach activities in two stages involved a core group of pilot schools across Europe and moreover reach wider circles of schools and teachers by disseminating of NANOYOU knowledge and materials.

Outreach activities for the elder group aimed at young people (at the age of 19-25) to raise their interest in the topic and to actively involve them in participatory activities.

Below you can find a sort summary of NANOYOU project evaluation results.

Changes in terms of knowledge

The NANOYOU outreach activities had an impact on students' knowledge about nanotechnologies. In general, students achieved rather good results in the knowledge quiz after NANOYOU teaching activities. Comparing the knowledge of students who did not experience NANOYOU outreach activities (non pilot schools, 1st survey) and the knowledge of students who experienced NANOYOU outreach activities (NANOYOU pilot school students of stage 1 and 2, 2nd and 3rd survey) clearly shows tendencies in increased awareness and knowledge. Students noticed a change in their knowledge concerning nanotechnologies before and after taking part in NANOYOU activities.

The provision of NANOYOU materials, the teacher training activities and the exclusive formats and their implementation in the school life contributes to raising awareness, knowledge and interest on nanotechnologies.

Assessment of instruments and formats

The NANOYOU consortium suggested various formats and developed a range of different tools to be used for teaching nanotechnology and running the NANOYOY outreach activities.

Formats

Especially those formats that allow for external contacts and activities (beyond school) are very appreciated by students, such as visits to a local nanotechnology laboratoryHalf day and full day activities are more positive appraised than singular lessons. Interactive as well as dynamic instruments are valued more. However, the integration of nanotechnologies communication and teaching activities in the existing curricula is difficult. The implementation of formats other than modular lessons and web activities require flexibility and adoptions within the school curricula and long term planning.

Flexible and modular structures allowing for cross disciplinary approach better support the activities suggested by NANOYU like hands on experiments, role play games etc.

Tools

In general most tools were assessed very well and achieved very positive results. The tools and material developed by NANOYOU did not cause any gender bias in the elder students group. Special attention has to be paid to the interests and capacities of the different age groups.

Interactive materials and materials that allow for innovative ways of learning are most appreciated.

In the following section there is a ranking of tools and their assessments.

Hands-on Laboratory Experiments

Experiments are the most successful instruments. Those experiments that are experienced during teacher training sessions are implemented more often. The interactivity and the possibility for trying and observing effects are appreciated. Experiments should be relevant to the daily life. Short videos demonstrating the experiments are very helpful for the teachers.

Video

The video is a very appreciated and convenient instrument. To be assessed very positively by both gender and age groups it is recommended to make available synchronisation or at least subtitles in the specific language and showing the video in parts together with additional or complementary information.

Virtual tools

The virtual tools in general were highly accepted by students and most of the teachers. Implementing virtual tools is highly related to teachers' habits and availabilities of infrastructurha at schools and at students' homes.

Virtual dilemma/dialogue

Real life examples work best, e.g. nanosocks were used mostly. They support ELSA discussions and they are attractive in terms of animations and illustrations. Life dialogues allowing for direct exchange between students or schools have been requested. In general it is more appropriate for elder students above 14 years. More applications especially relevant for the daily life of the youngest target group and examples of different fields of applications should be given.

Virtual experiment

In principle the students appreciate the computer game approach, but the usability and the challenge of the experiments have to be appropriate (according to age, internet connectivity and virtual experiences in general). Difficulties in usability may not overweigh the content.

Time machine

The time machine has the potential to embed nanotechnologies into wider contexts like technology development in general and also shows daily life applications, meaningful for the young target group. The advantage of this virtual tool is immediate interactivity and responsiveness of the tool and it's usage for self studying.

Roleplay game

The role play game initialises ELSA discussions and helps students to consider different stakeholder opinions. Teachers assess it as being more useful than students. It is more suitable for elder students and it needs time and additional information to prepare for the roles. Teachers from other disciplines could support the discussions.

Posters

Posters have to be clear and simple and give illustrations and general information. Posters in general tend to be more affirmative than informative, because posters are used to give messages rather than explanations. It seems that students are no longer familiar with the informative character of posters. For information they look for more interactive media like internet.

Jigsaw-Puzzle and Memory game

For those two instruments it can be confirmed that form and content have to be appropriate. Simple forms for younger groups require simplified content and more complex content asks for more sophisticated tools. The interactive part of the two formats has to be highlighted. Additional information (FAQ) should be provided.

ELSA - awareness and attitudes

After the outreach activities students' increased their awareness about nanotechnologies. No negative attitudes were developed within outreach activities. Students in general show much concern about ELSA and were able to consider pros and cons.

In principle students have rather positive attitudes concerning nanotechnologies but they are aware of risks and possible negative impact as well. Although there is a tendency among the students to support the further development of nanotechnologies they consider certain limitations as being necessary, in particular.
After taking part in NANOYOU activities students themselves estimate their knowledge and understanding of ELSA as sufficient.

Teachers training

NANOYOU undertook several teacher training activities face to face and online. Pre- and post questionnaires evaluated those activities. After the teacher trainings the teachers stated that they got new materials and new information for their teaching, they received a good briefing on nanotechnologies and gained more confidence for their own teaching. They increased theirs competences and knowledge concerning teaching NT and discussing ELSA. Teacher's trainings and teaching materials are key components. Not only the face to face trainings were highly accepted, also the additionally offered online courses were fully booked immediately and thus give evidence of a high demand for training by teachers. However, regular contact (e-mails, online communication platform, reminders) is necessary. After teacher training, teachers feel more confident and ready to integrate nanotechnologies in their lessons and act as multipliers for their colleagues.

School activities

In general NANOYOU pilot school teachers accepted and implemented the NANYOU materials to a wide extend. They conducted many activities in their pilot schools and beyond. NANOYOU initiated and set impulses for many new activities and initiatives that are still going on. Please see more details in the outreach implementation final report (D5.4). The concept of integrating pilot schools proofed to be very appropriate and was even more successful than expected.

Outreach activities in Science centres

Also the activities carried out in NANOYOU science centres attracted much interest. Activities ranged from workshops, conferences, art/science events to the travelling exhibition, which already moved from CENTRE CULTUREL SCIENTIFIQUE ET TECHNIQUE in Grenoble to ETABLISSEMENT PUBLIC DU PALAIS DE LA DECOUVERTE ET DE LA CITE DES SCIENCES ET DE L'INDUSTRIE in Paris.

Please see deliverable 5.4-Outreach implementation final report, for further information.

Portal

The NANOYOU Portal includes all the tools developed by NANOYOU & repository of existing tools. Materials are available in 12 different languages: English, French, Spanish, German, Italian, Catalan, Greek, Portuguese, Romanian, Slovak, Latvian and Lithuanian. Furthermore news, newsletter (723 subscribers), highlights (blog) and other resources can be found on the portal. The teacher blog achieved more than 200 entries and is available at http://blog.eun.org/nanoyou/. Also social media activities (including vimeo, youtube, flickR, slideshare) were widespread.

The number of visits in the portal has kept increasing steadily since its publication and at the present it's receiving between 15,000 and 20,000 visits per month and has been linked in more than 1000 pages of several kinds: education, partners, research centres, blogs, etc. It has received visits from more than 100 countries and many teachers visit it regularly and count on the NANOYOU resources to design some of their classroom activities. The total number of visits has been up to 163,388 visits.

Open issues

However, still some questions could not be solved yet. In future nano outreach activities some aspects should be considered:
How to organize a pan EU nano moderation?
How to integrate democratizing participatory processes?

How to reach those who don't come to science centers (including groups with concerns) and how to integrate them, also in EU policies?

Potential Impact:

The NANOYOU project was planned to inform and engage European youth about Nanotechnology (NT); the project succeeded in both objectives. The educational materials and outreach school program offered by the NANOYOU project, were received enthusiastically by students and teachers involved in the project. Teachers highlighted their satisfaction in having educational materials dealing with an exciting cutting-edge research, developed with a focus on applications, comprehensive and easy to use in class, yet flexible in format, adaptable to their class age and subject of teaching. The laboratory experiments were particularly appreciated, as clearly hands-on learning is a successful and effective way of engaging students. Another factor of success was the interdisciplinary approach on NANOYOU, which combined not only science topics like chemistry, biology, physics, but also humanistic subjects, like philosophy and history. The use of role play tools to discuss ethical, social, legal (ELSA) implications of nanotechnologies was also very successful. Students appreciated the possibility of critically discussing ELSA dilemmas and express their own opinion on these matters.

By analyzing the results of the knowledge quiz and the online questionnaire, we can state that the NANOYOU tools and activities had a meaningful impact on the specifiedtarget group including students and teachers.

Education materials development impact and future recommendations

The Impact on students' NT Knowledge

The NANOYOU project had a positive and effective impact on students concerning NT knowledge. The comparison between the responses to the knowledge-based quiz that students undertook at the beginning and at the end of the project shows higher scores after using NANOYOU-knowledge tools. It appears that the students knowledge had significantly changed from a starting point (before the project) of "never heard of nanoscience & nanotechnology" and confusing with the term "nano" used for different applications (Nano iPOD) to understanding "what makes nanomaterials "special", their new properties that have consequence on macroscopic world, and the new opportunities they offer in material science (for medicine, energy and ICT).

The Impact on students' attitudes and ELSA

Most of the students (85%) expressed positive attitudes concerning NT as they believe that nanotechnologies will improve our way of live. Generally speaking students were in favour of further developments of nanotechnology. They claimed that "it is worth paying the price for technological advancement". Yet they did stress out that it is important to put limitations as to how much and where nanotechnology should be used as they became aware of some risks that could affect our lives. Some students suggested using nanotechnologies for important applications such as improvements for medical treatments rather than inventions to make life easier. Students believe that nanotechnologies would help solve health problems but are concerned with unknown risks of small particles that might be harmful to the body or environment.

All in all students showed understanding of the complexity of Nanotechnology and learned that nanoscience is interdisciplinary (related to physics, chemistry, biology as well as ethics, social sciences etc). Discussing ELSA made the students realise that new technologies issues have controversial aspects and are not "black and white". They learned that innovation brings risk and we need to decide which risks we want to take while balancing risk and opportunity. Also they understood that innovation is a process and we need to learn from past success and unsuccessful stories.

They realized there are different aspects to consider and learned to critically think about them. Students learned that science is not just objective or impartial but also moved by interests.

In the teachers interviews they testified that by discussing different NT aspects students also gained general skills such as evaluating reliable information and expressing their ideas. They learned to listen and respect different point of views as well as to draw their own conclusions in regards to different aspects. Finally they report that students were able to form and defend their own opinion based on accurate facts while debating on Nanotechnology issues.

The Impact on teachers

Teachers felt that the NANOYOU project helped them integrate NT in school. The training sessions (which were offered to all pilot school teachers) were very successful in raising teachers' confidence in teaching NT, it helped them gaining additional information about NT to discuss with students and had a great influence on teachers understanding of fundamental NT concepts and ELSA issues. They realized how important it is to discuss NT using the dialogue tools. Teacher training was also important in raising teachers' confidence in using virtual knowledge and dialogue tools, such as the NT time machine, the virtual experiment and the virtual dialogues.

The success of the NANOYOU project can be summarized by the fact that teachers are ready to spend meaningful time on these activities in classes. . In one word, as one teacher put it, "NANOYOU was the initiator of a motor that will continue to run long after the NANOYOU project finishes". Numerous teachers that participated to the NANOYOU project expressed their interest in running some of the NANOYOU activities in the future with other classes, and in numerous cases they expressed their intention of inserting the topic in their curriculum, for instance adding some of the experiments as part of their laboratory chemistry activities. In some cases, such as in the school in Pavullo (Italy), teachers decided also to collaborate with the local university to create an accredited teacher training course in nanotechnology/ Teacher training was, as a matter of fact, a critical success factor in NANOYOU and some key recommendations are provided below for future actions.

Recommendations for material development:

The NANOYOU knowledge and ELSA tools were extremely successful. However, more knowledge and pedagogical based resources should be developed, for instance offering videos made by experts explaining their research. It is important to produce these audio visual materials in different languages to make them accessible for students from different countries. Educational material should be focused on applications of nanotechnologies that students can relate to, using real commercial products (or prototypes) as examples. In the NANOYOU project hands-on activities were extremely popular and more should be developed, offering a larger number of accessible practical experiments. Experiments should easy, fun, and focus on "nano-effects" that can "visible", also combined with real laboratory images, allowing students to see at the nanoscale. Enquire-based learning should be promoted, since it is an effective way of engaging students and promoting critical thinking.

More Interactive formats and dynamic instruments as computer based materials should also be developed, such as virtual simulations, where students can move atoms virtually (e.g., virtual STM), zoom-in simulations, and virtual experiments of real nanoscience laboratory experiments. These tools should give students the possibility to see the nanoscale world-albeit virtually- and have a deeper understanding of nanoscience research.

The computer-game base approach should also be increased involving memory games and puzzles, in which students can get acquainted with basic definitions and terms related to Nanotechnology.

Another requirement for future material development is an online platform where students can ask scientists questions in regards to nanotechnologies.

With regards to ELSA tools, more dilemmas should be developed for bringing ELSA in class. These tools are useful for presenting the "bigger picture of science". Dilemmas should focus on products young people can related to (such as electronic gadgets) and should focus on specific ELSA issues - having a good connection with daily life of young people. In general, an effort should be made to increase students' active participation in ELSA discussions, for instance asking them to choose a product/application, and think themselves on the dilemma this could pose.

Recommendations for teacher training:

In general, there is a need to allocate more resources and time for teacher's training. Training for a team of interdisciplinary teachers (part of the same school) should be considered. The training event should offer numerous hands-on activities and laboratory experiments that the teachers can then replicate at their schools. At the training teachers should receive extra resources for increasing their knowledge of nanotechnologies, and understanding of ELSA and EHS issues, as well as ideas for organizing lessons (in PowerPoint format) to introduce specific topics to the class. Teachers should be specifically trained to use the role-play activity (for discussing ELSA issues) and on the use of virtual dilemmas to increase their confidence using computerized tools. Performing a class simulation with the teachers is also recommended. Finally, teachers should be able to receive updated news about current research in nanotechnologies and new pedagogical approaches developed toward teaching nanoscience.

In many schools, NANOYOU was a driver for activities like: visits to local nanotechnology laboratories; teacher training in advanced physics topics; contact with industry to receive nanotech-products to test in school laboratory. Visiting local nanoscience laboratories was highly appreciated by students, as well as the collaboration with industry. It is suggested that a "network" of accessible research centres and local industries is created for each European country, to facilitate the school-university-industry collaboration.
Recommendations for curriculum implementation:

Science education in Europe at the secondary level is implemented differently in each country but one thing appears common: the number of students enrolling in science faculties, especially physics and chemistry, has been dropping in the last few years. The evaluation of the NANOYOU project highlights the interest and satisfaction from students in studying a cutting-edge research area, which is currently also a strong driver for industrial development in many EU countries. Teachers were also enthusiastic on the possibility of bringing innovation in their class rooms, and appreciated the interdisciplinary nature of nanotechnology, which allowed them to work collaboratively with teachers of different disciplines, including humanistic ones. All in all it appears that implementation of nanotechnology in school curricula will be advantageous for at least two reasons: it would provide school students with basic knowledge on this topic, raising their interest in this topic, possibly encouraging them in enrolling in science degrees; secondly, it provides an opportunity to rejuvenate science teaching in school, bringing innovation into the classroom, and encouraging critical thinking of technology developments through ELSA discussions.

In order to make it possible to keep on implementing Nanotechnology in schools, it is essential to take measures in integrating this subject matter into the science education.

It is suggested that a flexible module in Nanotechnology will be developed in order to be implemented in various formats, depending on national curriculum structures. This module will be taught as an integrated module in Chemistry, Biology and Physics at a matriculation level, in countries where these sciences are a part of the curricula. In other cases it could be offered as a summer course, an afternoon course or a weekly program .The Module would present an interdisciplinary approach while introducing the different aspects of Nanothecnology and could be offered as a stand-alone subject. The Elsa issues in regards to Nanothechnolgy could also be discussed in different subject matters such as Religious Education, Literature, English and ICT.

In order to succeed in integrating nanotechnology in classrooms, it is also essential to develop teachers' curriculum training modules for pre and in-service training as an accredited course.

Finally it is also suggested to develop a vocational nanotechnology program for the level of technician and practical engineers. This program will be tailored to match industrial needs in regards to nanotechnology professions.

Although the majority of partners agree, the University of Cambridge having consulted with its Faculty of Education is quite clear that this would not work in the UK and we remain and must be seen to be against this proposition. Please ensure that this position is reflected in the final report.

Outreach and Dissemination Impact and future recommendations

The portal

NANOYOU portal is available at http://www.nanoyou.eu

The number of visits in the portal has kept increasing steadily since its publication and at the present it's receiving between 15,000 and 20,000 visits per month. The portal is a unique repository of resources on nanotechnologies for education and has been linked in more than 1000 pages of several kinds: education, partners, research centres, blogs, etc. It has received visits from more than 100 countries and many teachers visit it regularly and count on the NANOYOU resources to design some of their classroom activities.

The portal needs to survive in order to keep providing these resources to the teachers and to people interested in nanotechnologies. It would be much better if apart from covering the maintenance there was an in-depth SEO and the possibility to keep adding resources; this would help the project spread even further.

Teachers' blog and teachers' community

The blog has proved to be a very attracting tool for visiting teachers as they can see some of the experiences that are being done in other schools and see the practical side of the project.

On the other side, the teachers' community is a very important tool to keep the teachers active and a place where they can communicate with each other, sharing experiences and helping each other in solving problems. This tool will be an essential support for the teachers once the NANOYOU team is not directly involved in the project anymore. We think that it would be really important to have someone to moderate it and dynamise it and to offer teachers some support, if not there is the risk that it just dies.

Teacher trainings

The best way to communicate teachers the potential of the tools developed by NANOYOU is to do it face to face. This gives the teachers the opportunity to interact amongst them and with partners that have developed the tool so if they have any doubt on the project or on some particular tools, it can be solved.

If the presentation is accompanied by a talk done by a researcher that can transmit his passion about the issue and by the opportunity to perform the experiments under the supervision of a researcher, like in the "teachers training sessions", the experience is even better. This gives the teachers the opportunity to interact with researchers and to ask all the questions they have regarding nanotechnologies, making them they feel more confident about teaching them in the classroom.

Also some guidance on how to use the dialogue games is appreciated by teachers, and the fact of playing with peers before implementing it in the class gives them the opportunity to experience themselves what the students will be doing.

If it's possible, it would be really good that the partners with the infrastructures keep organising teacher trainings in their institutions and to export this know how to other institutions so that teachers from different regions of Europe and Israel get the opportunity to attend some of these trainings.

Workshops for young people and exhibition

The exhibition has proved to be very successful in Grenoble and is now receiving quite a lot of visitors. It would be good for the exploitation of the project to potentiate that other institutions host it and that they accompany it by replicas of some of the workshops developed by CCSTI. The workshops really engaged youngsters with nanotechnologies and the resulting animations from the 48h video contest and the pictures from the picture contest are very attractive to young people and if replicated could nurture the NANOYOU portal with new contents while being a way of giving "voice" to the youngsters of different countries of Europe.

Evaluation and project impact

See more details in NANOYOU Del 7.6 - Report on the project's impact

The following recommendations represent a summary considering all important aspects in nanotechnologies communication to young people, predominantly at schools.

1. Pre-preparation

This phase should be dedicated to background studies on specific target groups, to learn more about their knowledge, previous experiences, interests and attitudes and to better address their specific needs.

2. Materials and media for young people

Outreach activities should look out for new communication channels. Media should be relevant for young people. This means participation in the development of media and of contents with different media, not only online or hands on activities, but also integrate such channels as research centres, science centres and museums, public libraries, also public space.

It needs teaching tools and guides (packages with guidelines fitting the instruments). Materials have to be dynamic and interactive. They should allow for inquiry based learning activities. Students could work out applications and consider the ELSA aspects by themselves. Hands on experiences allow for more engagement and thus better understanding. Materials like discussions and games and also „real"or virtual experiments are most appropriate.

3. Content

Content provided for communication activities should be relevant for young people, showing interesting concepts that are relevant to their everyday life. The use of day-to-day topics and examples are good starting points for the discussion.

Students should gain basic knowledge of NT (what is nano) in a simple way, understanding the complexity of nanotechnologies by supplying clear, short, easy to understand scientific concepts allowing for a knowledge based dialogue. The discussion should also contain current research processes and topics. To talk about current research is also a challenge for the future. e.g. to talk about ELSA. Instruments should concentrate not only on basic concepts but also on current research taking place.

Materials have to provide balanced information and have to be scientifically sound, based on correct science information. Discussions have to make clear different concepts and viewpoints about e.g. "scientific risk" and "perceived risk".

The focus on specific NT applications is much appreciated, using specific products, especially to discuss ELSA to avoid vague discussions and to allow better comprehension and integration in daily life aspects. Also the use of examples of previous innovations that the young people are already familiar with and that contain ELSA issues could be a starting point.

4. Moderation and training

How and by whom communication and outreach activities are undertaken? It needs open minded, highly motivated teachers or science communicators who are sufficiently prepared for the activities.

Teacher guidance and training therefore is a crucial pre-condition. Teacher trainings proved to work really well to communicate the project and to engage the educational community because they can see it in practice. Trainings could either be face to face or in form of webinars.

The provision of background information is required, predominantly about ELSA aspects and current research. Communicators have to become aware and sensitized about these issues to be prepared to address them effectively.

Communication activities need facilitation. Conducting games and discussions, and implementing an interactive dialogic approach, especially online, requires constant moderation.

5. ELSA

Ethical legal social aspects encompass all activities and might not be dealt with in an isolated way. ELSA discussions on nanotechnologies could be embedded in wider discussions on ethics and contribute to awareness raising on ethical issues in general or education in ethics could build the basics for nanotechnology debates on ELSA.

To be successful ELSA discussions should not be seen as add on, but inherent part of the outreach from the very beginning.

6. Basic conditions

Policies

To support NT communication (teaching) activities, the national level (ministries) has to be integrated. Amendments in school curricula ought to be undertaken, perhaps a new subject "nanotechnologies" should be developed or a better integration across subjects guaranteed to ensure the sustainability of nanotechnologies education. Changes require long term planning as well as readiness of relevant bodies.

Involving stakeholder groups

Further stakeholder groups have to be integrated in outreach and communication activities.

New links have to be set with NGOS and industry and nanotechnology companies from the private sector to bring knowledge to students on concrete applications of nanotechnology and type of careers available in nanotechnology sectors (organisation of school visits in companies...), but also support from private companies with nano-materials could be used for hands-on activities in classroom or other forms of sponsoring. Initiatives like NANOFUTURES initiative could be involved.

7. Process of methodology

Outreach and communication are not seen as a combination of single methods, but rather as a process that evolves over time and needs circular updates. Constant evaluation of activities to monitor and assess the process in terms of appropriateness and impact is needed.

It needs time and continuity, for multipliers as well as for participants to develop adequate knowledge and skills. Activities should also consider time to reading and learning about ELSA topic to be prepared for discussions.

NT curricula addressing ELSA have to be embedded in lifelong learning activities, because it means that you need to know how to learn, outside the school in open environment, like museums.

A network of multipliers, training nano educators and communicators is needed, the circuit of good trained nano-teachers should sustain.

Additional resources and time for nanotechnology education projects are required.

List of Websites:
Project website http://www.nanoyou.eu

Project coordinator
Mr. Yoel Rothschild (ORT Israel)
e-mail yoelrot@mapa.ort.org.il
tel: +972 3 6301320