The CERN mini-exhibition visit in Greece

(November 2011-June 2012)

This report was prepared in the framework of the PATHWAY and Discover the COSMOS projects that are aiming to create effective links between research and school education.

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2 The CERN Mini Expo in Greece

The CERN Mini Expo is a traveling exhibition that presents a brief overview of the research at CERN and its flagship project, the Large Hadron Collider (LHC), through a combination of large graphic panels, on-screen displays and videos that are combined with two scale models of the ALEPH detector and a cross sectional part of the LHC. It is appropriate for use at events varying in duration from a few days up to a few weeks. Additional material could be added by the organizer in order to promote local research activities in the field of High Energy Physics. Its advantage over bigger exhibitions is that it is easier to assemble and disassemble, which means that it can serve a larger audience by traveling to more places. Usually the support of guides is necessary to explain to visitors the rational of the CERN experiments and the developments in the field.

The CERN Mini Expo arrived in Thessaloniki in October 2011. The initial plan was that the CERN Mini Expo to visit also Alexandroupolis, a city located near the boarder line with Turkey. Following a meeting, held in Athens, in the beginning of November 2011, between the CERN representatives and the members of the PATHWAY and Discover the COSMOS[1] research groups, the enrichment of the usual presentation of the exhibition with additional materials (guides for teachers and the general public, educational games, web based materials to help visitors to prepare their visit) was proposed and the support of the realization of the exhibition with preparatory seminars for the guides and training activities for teachers who were willing to guide their students themselves to the exhibition. The most important addition that was proposed was the connection of the different exhibition themes with the Greek school curriculum that will allow for the teachers to plan their visit according to the educational needs of their students. The exhibition was organized, according to this plan, in Athens in November 2011. More than 5,000 students and 200 teachers visited the exhibition and received effective training and support. The press and the TV coverage was significant, while the exhibition's web site received about 20,000 hits in less than one month. Following the success of the proposed approach in Athens the same methodology was adapted in Alexandroupolis (December 2011). Again the impact to the local educational communities was unique. The organizers, with the support of the Greek teams from Ellinogermaniki Agogi and the National and Kapodestrial University, decided to expand the Greek "adventure" to more cities. Kavala in North Greece (February 2012), Heraklion (March 2012), the biggest city in Crete, Volos (April 2012) in the Central Greece and Patras (May 2012) in Peloponnesse were added to the plan.

The CERN Mini Expo was hosted for first time in schools in Athens and Heraklion. In Thessaloniki it was hosted at the Science Center NOISIS, in Alexandroupolis at a Conference Center of a Hotel, in Volos at a Cultural Center and in Kavala and Patras at the University Conference Center.

[1] PATHWAY and Discover the COSMOS projects are co funded by the EC and are focusing on developing effective outreach activities that bridge the gap between scientific work in Astronomy and High Energy Physics. Both projects are focusing on students and teachers in primary and secondary schools.

Figure 1 presents the tour of the CERN Mini Expo in Greece. The number of school students and teachers are presented on the same Figure. The aim of the local organizers was mainly to inform the educational communities about the developments taking place at CERN. Overall more than 25,000 people visited the exhibition.

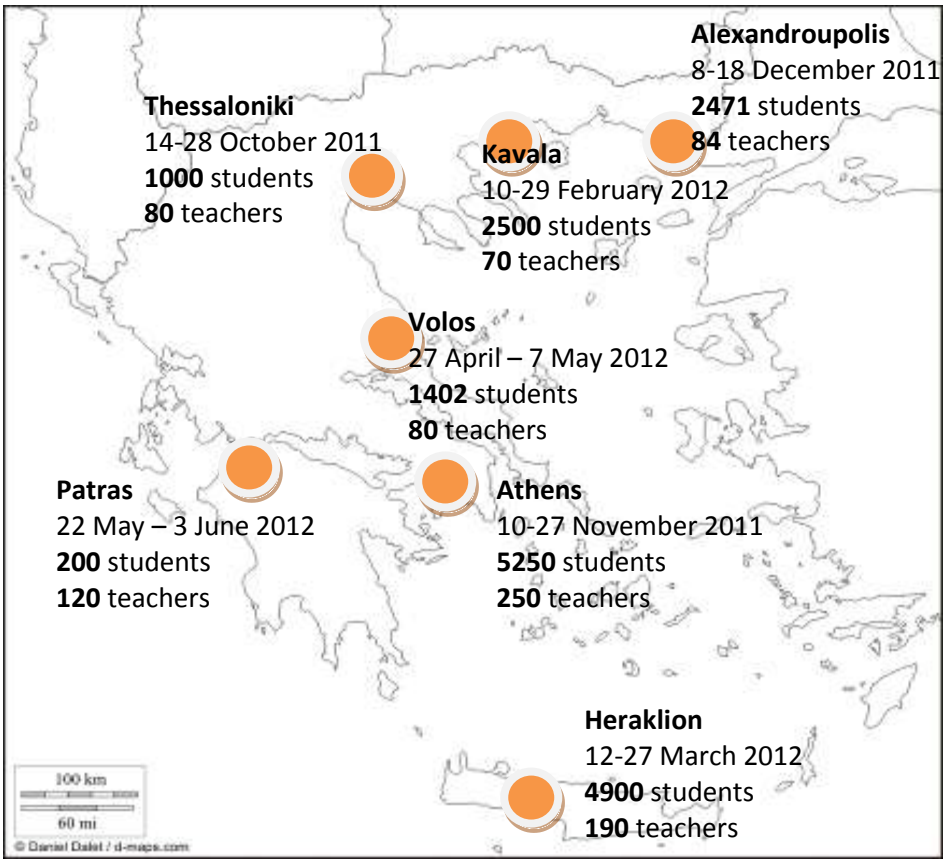


Figure 1: *The CERN Mini Expo in Greece: Locations and numbers of students and teachers visits.*

3 The CERN Mini Expo in Greece. Locations and Visitors

The exhibition travelled throughout Greece and visited seven cities. In each case, CERN team collaborated with local institutions which hosted the exhibition and actively advertised it in the local and national media. The approach implemented was the same in all locations (with the exception of the exhibition at Thessaloniki). The activities in all cities were supported by the National and Kapodestrian University of Athens and Ellinogermaniki Agogi. A short description of the characteristics of each location is described in the following sections.

3.1 Thessaloniki

The duration of the exhibition was from the 14th to 27th October 2011 and got prolonged until the 30th October 2011. It was housed at "Temporary Exhibition Hall" (250 square meters) at NOESIS, Thessaloniki Science Center and Technology Museum. On the 18th October an inauguration event was held which was attended by NOESIS members of the Board of Directors, professors from the Aristotle University of

Thessaloniki, as well as representatives of the Association of Information Technology Companies of Northern Greece.

3.2 Athens

Ellinogermaniki Agogi was the first school that ever hosted CERN's traveling exhibition for seventeen days in the school's premises. The exhibition was open for the public from the 10th until the 27th of November, 2011. During this period several schools from Greece as well as numerous individual visitors and families visited the exhibition and got acquainted with the work done in CERN. Ellinogermaniki Agogi prepared supporting materials for the expected visitors and organized the official presentation of the exhibition in the 16th of November as well as several training workshops for teachers who wished to learn how they may incorporate CERN related activities in their teaching. Throughout the exhibition, physicists from the Research and Development Department of the school as well as physicists from the University of Athens served as guides.

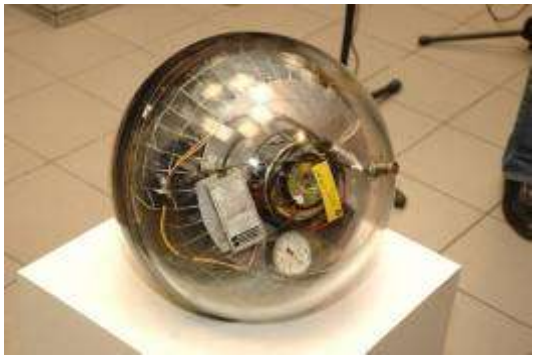


Figure 2: *Additional materials from local experiments were added to the exhibition in different locations. In Athens one of the detectors of the NESTOR neutrino telescope was also presented as an alternative method to search for the origins of the universe.*

Ellinogermaniki Agogi was in charge of all the school visits that were realized during school hours (9:00 – 15:00). Each visit lasted approximately 1 hour and it included a general introductory session, a tour to the exhibits and a "questions and answers" session. Although the main procedure followed was always the same, each visit was tailored to the needs of the respective group of students based on their age and current knowledge.

3.3 Alexandroupolis

The CERN Exhibition was hosted in Astir Hotel and organised by the Prisma Electronics SA with the support of the Municipality of Alexandroupolis, the Athens Chamber of Commerce & Industry, Ellinogermaniki Agogi and Astir Hotel.

All guides, mainly secondary school physics teachers from the city of Alexandroupolis, attended a training session on the 9th of December, date on which the inauguration of the exhibition took place. There were two additional round table sessions organised throughout the duration of the exhibition; one training session targeting secondary school teachers and students which took place at the Astir Hotel on the 14th of December, and a second discussion session with physicists which was broadcasted live on Alexandroupolis' local TV channel Delta TV.

3.4 Kavala

The CERN Exhibition was hosted in the premises of the Kavala Institute of Technology and was co-organised by the Department of Electronic Engineering, Kavala Institute of Technology, the Unit of Innovation and Entrepreneurship, the Journal of Engineering Science and Technology Review with the support of the Hellenic Physical Society Division of Kavala and the Kavala Institute of Technology.

Three Professors and 30 graduate research students from the Department of Electronic Engineering along with 10 high school physics teachers, members of the Physical Society Division of Kavala, provided active support throughout the duration of the exhibition. Besides the inauguration of the exhibition on the 10th of February, there were two seminars organised: a special presentation targeting physics high school teachers (10 Feb 2012) and a seminar for third-level students of the Department of Electrical Engineering of Kavala Institute of Technology (24 Feb 2012).

3.5 Heraklion

The exhibition, which was housed in the premises of the 2nd Lyceum of Heraklion was organised by the 2nd Lyceum of Heraklion, the Hellenic Physical Society – Eastern Crete Division, the High Energy Physics Group, Department of Physics, University of Crete and the Municipality of Heraklion.

After having attended an information session, eleven high school physics teachers along with six graduate research students volunteered to work as guides throughout the duration of the exhibition.

The exhibition included, beyond the standard components of the CERN Mini-Expo, a small selection of hardware of the LHC and its associated experiments (courtesy of Dr. Petros Rapidis at National Centre of Scientific Research Democritos, Greece and Dr. Sofoklis Sotiriou at Ellinogermaniki Agogi). There was also an audiovisual session during which visitors could watch two short films and learn more about the history of CERN (in Greek subtitles) and the LHC.

3.6 Volos

Hosting CERN Exhibition in Volos was an initiative of the Municipalities of Volos and South Pelion and the University of Thessaly, who also provided the venues and the financial support. In its realization also contributed the Secondary Education Administration and the Space and Astronomy Society of Volos. An organizing committee was established by the Municipalities, the Secondary Education Administration and the Astronomy Society which handled all the issues related to the exhibition including the visitors program.

Following the necessary arrangements with CERN exhibition management and the disposal of Nea Ionia Cultural Center by Municipality of Volos, the Exhibition came to Volos, was installed and inaugurated on the 27th of April, on which point began the public and the school visits. South Pelion Municipality took over the responsibility of organizing the visitors program.

3.7 Patras

The CERN exhibition was hosted in the Conference & Cultural Centre of the University of Patras and was organised by the Physics Department of the university with 30 people, academic staff and postgraduate research students, volunteering to help either as guides for visitors or with administrative and media relations support.

Besides the standard exhibits included in the CERN mini-expo, there were various posters and a video about the CAST experiment at CERN, which is led by the Department of Physics at the University of Patras. The opening event took place in the Conference & Cultural Centre on the 25th of May, with speeches from the rector of the University of Patras and the head of the Department of Physics, followed by presentations by guest speakers, including CERN delegates and members of the High Energy Physics academic community of Greece.

Given that the dates of the exhibition coincided with both the high-school and university national examinations, considerably less students had the opportunity to visit the mini-expo, thereby no special training sessions were scheduled. Yet the event received adequate media coverage, with a live short tour broadcasted on a national TV station on the afternoon of the 31st of May, followed by a longer reportage broadcasted the following day by a local TV channel.

Table 1: *Number of School and General Public Visitors in the different locations where the CERN Mini Expo was presented.*

Visitors	**Thessaloniki**	**Athens**	**Alex/polis**	**Kavala**	**Heraklion**	**Volos**	**Patras**	**Total**
School Visitors	***1080***	***5500***	***2555***	***2570***	***5090***	***1482***	***320***	**18597**
Teachers	80	250	84	70	190	80	120	**874**
Students	1000	5250	2471	2500	4900	1402	200	**17723**
General public	***720***	***2700***	***1171***	***1500***	***310***	***630***	***250***	**7281**
Total	**1800**	**8200**	**3726**	**4070**	**5400**	**2112**	**570**	**25878**

4 Methodology: Developing an Educational Approach for the CERN Mini Expo

This section presents in detail the additions made and the activities that were organized to maximize the impact of the CERN Mini Expo visit. A large variety of activities were organized and numerous materials were developed that could be categorized in the following:

a) **Web-based materials** were developed to support the preparation of the teachers and their students for the visit. A devoted web-site (cern.ea.gr) was developed and used in all locations (common formal and approach). It was enriched with guidelines for teachers and interactive educational materials for students. Additionally educational pathways for families were developed to support informal learning and to involve interested parents in the process. Finally existing digital educational materials (e.g. Hunt for Higgs Game, the LHC Game, Powers of Ten application) were organized according to the students age and they were presented during the exhibition at additional workstations that were used for this purpose.

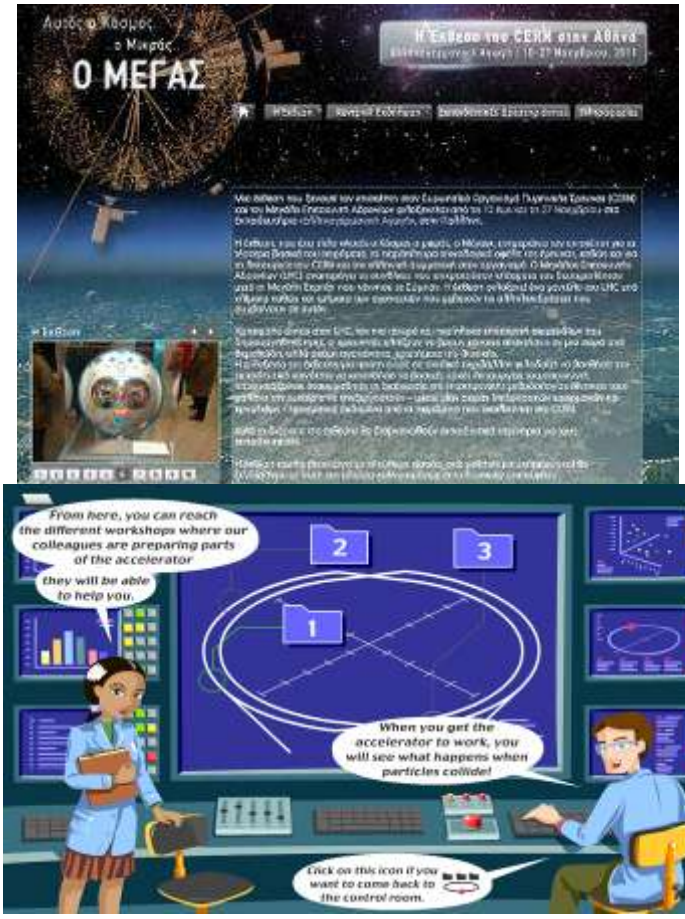


Figure 3. *The website of the exhibition was the main hub for accessing relative information and content. The website included explanatory texts about the exhibition, information about the opening ceremony in different locations, dates of the teachers workshops that were carried out as well as information and supporting materials to facilitate the visitors in booking and organizing their visit. The website also offers access to a series of CERN educational materials and interactive games, like the LHC Game.*

b) Two advanced technological applications based on the use of **Augmented Reality tools and handheld devices** were developed and used in Athens and Alexandroupolis exhibitions. An augmented reality application representing the particle collisions in LHC (created by the Fraunhofer Institute of Technology), was presented with the

ALEPH detector model. Additionally a series of mobile applications (using both QR and RFID technologies) were presented to the visitors.

Figure 4. *Following the particle trip in the LHC through the use of the Augmented Reality applications. Such a technology visualizes the invisible processes in the detector and acts as a significant add on to the visitors' experience.*

c) **Demo visits for teachers** were organized before the opening and during the exhibition to introduce teachers in the issues related to CERN and its experiments. The training was focused on the connection of the themes of the exhibition with the school curriculum. Proposals and practices for elementary school students, for lower high school and upper high school students were discussed and demonstrated during the practical sessions of the training.

d) The realization of the exhibition was combined with a series of innovative events that were organized in interested schools in the wider area. In this framework a series of **e-Masterclasses** were organized to introduce students to the CERN experiments. These events included real-time connection with ATLAS Control Room at CERN and the use of the event analysis tool HYPATIA that help students to act as scientists. These activities were organized in Athens, in Heraklion and in Patras.

Figure 5. *Students from the rural school of Lalas village, who were not able to travel to Patras to visit the exhibition, had the opportunity to perform a virtual visit to ATLAS control room and to get a first hand experience on how a CERN experiment works.*

Figure 6. *Greek organizers developed a series conventional materials for the visitors. Here the educational guide for teachers is presented.*

e) **Conventional Materials (Guides for the General Public, Guides for Teachers and Students)** were developed and distributed during the exhibition.

In the following section we are presenting some indicative examples for the implementation of the methodology described above. We are describing the rational of the process of preparing and organizing the visit to the exhibition, we are presenting the Augmented Reality application that was used and we explain how the e-masterclasses activities were organized in parallel with the exhibition.

4.1 Organizing the visit to the CERN Mini Expo

A great deal of science learning, often unacknowledged, takes place outside school in museums, libraries, exhibitions, nature centers, after-school programs, science clubs. Collectively, these kinds of settings are often referred to as informal learning environments. Understanding the science learning that occurs in these environments in all of its complexity and then exploring how to more fully capitalize on these settings for learning science are the major issues addressed by the OpenScienceResources educational tool (www.osrportal.eu) that is supporting teachers and museum educators to design and implement "Educational Pathways" that interconnect schools and these informal learning environments. The Greek organisers of the CERN Mini Expo have used this system to develop a series of field trips (see Figure 7) in the exhibition that they were focusing in different target groups (primary school students, high school students, family visits).

Figure 7. *The OpenScienceResources interface that describes in detail the organization of the visit to the CERN Mini Expo. The materials are classified and organized according to the school curriculum.*

These field trips were available to the public through the web site of the exhibition. In order to capture the multifaceted nature of science learning, the development of these "Educational Pathways" is based on a series of "strands for the design of the Educational and Outreach Activities" and articulates the science-specific capabilities supported by the environment of a research infrastructure that the CERN Mini Expo simulates. This framework builds on a four-strand model developed to capture what it means to learn science in school settings[i] by adding two additional main strands incorporated for informal science learning, reflecting a special commitment to interest, personal growth, and sustained engagement that is the hallmark of informal settings

(as it is proposed by the Discover the COSMOS Coordination Action http://www.discoverthecosmos.eu).

Table 2: *The main strands and the Educational Objectives for the design and implementation of Educational and Outreach activities for involving students in eScience.*

Strands	Educational Objectives
Sparking Interest and Excitement	*Experiencing excitement, interest, and motivation to learn about phenomena in the natural and physical world.*
Understanding Scientific Content and Knowledge	*Generating, understanding, remembering, and using concepts, explanations, arguments, models, and facts related to science.*
Engaging in Scientific Reasoning	*Manipulating, testing, exploring, predicting, questioning, observing, analysing, and making sense of the natural and physical world.*
Reflecting on Science	*Reflecting on science as a way of knowing, including the processes, concepts, and institutions of science. It also involves reflection on the learner's own process of understanding natural phenomena and the scientific explanations for them.*
Using the Tools and Language of Science	*Participation in scientific activities and learning practices with others, using scientific language and tools.*
Identifying with the Scientific Enterprise	*Coming to think of oneself as a science learner and developing an identity as someone who knows about, uses, and sometimes contributes to science.*

Additionally in the framework of the teachers' workshops and seminars teachers were supported to design their own "Educational Pathways" and to organise their classroom visit according to their students learning needs and interests. Teachers were also able to adopt the existing materials and design new activities for their students. The materials of the exhibition could be used as supplements of the school curriculum, e.g. in Newton laws, in the movement in the magnetic field, conservation of energy and momentum, cosmology, so a variety of "Educational Pathways" were proposed. Overall 25 additional "Educational Pathways" were developed, including an interactive game with the use of handheld devices. QR codes were placed in specific areas of the exhibition and the visitors could use their mobile devices to scan the QR code and receive specific information, quizzes, videos and other relative materials.

Figure 8. *Visitors were able to receive further information and materials through their mobile phones with the use of QR codes.*

4.2 The LHC Augmented Reality application

Based on educational research findings, it appears that innovative applications, like Augmented and Virtual Reality can spark interest in a topic and, in some cases, motivate viewers to learn more or to take action. These applications are an example of what informal science venues can do to bring in crowds and generate excitement about science.

Augmented Reality applications are often used on Science Center exhibits enabling visitors to: a) experience science first hand by actively manipulating the experiments and b) enhance their understanding through the display of otherwise hidden phenomena.

Figure 9. *A trip to the inner ATLAS Detector is offered with the use of augmented reality applications offered by the Science Center to Go application. The system was use in Athens and in Alexandroupolis. It has to be noted that this system could be used also in the Visitors Center of the ATLAS Experiment at CERN.*

In the framework of the presentation of the CERN Mini Expo in Athens and in Alexandroupolis the Science Center To Go system (http://www.sctg.eu/) was used to offer such an experience to the visitors (see Figure 8). The development team of the system (Fraunhofer Institute of Technology, Germany) has created an interactive application that combined with the ALEPH detector model of the CERN Mini Expo is offering an integrated view on the process of the particles movement in LHC and their collisions in the center of the detector. In this way the visitor makes full use of the powerful capabilities offered by tailor-made exhibits combined with Augmented Reality. During the demonstration visitors had the opportunity to interact with the system that illustrates the collisions.

4.3 Virtual Visits to CERN

Following the model of Hands on Particle Physics Masterclasses, a series of virtual collaboration activities, called e-Masterclasses were designed and implemented, promoting inquiry based and problem solving processes in virtual and blended learning environments. In this case students performed the assigned tasks from their schools. In most cases students visited also the exhibition. There were also cases of school classes that were not able to visit the exhibition due to the timing (e.g. overlap with exams) or due to the distance from the place where the exhibition was organised. The e-Masterclasses include a presentation of the rational of the CERN experiments, a

virtual visit to the ATLAS Control Center and a discussion with the researchers on shift, and the "hunt for Higgs" challenge by using real data from the ATLAS detector and analysed with the HYPATIA educational tool.

Figure 10. *CERN scientist explains to the school students the structure of the ATLAS detector in the framework of the virtual visit to the experiment's Control Room (left).Students are analyzing the ATLAS data and they are looking for Higgs candidate events (right).*

5 Presentations and Teachers Training Seminars

During the realization of the exhibition a series of parallel events, such as public presentations, seminars and training workshops for teachers were organized. Their purpose was dual: a) address the general public, presenting the research carried out at CERN and b) address science teachers by offering more specialized presentations, as well as training on tools and methods that could be integrated to their teaching practices.

Figure 11. *Moments of the opening Ceremony in Athens at the Ellinogermaniki Agogi School. About 800 people attended the event. The students have prepared the Higgs song that was presented to the audience. Dr. Rapidis, the Greek Representative at CERN, Dr. Tsesmelis from the CERN Directorate, Prof. Kourkoumelis, the ATLAS outreach coordinator and Mr. Lewis Manager of the CERN Mini Expo explained to the audience the rational of CERN experiments and the efforts for the discovery of Higgs.*

Table 3: *Parallel Events that were organized during the realization of the CERN Mini Expo in the different locations.*

	Thessaloniki	Athens	Alex/polis	Kavala	Heraklion	Volos	Patras	*Total*
Presentations	***1***	***1***	***3***	***2***	***2***	***6***	***1***	***16***
Demo Visits for teachers	0	2	1	1	2	1	0	***7***
Teachers Training Workshops	0	8	1	1	1	1	0	***12***
MasterClasses	0	2	0	0	1	0	0	***3***

6 Assessing the Impact of the CERN Mini Expo

"The exhibition triggers the curiosity of the visitor and makes them wonder how nature works and as a result many students start thinking of pursuing a career relative to this field. Congratulations to all who helped with this event!"
Student from a School at Heraklio, Crete

The Greek organizers have set up a systematic evaluation process based on both qualitative and quantitative tools. There were two main axes of the evaluation exercise that was implemented in the different locations (with exception of Thessaloniki where the exhibition was realized for first time) that were transformed in two main sets of research questions:

a) Which was the impact of the presence of the CERN Mini Exhibition to the educational communities who visited it? Was the proposed approach of

organizing the visit and combining it with the school curriculum effective and helpful for the teachers? Were the demo visits and the teachers training workshops a useful addition to the set of the usual parallel activities?

b) Can an event such as the CERN Mini Expo presentation, generate a "social excitation" (supported by getting positive feedback by media exposure and social networking effects), which drives very large numbers of people to increase their interest on science and on scientific issues?

Although the detailed analysis of the evaluation data is out of the scope of this report we would like to present in this session a series of findings and the proposed methodologies to receive effective feedback from visitors. This could be a useful feedback for the CERN Mini Expo management to follow similar approaches in future presentations of the exhibition.

6.1 Assessing the Impact of the CERN Mini Expo to students and teachers

A series of instruments were used to collect data about the educational value of the exhibition and the developed materials to support its presentation to the students and teachers. Specific questionnaires were developed and adopted to the local cases. In many locations interviews with the teachers and the students were contacted. These data were integrated with information that was retrieved from the web analytics, like the number of downloads of the educational materials, the time spent on site, the number of pages visited. Student responses revealed that the 87% of them had already been informed about the CERN Mini Expo content through the web site and the information that was delivered from their teachers. This is a very important finding as it demonstrates that the students were prepared for the visit and the proposed approach of the organizers was implemented effectively at a high degree. Students' reactions show that they have great interest in the interactive applications (e.g. the Hunt for Higgs). The mobile application that was used in Athens (with the use of QR codes) was considered the most interesting application of the CERN Mini Expo (93% of the students characterize it as the most attractive application). About 50% of the students showed preference to the video presentation while about 40% students claimed that the 3D models of the detector and the LHC were the most interesting components of the exhibition. 80% of students claimed that the presentation made by both the guides and their teachers was very understandable but they would prefer to discuss all these issues with their teachers. In locations where the interactive applications were not included in the presentation (e.g. Volos) 80% of students claimed that they would expect that the Exhibition would be more interesting and according to their opinion that could be achieved using more interactive subjects – exhibits (50% percentage) or audiovisual projections (50% percentage).

Teachers who visited the exhibition believe the connection of the school curriculum with issues of contemporary science could increase students' motivation and interest in science. Furthermore teachers are very interested to include such information in their lessons. Teachers claimed that the Educational Pathways that were proposed could help to bridge the gap between real scientific work and the classroom practice. The main findings from the discussions that we had with the teachers during the demo visits and the workshops could be categorized as following:

- Teachers believe that such exhibitions could increase the interest of students as well their motivation in science. According to their view scientific knowledge is by its nature abstract and theoretical. It often contradicts common sense and is developed through controlled experiments in artificial, “unnatural” and idealized laboratory settings. Learning science generally requires hard work and considerable intellectual effort which are not a dominant part of contemporary youth culture. With such applications exhibitions scientific work and complex phenomena are presented in like a user-friendly exploration and discovery that engages students in the process.

- According to the teachers view the science curricula have to be updated. They need to include issues of modern science and to offer to teachers and students the opportunity to interact with real scientist to realize “how science works”. Many teachers (although it is not foreseen from the science curriculum) perform limited or even significant interventions to their lessons in order to inform their students on what is happening at CERN and to prepare them with the exhibition.

- Teachers are very interested to use resources that are connected with the school curriculum. For them it was very useful that the visit to the exhibition and the explanations were based on issues presented in the school curriculum. This offers a significant upgrade to their teaching.

- Scientific achievements may call for admiration, but they also create unease. Many people dislike the image and ambitions of modern physics. They have an emotional and rational fear of scientists who “tamper with Nature” or “play God”. Many people react emotionally to the quest of physicists for “The Final Theory”, also called “The Theory of Everything” or even the search for “The God Particle”. The lofty ambitions of modern science may attract some young people, but are capable of repelling others. Many people feel that science is intruding in ‘sacred’ areas and are reluctant to accept the idea that science can explain everything since in their minds Nature is sacred and mystical - not explainable, controllable and rational. An avoidance of science in their case may in fact stem from a deliberate choice of values and is thus not something that can be remedied by more information, especially from scientists. Exhibitions like the CERN Mini Expo, enriched with the appropriate educational interface, could create effective links between scientific achievements and school practice and demonstrate that at the end of the day the search of the “God Particle” could be explained (and demonstrated in the school lab) is an easy and understandable way.

- Among the tools and interactive applications presented and used for many teachers the educational design of HYPATIA is one of the most important applications to demonstrate what is happening at CERN. The fact that the tools offers the chance to the students to make mistakes and involves them in different paths of scientific exploration is the major feature that an environment that promotes inquiry must include.

The educational materials of the exhibition were made available through the website of the CERN Mini Explo. The educational pathways (focusing on teachers who were planning their visit to the exhibition) they were made available through the

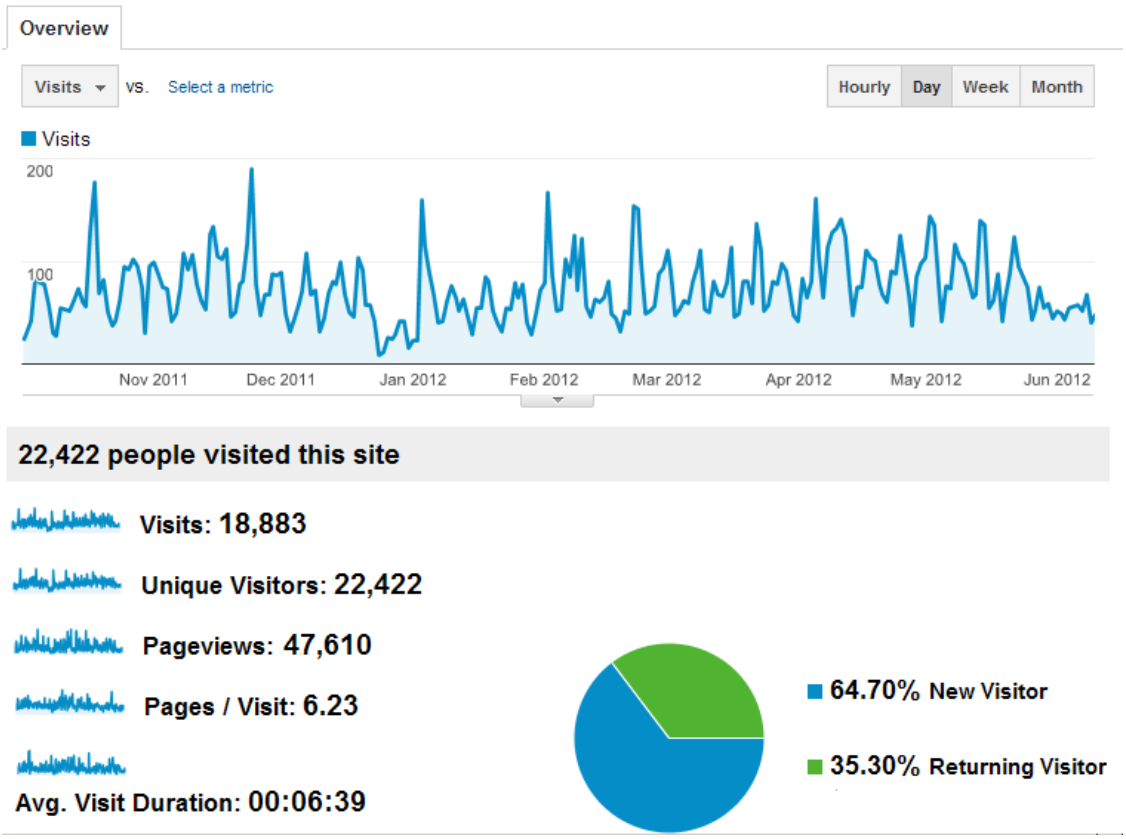
OpenScienceResources Portal. Table 4 presents the downloads (as measured by the web analytics of the site) of the different materials. Table 5 presents the web analytics of the CERN Mini Expo website. The data for the mobile access of the website are also presented in the same table.

Table 4: *The number of downloads of the CERN Mini Expo educational materials.*

Educational Materials	Location	Downloads
Educational Pathway for High Schools	www.osrportal.eu	550
Educational Pathway for Primary Schools	www.osrportal.eu	350
Educational Pathway for Families	www.osrportal.eu	480
CERN Mini Expo Guide	cern.ea.gr	18,600
CERN Mini Expo Guide for Teachers	cern.ea.gr	650
CERN Educational Applications	cern.ea.gr	15,790

Table 5: *The web analytics of the CERN Mini Expo website.*

Indicators	Analytics
Pageviews	47,610
Number of unique visitors	22,422
Time on Site	6,4min
Pages per visit	6,2 pages
Pageviews (mobile)	2,340
Time on Site (mobile)	2,3min
Pages per visit (mobile)	3,2 pages



6.2 The CERN Mini Expo as a means of "social excitation" for science

In this section, we present the results of a study on the quantitative characteristics of the social excitation generated by the visit of the CERN Mini Expo in the different Greek cities. We classify these social excitations and compare their quantitative characteristics to related social phenomena. Finally, we discuss the implications of our results toward the strengthening of network-smart science & society initiatives' strategies that could be adopted in the near future from the exhibition managers during the visit of the CERN Mini Expo to other countries. We are claiming that the approach that was followed in Greece, namely the realisation of a series of presentation of the exhibition in relative short time in different locations, along with the organisation of extended teachers training and support activities and the involvement of the educational and local authorities, could have a significant impact on raising the interest of the communities in science.

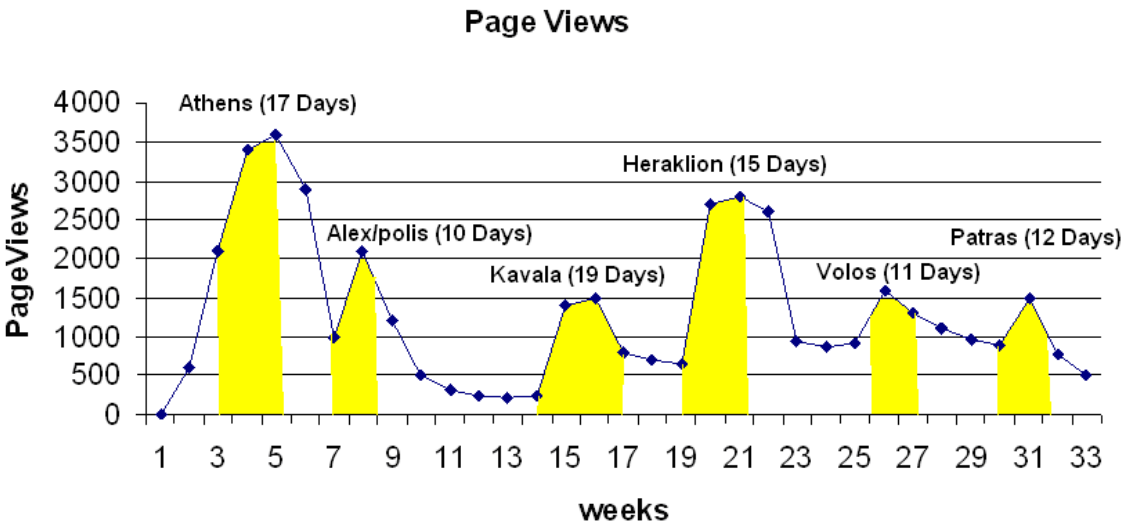


Figure 12. *The distribution of the pageviews of the CERN Mini Expo website (and its mirror sites in the different locations) indicates the great interest of the visitors on the theme of the exhibition. The organization of the exhibition in different places in the same country increases the interest of the media and generates excess-demand for science education offerings, reducing the need for expensive advertising campaigns.*

Figure 13. *The distribution of the pageviews of the CERN Mini Expo website (cern.ea.gr) indicates the great interest of the visitors on the theme of the exhibition during the organization of the event in Athens. The data are covering the period of November-December 2011. Although the following presentations (expect the Alexandroupolis event) were not planned yet the graph clearly demonstrates that there is high interest in the exhibition in Kavala, Volos, Patras and Herakleion (more than 500 pageviews). Such social data could be useful for the planning and the organization of the following events in places where the social excitation is expected to be higher.*

Table 6: *Publicity and presence in the media.*

	Thessaloniki	Athens	Alex/polis	Kavala	Heraklion	Volos	Patras	*Total*
Press	3	22	1	2	2	6	1	37
TV and Radio	0	12	2	3	5	2	5	29
Internet	5	50	5	4	10	8	2	84

Figure 14. *Numerous articles were published on the local press during the organization of the exhibition while there was a significant presence of the exhibition at the social media.*

Targeted science & society campaigns coupled with the CERN Mini Expo can greatly enhance the promotion potential of informal science education (even in complex themes like High Energy Physics) and disseminate the relative issues (e.g. how science works, research at CERN) in the educational communities but also to the general public. As we have seen (see Figure 12 and Table 6), the presence of the exhibition, can generate a "social excitation" (getting positive feedback by media exposure), which drives very large of people to High Energy Physics related sites and content. Thus the

organization and the presentation of the CERN Mini Expo can be exploited to generate interest for science and to promote the outreach efforts made by CERN researchers. In addition, targeting science education initiatives to specific communities can multiply their impact by the exploitation of social network effects. This is an area of research that the authors of this report plan to further study by performing a number of experiments in education portals (e.g. the Learning with ATLAS @ CERN and the Discover the COSMOS) which exhibit strong social interactions.

7 Overview and Future Plans

The Greek organizers of the CERN Mini Expo have devoted a significant effort to develop a methodology for the wider dissemination of the research that is taking place at CERN to the educational communities as well as to the wider public in Greece. The moment that the country is experiencing a severe financial crisis that clearly affects the educational and the research sector, the hosting of the CERN Mini Expo in Greece offered the opportunity to the Greek scientific community to present its active involvements in the unique experiments that are taking place at CERN and at the same time to introduce the Greek youth to frontier research. A variety of tools and applications were used to enrich the contents of the CERN Mini Expo. Numerous applications and ICT based interactive tools were also tested in the framework of the exhibition. Effective training was offered to the teachers in the different locations. Teachers had the opportunity to present the exhibition to their students following educational pathways that were designed for this purpose. These pathways were designed in such a way to connect the exhibition contents with the school curriculum. Guides for teachers and the general public were developed and distributed in all locations.

The outcome of the effort is very impressive: about 18,000 students have visited the exhibition. Overall, more than 25,000 people experienced the CERN atmosphere in the different Greek cities. The number of visitors (unique visits) of the CERN Mini Expo website was about the same demonstrating the effectiveness of the proposed approach as the website served as a hub to numerous materials and applications.

The Greek organizers have performed a systematic study to assess the impact of this large scale effort. The data collected clearly demonstrate the presentation of the exhibition has managed to increase students interest in scientific issues, while the proposed approach helped teachers to integrate the visit to the exhibition to their school curricula. The materials developed were used and evaluated in real conditions from the teachers and their educational value was recognized.

Finally the qualitative and quantitative date the were collected demonstrate that the presentation of the CERN Mini Expo can generate a “social excitation” (getting positive feedback by media exposure), which drives numerous people to High Energy Physics related sites and content. Thus the organization and the presentation of the CERN Mini Expo can be exploited to generate interest for science and to promote the outreach efforts made by CERN researchers. In addition, targeting science education initiatives to specific communities can multiply their impact by the exploitation of social network effects.

The Greek team is aiming to further support the effort that was initiated in Greece in the framework of the presentation of the exhibition in its next destinations. The Greek team is already in contact with the educational communities and partners in Cyprus, Serbia and Spain (the next destinations of the CERN Mini Expo) to perform the necessary arrangements and to localize the developed resources.

8 References

[i] National Research Council. (2007). *Taking Science to School: Learning and Teaching Science in Grades K-8*. Committee on Science Learning, Kindergarten Through Eighth Grade. R.A. Duschl, H.A. Schweingruber, and A.W. Shouse (Eds.). Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.