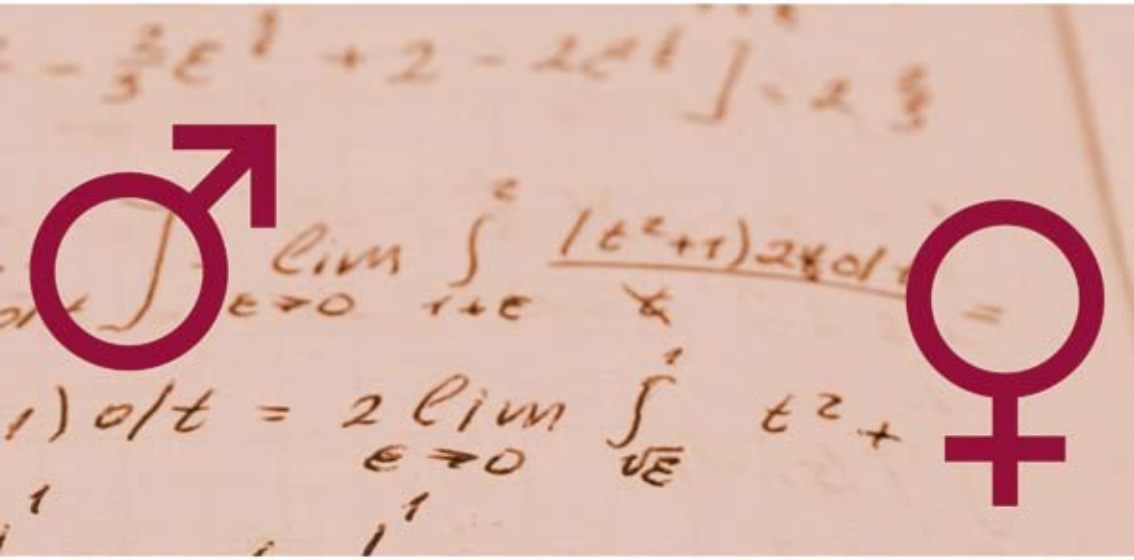
BRINGING YOUNG PEOPLE CLOSER TO SCIENCE AND TECHNOLOGY PROFESSIONS

A Gender Perspective in a Practical Handbook



GAPP - Gender Awareness Participation Process
www.gendergapp.eu

The partners

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Ciencia Viva,
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Amsterdam – The Netherlands

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Warsaw – Poland

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Introduction: the reason why and the addressees

This handbook is meant to illustrate some successful practices implemented to bring young people, especially girls, closer to science careers.

It is the result of a long research work on the public comprising young people aged 14-18, their parents, teachers and professionals working in the field of science and technology, followed by practical activities that the seven partners of the European project GAPP – Gender Awareness Participation Process have devised and implemented over two years.

Subsequent to the first phase of the project, the operators involved realised that the initial goal of favouring the choice of a scientific career among young people had to be replaced by the goal of making them aware of who the people working in S&T are and what they do, the first step needed to spur them to embark on this type of career.

Then, awareness-raising became the central goal, to be achieved through concrete practices, to be participatory and appealing to young people.

Based on a "philosophy of practice", as illustrated in the descriptions following this introduction, the six GAPP-involved countries developed a series of Pilot Activities. Each country devised and implemented different participatory projects, very various and rich in ideas on their future implementation. Thus, the result was a project with a real European scope, given the common goals and the range of propositions.

Our work was carried out in the framework of the science centres which contacted and collaborated with local schools; the result was the identification of new and viable methods to make science centres and schools work together, directly involving the world of research.

This handbook is addressed to all the science communicators that need some concrete ideas to disseminate the good and bad

of being S&T professionals. Hence, its addressees are science centres and museums, teachers and science educators, researchers in the educational field, but also researchers in scientific and technological disciplines interested in communicating their work, European officers for Education, University mentors, policy makers, women associations.

The beneficiaries of this handbook are the students of the schools where these activities were and will be implemented again.

The purpose of this handbook is to provide good ideas to bring two distant worlds, young people and S&T careers, closer in a practical way. The reader shall have the task of adapting the activities to their interlocutors and of adjusting them to their needs.

All the information about the project and the results of its different phases in the participating countries, as well as this handbook, are available in the website www.gendergapp.eu.

Pilot activities: instructions for use

In the GAPP project, Pilot Activities are implemented to integrate the learning process at school with practical activities that provide students with an insight about "what is behind a scientific career", in terms of meaning, models and diversity of professions connected to science and technology. Therefore, the involvement of school teachers, students and professionals in S&T underlies all the activities.

Pilot Activities consist in activities which spur young people towards a scientific interdisciplinary view, more capable to meet the complexity of the contemporary world, explaining how science and technology are connected to their everyday life, and giving them a modern vision of science, on the one hand, while exploring the gender gap in science and technology professions. The result starts from the scientific interests of young people for developing hands-on activities, workshops, visits, laboratory activities in different institutions, in order to create a connection between what they studied and the real world.

Each pilot activity features an active meeting of young people with researchers in the field of S&T.

Pilot activities are described here starting from their goals, through the description of their implementation, up to a list of the material sources needed to develop their potential and meet possible difficulties.

At the end of each report you will find some useful contacts if you wish to further deal with this theme and to repeat the experience at your own institution.

The duration of the activities was variable. However their planning since the start of the school year is desirable.

Further details on the activities and their evaluation are available at www.gendergapp.eu in the section "Results".

Working in scientific and technological laboratories

Background

On the basis of the need to make young people aware on what science and technology professions are, Pilot Activities were aimed at: connecting the schools with the world of the research; building a direct contact between researchers and students; new opportunities for students to understand scientific data processing in the business world.

The core of the activities was a series of visits of the students involved in 9 laboratories, where the researchers have welcomed them, explained their activity, their everyday life, along with the understanding of specific scientific disciplines.

These activities were created and implemented by Fondazione IDIS-Città della Scienza of Naples.

Targets

- About 340 students aged 14-18 (17 classes of high schools).
- 15 teachers in the fields of mathematics, physics and science (6 males and 9 females).
- 14 researchers (9 females and 5 males) of whom 6 physicists (2 females and 4 males), 1 chemist (female), 1 biologist (female), 3 geologists (2 females and 1 males) and 3 engineers (female) from 9 scientific and technological Institutions in the Naples area.

Duration

- 5 months.

Activity step by step

The organisation of the activities started with meetings between teachers and IDIS staff, and between the researchers and IDIS staff. The teachers emphasised the didactic value of practical activities in the laboratories on scientific and technological subjects connected to scientific and technological topicality, real life and work. Researchers also agreed on these remarks and they proposed activities on basic physics, nanotechnology, seismic risks, nanoelectronics, and the environment: quality of air, the composite materials, biochemistry, and volcanic risks, to be held in the university laboratories and in the research centres.

The activity chosen was a practical activity in the research laboratories on scientific and technological subjects connected with scientific and technological topicality, real life and work.

Each activity was divided in two main steps:

- the first one was a practical educational activity in the scientific laboratory of the research Institute involved;
- the second one was a meeting with the scientist to discuss directly with him/her the topic of the research, the new applications in the future and to understand the curricula needed to pursue the same career.

All the activities were terminated at the end of the fifth month with a plenary meeting of all participants (with a smaller number of students), where they discussed the experimentation implemented and the future development of further significant activities to be included in school curricula and in Universities as vocational guidance for students.

The follow-up

The meeting was an opportunity for some relevant suggestions:

- to extend the project to a three-year cycle, so as to allow students to meet researchers from different disciplines;

- this implies: a co-ordination of the initiative with the establishment of the panel of Centres of research/Universities, researchers, teachers/students activities, to be put forward to schools; the first year will see brief meetings, diversified with various institutions in the world of research; the thorough study of a topic chosen in laboratories (3 days at the laboratory); a period of work (16 days in two months) in the research institute in the second year of study; contact with the researchers during the last year in order to deepen and devise the brief thesis students have to draw up for the final year exam;
- other activities suggested are: students visiting the academic environment, meetings with university students, visits to places where research takes place with the guidance of researchers, practical activities in the laboratory;
- a more efficient communication and exchange of information between the researchers and the teachers before carrying out the activities is desirable to make the students understand better the meaning of the activity.

Resources

- Human resources, as from the *targets* described above.

Strong points

- The success of the activities is based on the participation of the students in the life of the researchers, implemented through a visit to their workplaces and a direct contact with them, at the same time offering teachers the chance to link this activity with their school programmes.

Weak points and possible improvements

- Timing: students would have liked to have more meetings and to add activities in the field.
- There were difficulties in the rigidity of the universities as places where the activities would develop, because the laboratories are really small and cannot contain such a big number of students (about 20) at the same time, two of the 9 centres did not offer the availability of their structures so that researchers went to the schools taking with them the instrumentation of the laboratory and carrying out the experiments in the classes.

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The scientist's blog

Background

This activity aims at bringing students closer to researchers, by giving a more real image of scientists, their work and career in an informal atmosphere achieved through a blog communication modality. The idea underlying this activity is that the current image of scientists belongs to an old-fashioned stereotype, seeing them predominantly as males that live in labs, use a white scientist smock, wear glasses, have a moustache and their hair is always tousled. Do the people who work in research really look like this? How do they spend their days? These were the questions which lay the foundation of the blog devised and implemented by the Pavilhão do Conhecimento-Ciência Viva of Lisbon.

Targets

- 220 students (aged 16-18) from 9 different high schools.
- 10 teachers from different subjects (such as Philosophy, Physics and Chemistry, Biology and Geology).
- 5 scientific institutions and 1 university.

Duration

- 5 months.

Activity step by step

The scientist's blog activity promotes communication between students and scientists. Scientists contributed to this blog in three major areas: work, career and personal areas. The activity also

offered a visit to their institutions and laboratories, providing the students with a direct contact with the work done in the institutions by scientists and other researchers.

Students had the task to develop the blog by asking questions, making suggestions and expressing their opinions about certain issues chosen by them or by the scientist; and to involve their families, for instance choosing questions to be asked to scientists.

Teachers had the task to stimulate and support students during the development of the blog; to stimulate students to involve their families participating in the blog; and, during eight classes, to dedicate some time to the blog.

First step – months 1/3

The first step was the creation of the blog: in order to find a functional blog editor, as far as administration and usage were concerned, a search on blog editors was performed and Nucleus was chosen. After choosing the blog editor, it was necessary to publish it, that is, to choose a server to physically allocate the software and to make the editor itself available. After some technical considerations, it was decided to associate the blog to Ciência Viva domain. New tests were made to evaluate the internal and external editor's performance. The blog started being designed from an attractive point of view.

After everything seemed to be correctly functioning, it started the training to the people who would directly or indirectly be using the blog. So, a mini-manual was created with the explanation of all basic functions, such as: how to create a new item in the blog, how to introduce links for external sites, among some other useful information on editing the blog.

During the conception of the blog's structure and its contents, it was decided to build a main page with links to the blogs of each institution.

All this period of time included: selection of the blog editor, installation and evaluation in a test server, in order to exclude editors that were not interesting, selection of the host server, in-

stallation and configuration of the blog editor, accessibility performance evaluation, graphic layouts, contact with schools and researchers, users and administrators training, creation of the blog structure, accessibility and permissions.

Second step – months 2/4

Researchers and teachers were contacted. The characterization of the students was collected and some technical problems related to the blog were solved.

Third step – months 4/5

The activity lasted for 4 weeks and it ended in the 5th month with the visit at the scientists laboratories. As far as planning is concerned, the role played by the teachers in activating and coordinating the students was fundamental.

Resources

- A blog editor, a server.

Strong points

- For the students: the chance to chat with researchers about their work and careers, to ask some questions and to enjoy the question-answer system used by the researchers.
- For the teachers: a new instrument, either for the use of the blog communication modality and the visit to the lab.
- For the scientists: to build a better perception about their profession and to show to the young people the possibilities of future careers.

Weak points and possible improvements

- Recruitment.
- Operating problems occurred as schools had difficulties on accessing the blog (i.e. old software in the schools, little knowledge of these programmes).
- In order to have a richer exchange between students and scientists the visit should take place before the blog activity.

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Science students as role models

Background

The aim of this activity is to present students and parents with role models, so as to make them aware of what a science and technology profession implies.

The Pilot Activity has been carried out at the Experimentarium science centre in Copenhagen, in collaboration with a UU centre, a governmentally-financed Danish institution responsible for the educational guidance of pupils from the 6th through 10th grade (compulsory education period, children aged 12 to 16). The idea behind the collaboration between the Experimentarium science centre and the UU centre is partly to gain credibility with regards to parents and children during the activity, and partly to integrate the activity into the UU centre's activities to thereby further the development of an economically viable activity.

Targets

- 248 students aged 14 (116 girls, 132 boys, 7 schools).
- 207 parents (110 mothers, 97 fathers).
- 16 teachers.
- 7 guidance counsellors.

Duration

- 5 months.

Activity step by step

The activity envisages meetings at school featuring students and parents with experts from the science centre Experimentarium.

The class visits imply a small group of Experimentarium's young students-teachers (called *pilots*) visiting the classes. All of these pilots have been studying different 5-year scientific curricula. Therefore, the visits give both pupils and parents a chance to be face to face with someone who is studying and has chosen science as a career.

The visits start with the Experimentarium's pilots introducing themselves and their studies. Following this, pupils and parents work together in three workshops:

Picture lottery

In this workshop, the groups have to match game pieces with people possessing various types of education. Among the game pieces there are young and old, famous as well as unknown people. The message is that scientific studies can open doors to a wide variety of work which corresponds to the varying types of people, enrolling in the different scientific educational institutes.

Free fall

In this workshop, by the use of very few means, the groups have to construct a device which can protect an egg, so that it can drop for about a meter without breaking. The message here is that it takes a combination of several different skills to implement such a task, and that some of these skills might not normally be associated with science. This corresponds very well to how many scientific work processes are carried out.

Everything in its own place

In this workshop the group has to divide a selection of everyday products into groups that correspond to the particular types of education lying 'behind' the products. The message is that if you want to make a difference in the world and develop things that everyone can appreciate, a scientific education might just be the way to do it.

Resources

- Pilots (explainers from the science centre).
- Pictures, eggs, everyday products.

Strong points

- To make youngsters think on S&T professions together with their parents.

Weak points

- Recruitment of active and willing participants among teachers.

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Meeting the (female) scientist

Background

This Pilot activity envisaged the organisation of four meetings and discussions with female scientists and secondary school students and were run by the Royal Belgian Institute of Natural Sciences in Brussels.

The RBINS main hypothesis was that if scientists and students had the opportunity to have an exchange and experience the daily work of a researcher, young people would integrate female role models and would gain a better understanding of what it actually means to be a scientist. Meeting scientists who are women and sometimes mothers could have an impact on girls who otherwise would not have chosen a career in S&T, thinking that it would not allow them to lead a career and a family/social life at the same time.

Targets involved

- 44 students aged 15-18, from 4 high school classes.
- 5 science teachers.
- 3 female scientists from RBINS.

Duration

- 3 months.

Activity step by step

Four pilot-activity meetings between scientists and students were organised: three of these meetings took place at the Mu-

seum of the RBINS, while the fourth one took place in a school classroom. Differently from the first one, the latter saw the presence of three scientists at the same time. Moreover, it was less focussed on the scientists' subject of study than the other meetings.

The first step was the recruitment of schools, through the contacts existing between RBINS and local schools.

At the Museum

On the day of the meeting, students and their teacher were received by our GAPP reporter at the entrance of the Museum. The scientist joined the group and guided the participants into the Museum were she practices her discipline. There, she talked for approximately one hour about her work. This presentation was followed by about one-hour explanation of the scientist's job in her lab, demonstrating the functioning of the instruments and materials (bones, skulls, computers). By the end of each meeting the person in charge of the activity allowed some question-answer exchange between the pupils and the scientist about her career and training.

In the classroom

The students were welcomed in their class by the GAPP reporter. They were told they were going to meet three scientists available to talk to them about their jobs and careers and to answer their questions. They did not know the scientific fields that were to be represented and did not know that only women scientists were to participate. Each scientist had taken with her some scientific material (objects, maps) that could represent her discipline. One after another, they showed these objects to students who had to guess what their work was. Once the job was made clear, the students and the scientist launched a discussion about the reasons behind this career choice, the daily work, lasting approximately 15 minutes. Afterwards, the second scientist repeated the activity for

more than 15 minutes and then the third one did the same. Once the three scientists had been presented, the GAPP reporter introduced more specifically the gender issue providing food for thought with some questions about the advantages/disadvantages of being a female scientist, the reason why there are fewer women than men. An open discussion followed on the subject.

Resources

- Scientists work tools.

Strong points

- Discovering S&T jobs through practice and the experience of real-life professionals may act in favour of the promotion of these careers.
- Students had to re-think some of the prejudiced ideas they had on these jobs: whereas the meetings confirmed that scientists love their work, students also discovered human beings not very different from them. This discovery may have some consequences on the mystification surrounding the job and, to a bigger extent, demystify the world of sciences itself.

Weak points

- A single meeting with the female scientists is apparently not enough: students have shown the need to know other careers in science, which can be tackled by planning further meetings with female scientists of different disciplines.
- A final reward or giveaway material for the students and teachers should be considered.

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Tube Your Future

Background

The aim of this activity is to have students actively constructing an image of what it is like to work in the field of science and technology by interviewing and filming professionals in S&T. It was created and performed by the science center NEMO in Amsterdam.

Starting points were the following:

- Pupils aged 14-18 have a limited idea about what kind of professions can be found in the world of S&T. What does a biomechanical engineer or a physical geographer do all day?
- Pupils, especially female pupils, lack positive role models working in the field of science and technology.
- Parents play an important role with regard to study and career choices of their children.
- New media are a good way to communicate with children.

Tube Your Future focuses on giving pupils a more complete image of the world of science and technology and offering an opportunity to meet professionals working in this field. By filming and interviewing professionals, pupils create their own image of the kind of work science and technology involves. Pupils are not offered a ready-made film. They ask questions following their own interests and prejudices. This gives them a chance to form a realistic idea about what kind of people work in science and technology.

Targets

- Around 300 students aged 12-16 (7 schools with 10 classes).
- 22 teachers.
- A list of 50 professionals, either women or men, in the field of S&T was provided to the students, by NEMO personal

networks, VHTO and Jet-NeT (see "Activity step by step" below).

Duration

- 5 months.

Activity step by step

The *Tube Your Future* Pilot Activity is a video contest that challenges pupils to interview and film professionals in the field of science and technology.

In order to carry out the activity, science center NEMO built a partnership of 5 members: Bètapartners (network of secondary schools, universities and organisations for the promotion of scientific studies), Jet-Net (Youth and Technology Network, a network between schools and technological companies), NIBG (The Dutch Institute for Image and Sound), Platform Bèta Techniek, VHTO (the national expert organisation on gender and science and technology).

First step – month 1

Started with a presentation in the periodical Bètapartners meeting.

The search for professionals started. The *Tube Your Future* webpage was created (www.tubeyourfuture.nl) and the writing of the student and teacher manuals on how to carry out the activity started.

Second step –months 2-3

The pupils participated in two *Tube Your Future* workshops. The first one 'Filming and Editing' was given by the NIBG (see above). Pupils had to make a complete television news program, each

cooperating group of five taking care of one item. For this they were provided with rough filming material to edit and a camera and microphone to film a self-made interview. The second workshop 'interviewing technique' was given in the classroom. The workshop consisted of several role plays in which the basic mistakes made in interviewing were highlighted.

Around the half of the 3rd month each school was provided with a list of professionals that had previously given their availability to be interviewed and filmed, contacted previously by NEMO. The organisation of the final award gala started.

Third step: month 4-5

The pupils started filming and editing in groups of five. Most of the groups were made up of boys or girls only, as requested by NEMO. Sometimes class organisation did not allow exclusively single-sex groups. During the interview each group member had its own task; the interviewer, the interview assistant, the director, the

camera and sound (wo)man and the producer. The film, that had a maximum length of 4 minutes, could be uploaded on a special NEMO channel on YouTube.

Over the fifth month the glamorous award gala took place in science center NEMO. All participating pupils, teachers, professionals and partners were invited.

The gala started at 2 pm and the pupils and their teachers were welcomed by a red carpet and bubbles, lemonade for the pupils and *prosecco* wine for the teachers. The crowd was warmed up with a science quiz. Afterwards, the pupils followed a programme which included watching films by other pupils, short meetings with professionals and having a brief pause during which they were allowed to walk around the science center. All the films where shown in a random sequence order at NEMO's cinema. Each student watched the films for twenty minutes. In the short meeting sessions, professionals in the field of science and technology chatted with groups of five to ten pupils about their work. Each session lasted ten minutes, each student had the opportunity to talk to two professionals. Boys and girls were separated. Most of the professionals were ladies.

Finally it was time for the award ceremony. Firstly the members of the jury were introduced. Secondly the eight nominees were announced. The makers of the nominated films had to get up and stand next to the stage, while a rap group of three participating pupils entertained the public. After this performance the jury started to give out the awards: The Golden Hammerhead for best technique, The Golden Lama for the most original film and The Golden Giraffe for the best film. Winning pupils posed happily for the camera with their awards and their newly-won iPods.

Resources

- Trainers (interviewing and filming).
- Cameras and computers.
- Location for the award gala (show of the students' films, speed dating sessions with (female) professionals, refreshments, music, quiz show).

Strong points

- Youngsters create their own images of S&T professions, without adult biases, through a very creative activity as is filming.
- The production of a film and the final gala contribute to identity building.

Weak points and possible improvements

- In order to organize and realize the activity, a high budget, as well as a suitable equipment, is requested. On this side, a partnership with several other adequate institutions makes it feasible and successful.
- Given the different and rich steps of the process, this is a time-spending activity.

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Movies and lessons

Background

The aim of this activity was to strengthen the interest of young people, especially girls, in both the work and the life of scientists, and the cooperation with teachers having the purpose of broadening their knowledge on contemporary science, prospective possibilities of being a scientist. This was done along with the active participation in the process of disproving youth stereotypes on scientists and science. The activity unfolded with various phases: training for scientists to raise awareness among them on the issue of scientific careers for youth and in a gender perspective, some meetings between teachers and scientists in their research centres and a film shown in the classes which saw the experimentation on the life of two young scientists, a man and a woman. The activity was devised and implemented by the Youth Research Centre in the Institute of Applied Social Sciences at the University of Warsaw.

Targets

- 320 students aged 13-15.
- 13 science teachers.
- 4 scientists (3 chemists and 1 physicist, 2 women and 2 men).

Duration

- 5 months.

Activity step by step

Two kinds of educational activities were carried out. The first one was to activate teachers on the grounds of creative work and cooperation with youth. The second one envisaged a discussion implemented directly in schools by the teachers taking part in the project using the methods, issues and topics identified during the first activity. The teachers could also use one (or two) short movie(s) on young scientists, their work and life. As part of the PA, the teachers were trained by the Youth Research Centre in the Institute of Applied Social Sciences at the University of Warsaw, The Copernicus Science Centre and Partners Poland Foundation. During the visits in scientific centres the teachers could enter and meet scientists working at The Institute of Organic Chemistry and the Institute of Nuclear Physics of the Polish Academy of Science, as well as the Institute of Aviation.

First step – months 1/2

This first phase saw the conceptual work on the detailed implementation of the PA in Poland and talks with institutions and experts working on educational projects in the field of science popularisation and gender equality.

Second phase – month 2

The plot for the script of the movie featuring young scientists talking about their scientific work and private life was prepared. Scientific institutions were contacted and, through initial talks, the first choice among young scientists was made. 12 potential young candidates were chosen for the film, out of which 4 people were finally involved, two pairs of young scientists dealing with physics and chemistry. Then scenes were shot and the movie was edited in its final version. The movies were produced by professionals constantly cooperating with public television.

Third phase – month 3/5

The invitations were sent out with the cooperation of the Education Department of the Warsaw Municipality to over 200 schools. On the first day, teachers were to be introduced to the GAPP background and took part in visits to research institutes during which they could ask their own questions to scientists about working in science and how it is to be a scientist. The programme of the second training day included a debate, presentations and workshops. The teachers discussed their own vision of science, their understanding of science, possibilities to work in science and the reasons for the difference in the interest in hard sciences between girls and boys. Then they watched the movies with young scientists, and set up some groups to get prepared for different tasks, exercises and topics applicable during the discussion on science. The teachers prepared individual lesson scenarios involving discussion with students, which were later evaluated by the team of experts and, after necessary changes, approved for implementation.

All of them followed a similar blueprint: discussion and presentation of personal views on scientists, their professional and private life (frequently the aim was to produce some drawings, drama performances etc.), presentation of the movie "Young scientists

on themselves and on science", lesson/debate on the movie, stereotypes in the perception of scientists and their work, place of women and young people in science, etc.

A possible extension of the project may be the production of a website containing all the material needed by teachers to carry out lessons on scientific themes.

Recommendations for a successful result of the activity are: work in teams comprising 5 people at most (everybody has an individual task), give a limited number of tasks and allow more time for presentations and discussions and give homework: presentations on science and inventions, application of projection techniques as drawings and drama, present biographies of women scientists and young specialists.

Resources

- Trainers.
- Films on (female) scientists.
- Screening of films in classes.

Strong points

- It is a simple tool enabling the active participation of students and teachers to understand the chances offered by the scientific work in the field of hard and technical sciences.
- The film to be screened in classrooms is available for free, but it requires some dubbing expenses (it was filmed in the Polish language).
- It shows teachers contemporary science; gives them direct possibility of personal contact with scientists and arouses their interest; engages them in the active preparation of teaching techniques; helps them to transfers their interest to students during discussions-lessons organized at schools on the basis of individually prepared scripts; shows them how

engagement in science can help to rise the interest and motivation of young people in hard sciences and technical subjects.

Weak points and possible improvements

- Recruitment of active and willing participants among teachers.
- A suggestion for a further improvement is the creation of other movie productions presenting young scientists, women and men working in other scientific and technological areas.

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Tips crossing the Pilot Activities

Despite the variety in the Pilot Activities, there are some common points, both in the most successful elements and in the difficulties arisen during the implementation, which is worthwhile to highlight for the readers willing to experiment them.

The key element in the success of all the activities is the contact between the young people and the world of research. All the targets of the activities have maintained that the most positive element in their experience was the encounter with scientists and their workplace. This confirms the importance of the evidence achieved in the phases prior to the Pilot Activities implementation: the poor knowledge young people have on the identity of the people working in S&T and on what they do.

Therefore, the reasons for this success and the change in the image of S&T, as well as in the image of those working in the sector, are confirmed by the most recent studies on the world of the young people and science[1]: the perception of science at school is very different from the one of the science in the "outer world". Also the first phase of the GAPP project confirmed that whereas science at school is seen as boring and "far away", other science communication forms are more positive and appealing. The "outer world" science, however, still is a quite unknown and usually regarded as a myth.

This is why, quite importantly, an effort has to be made to make those two images coincide, matching the two realities: during the Pilot Activities, the students asked for a better contact, when not provided, through practical exercises and experiments, aside from meeting scientists and researchers and listening to their accounts.

The idea underlying all of the six Pilot Activities is the contact between two worlds apart. A further element marking them is

[1] See for example ROSE (*The Relevance of Science Education*, www.ils.uio.no/english/rose) and M.C. Brandi et al., *Youth and Science in Italy: between enthusiasm and indifference*, in Jcom 4(2), June 2005.

the participation level from boys and girls alike, not only as far as the attendance to the activities is concerned. A key point is how the six partners have built a contact between students and researchers, how they revealed the world of research to the students. The strategies ranged from an extremely active role played by the young people in activities where this active role of theirs emerges later on: from the *Tube your future* experience, which implied a total independence of the students in the responsibility of selecting, contacting and interviewing the researchers, to the training provided by the teachers and the projection of ready-made films for the students by the *Movies and lessons* project.

Concerning the focus on the gender, an evident result of the activities is the total gender equality in the participation of the young people, as demonstrated by their belief that they all have an equal potential. Moreover, the project has confirmed all the results from the statistics at European level which reveal that girls are more inclined to study biomedical sciences, whereas boys are more interested in technologies. On the other hand, the interviews carried out during the evaluation of the Pilot Activities reveal that it is researchers that mostly express differences in the way men and women work; everybody agrees on the fact that potentially anyone can become a scientist.

The strong and weak points of the activities cross the following areas.

Media and participation

Participation is spurred by placing on the students the responsibility to participate actively in the experimentation. Examples include the filmed interviews of *Tube your future*, the questions asked by young people during the meetings in laboratories, museums, classes (*Meeting a (female) scientist*, *Working in scientific and technological laboratories*, *Movies and lessons*) or the blog (The scientist's blog). Here the medium does not only build the message, but it also determines the participation of the actors

involved in the activities. The more interactive, and innovative it is, the more boys and girls feel free. The positive effects of the "highly self-managed" means (the blog and film-making for example) are a high degree of participation and responsibility awareness among the young people. The negative effects concern the high probability of abandonment of the participants, who have the responsibility of implementing the activity (the blog in the first place).

In this context, anyway, team work was highly appreciated both by students and teachers, also including parents when there was an active participation by them.

The high level of participation in the activities and their appreciation is a strong point for the entire project and all the six activities developed.

Weak points in the implementation of the participation showed up only when the organization was weak as regards the timing and the difficulty in recruiting the participants.

Content

A very positive result for all the partners is a substantial change in the image of the S&T professions among the youth, and sometimes among teachers and parents as well. Boys and girls usually associate them with school subjects as physics and maths, without having a real awareness on the multidisciplinary work needed in those professions. Moreover, very frequently, young people associate those jobs to particularly intelligent and serious people, which highly discourages them to pursue a scientific career. After the Pilot Activities, the vast majority of the students changed their perception of a scientist.

Although very different to one another, all the experimented activities have achieved this goal, debunking the myth of the image of scientists, who managed to come down their ivory tower.

Organization

This is the factor showing the highest number of weak points, especially as regards the timing.

Generally, the different activities show the need to contact schools since the start of the school year, so that teachers can establish their programmes in a more precise way and school contents can be better integrated with the participatory activities offered by science centres. Many activities have proved costly in terms of time spent at school and outside for the students, but also for teachers and parents. This is why you need to spread the most demanding activities over many months in the year (*The scientist's blog*, *Tube your future*).

On other occasions, it was proved that a single meeting is not enough to achieve the goals of the project (the *Meeting the (female) scientist* and the *Science students as role models* activities).

An effective organization, also in terms of space (i.e. the laboratories where the visits were implemented were often too small to host a large number of students), demonstrates a higher ef-

fectiveness in participation. The most positive examples are those in which an informal atmosphere was created, different from the lessons and the usual school routine.

Moreover, it is important to leave the students with a sign of their work or of their participation: a final meeting with gadgets and awards.

Finally, a positive result for the entire project is the fact that no activity shows any characteristic that prevents its implementation outside the borders of its home country, in a truly European spirit. Despite the differences in the school systems of the different participating countries, all the activities can be carried out in any country. A good organisation makes them feasible in schools of any grade and within a wide age interval for the students. To achieve a better effectiveness, however, the best option is to involve students when they are 14-15.

Finally, as regards the reference targets, as the targeted public is made up of teachers, because they are the meeting point between the young people and the world of science, the Pilot Activities should represent an integration of their lessons and of the textbooks. Thus, a great deal of attention should be paid when implementing and linking the Pilot Activities to school curricula.

Origins of the Pilot Activities: results from the research phase

To reach a definition and the experimentation of the Pilot Activities, a qualitative research phase on the targets of the project was carried out in the six countries participating in GAPP. This first step of the project achieved an important result, which was to collect opinions and ideas on science and technology and scientific careers from core targets.

On the basis of different national school organisations, in terms of duration and paths, a research plan was built, envisaging the involvement of students, teachers, parents and opinion leaders in the field of S&T. Each country saw the implementation of eight focus groups, two for each of the following targets: students aged 14-16 and 16-18, teachers, parents, for a total of 48 focus groups (approximately 280 people). The guideline provided by the scientific partner was tested in two pilot focus groups.

Ten in-depth interviews have been performed in each country with science and technology professionals, in public and private context, politicians, people with expertise in gender topics, both men and women.

On the basis of the results obtained in the qualitative phase (Focus groups and IDI) participatory workshops employing Open Space Technology (OST) were organized by all the partners with the objective of putting forward concrete proposals for Pilot Activities.

Focus groups

The most significant division appearing in the students' classifications on science from the focus groups discussions is the one between science itself and science understood as education & learning process experienced at school. The first is evaluated positively and is described in terms of adventure, challenge, satisfac-

tion, progress etc. The second is perceived negatively, in terms such as boredom, hard and unfruitful work, stress.

An interesting issue in the perception of science and technology is not a good or bad view of science, which is generally very positive, or technology, which is more critical given the possible risks associated. The issue is not a correct perception of what a scientist does or the lack of capacity of giving correct answers on what science does, but the confusion emerging between S&T. Youngsters do not have a clear idea of the link between the two. They demonstrate an *ancient* idea of the separation between science and technology, which disappeared quite a long time ago with the advancement of science in the past century. For young people in the six countries participating in the project, there is a significant gap between science itself and school science, which is mainly about education and a learning process. In the students' opinion, the first one is good and has to do with *adventure*, *challenge*, *satisfaction and progress.* The second one is negative and has to do with *boredom*, *hard and unfruitful work*, *stress*.

In terms of gender difference and attitudes towards different disciplines, we confirm the results of the current studies on this topic: girls tend to emphasise a little more the social outcomes of S&T concerning health issues, whereas boys are slightly more attentive to the success that some well-known male scientists or technological entrepreneurs have achieved.

Similarly, the representation of the scientists conform to the current stereotype: scientists are half heroes, half crazy people, completely focused on their scientific issues, travelling a lot (which is one of the most important discriminating factor in the gender issue), working alone (in professions as the mathematician or the IT expert). In the common imagery, the representation of a researcher is very much a male one.

On the other hand, when asked about what a scientist does, the main result is a vague idea of the work of science. For example, in the focus groups with youngsters aged 14 to 18, before asking whether they wanted to become mathematicians, they were asked to describe who she or he is and we found out that young people do not have a clear view of what a mathematician does. In the second part of the FGs, we asked to select some images taken from generic magazines describing the scientific professions among: engineering, IT, chemistry, mathematics, physics, biology. Nobody made an attempt at using images to describe the job of a mathematician. Firstly, because it is materially difficult to find images describing this job, but clearly it is also difficult to mentally picture a professional environment where he or she works.

Main influences in the choice of a career are personal interests, teachers and parents. In general, students think the choice is theirs, parents think teachers have the most important influence on their children and teachers believe it is parents who decide in higher social background and friends elsewhere.

In any case, all the targets believe it is very much important to have direct contacts with the S&T world during the school period.

In-depth Interviews

The goals of this part of the research were to learn and to understand the interviewees' personal stories, their scientific, cultural and social background and the difficulties they had to face in their career, and their ideas on the difficulties that young people may encounter when engaging in such a career. As the interviewees were chosen within a circle of privileged witnesses, opinion leaders in most cases, interviewing was also aimed at learning their vision on the future career opportunities for young people of both genders in their field of research or activity.

In most of the biographies the gender issue does not turn up and is not a matter mentioned by itself. The interviewees perceive this discrepancy as natural, enrooted in cultural and sometimes biological differences. All of the interviewees – men and women alike – highlight some aspects in which their gender has always played an active role for their career. Not in all cases are they negative highlights: some advantages provided by gender are frequently mentioned. A clear result is that a researcher may or may not be a good researcher, totally irrespective of their gender.

Prejudices are yet even more evident when responsibilities must be shared and distribution of power is concerned, because historically men are in control. A female researcher is first seen as a woman and then as a researcher. According to the interviewees, given a substantial equality in the possibility becoming a good researcher, there is a different social pressure on male and female workers, male and female scientists, wives and husbands, owing to historical and cultural reasons. This also means that being a woman can also be a further opportunity because it undoubtedly favours visibility. On the other hand, today women are induced to search for an intellectual compensation.

Almost all of the interviewees stress the importance, for the emergence of a scientific vocation, of early contact with science and with practices that could raise the youngsters' curiosity about the world.

The expectations for the change of the quantity and the role of women are first of all connected with civilization changes. Much

hope is connected with the growth of economic condition, population and more expenses for science. As for practical solutions, they deal with the reforms in educational systems, however not in structure but in substance. There was also an agreement on policy-based changes, which should target at an equalisation of the proportion of gender in science. The idea of parity was especially criticised. All the interviews seemed to reveal the consciousness of a cultural change with a dual impact. The positive one is about the increasing equality of women, differentiation and exchange of social roles. The negative one centred on the decrease of interest in difficult sciences by young people, not only girls.

Open Space Technology workshops

The aim of the OST was the selection of actions and activities between the school and the world of S&T work that could turn out to be stimulating for the students.

In the GAPP project, OST workshops acted as a very important part of the work, as the last action of the qualitative research and the start of the experimentation phase. With these workshops all the partners were able to identify the ideas, the interests, the needs of the young people, particularly young girls, and of people belonging to the research and business worlds, teachers and parents, on science and technology studies and their related careers.

This objective has been achieved by comparing the proposals obtained by each national OST and by choosing the most suitable Pilot Activities to be tested with the school groups in each country. In order to achieve this, the action had to involve as many relevant actors as possible to work together in a open, creative way. The goal declared at the beginning of the sessions was to obtain, in a participative way, a list of proposals for defining practical actions involving scientists, engineers and professionals with a S&T background from the public and private sectors to be tested in high schools with students.

After the initial phase, the meeting agenda of each OST was divided into three discussion phases. During each discussion pha-

se the participants suggested many interesting topics, creating about 15 discussion groups during the entire day. The topics can be grouped into three main categories:

- Education and science popularization, methods of science teaching.
- Gender issue in the context of science and technology, existing differences, tools and methods of over crossing it.
- How scientific education can stimulate the choice of scientific and technological careers.

At the end of the discussion each group drew up an instant report with the description, dynamics of the discussion, names of participants and results.

The areas where the most useful proposals were put forward regard science education and science in society themes. In the first area, what is called for is: a higher attention paid to teacher training, with activities centred on improving communication teaching channels and languages, a stronger awareness on gender differences and on teachers as role models, the development

of guidelines for school lessons, the inclusion of historic science personalities in curricula, the development of variations in lessons, starting with experiments and then adding theory and increasing the quality of the experimental work. Moreover, more life-close science learning, doing practical activities and building bridges between disciplines is strongly suggested.

As regards science within society, the imagine of science and scientists represents the key point. The ideas that science is only for excellent students and nerds and that research topics are too specific and not related to social aspects are to be demystified; role models are to be used, visiting and interacting with scientists and female scientists in particular, and establishing contacts between schools and universities/laboratories in general. Also, a change even in the image of science in parents is encouraged, developing special activities for families, TV programs for children and families. An important role can be played also by science centres and science museums, to implement activities that hold in due consideration gender differences in S&T and its professions.

This format has been very effective with young people, who seldom have the opportunity to express their creativity freely in matters concerning education, career choice and educational activities. In the planning activity, each partner designed an appropriate approach and invited a large number of participants in the OST workshop. Furthermore, the presence of various groups of interest among the participants ensured the development of creative, innovative proposals.

From theory to practice

Across the countries involved in this research, the starting point is a perception of S&T which confirms the current stereotypes, as from other large surveys as the Eurobarometer (Special Eurobarometer 224 / Wave 63.1).

In particular, the exact sciences are generally considered to be more difficult than human studies, as they would imply a special talent. On the other hand, technology involves a lot of sawing:

being a hands-on activity, many students think that you need to be physically strong and that you get dirty, leading them to think that it is more a field for boys than for girls. Sciences and technology arouse spontaneous positive feelings amongst our participants. We have not found any conclusive differences between the two genders in terms of education choices and job opportunities.

It is worrying that students do not seem to have a clear concept of the professions available. Their frame of reference is primarily the subjects they have at school and the experiments they perform there.

In particular, participants call for a better knowledge of S&T professions: all of our participants told us of the importance of practice in S&T and see S&T as strongly linked with reality.

In order to come closer to S&T, gaining experience with science and technology since an early age has emerged to be very important. Moreover, a change in stereotypes has to be carried out starting from teachers, role models, from the meeting with S&T professionals in schools, science centres, museums, and through the media, in fiction and advertising, by filming interviews with young and dynamic role models, both for boys and girls.

Practically, a direct participation and a "science and scientific careers in action" approach is to be desired as much as possible. Hence the launch of the Pilot Activities described in detail in this handbook.

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The pilot activities presented here are the result of the Gender Awareness Participation Project.
The contents are addressed to science centres and museums, teachers and science educators, researchers in the educational field, but also researchers in scientific and technological disciplines interested in communicating their work, European officers for Education, University mentors, policy makers, women associations.