

SPACE

a w a r e n e s s



INSPIRING A NEW GENERATION
OF SPACE EXPLORERS

FINAL REPORT



1. SUMMARY

Space Awareness used the excitement of space to attract young people into science and technology and stimulate European and global citizenship. Space Awareness targeted diverse groups that are influential in the complex processes that lead to career decisions. The project was designed to show teenagers the opportunities offered by space science and engineering. Furthermore, Space Awareness sought to inspire primary school children when their curiosity is high, their value systems are being formed and seeds of future aspirations are being sown.

Space Awareness engaged children and teenagers directly and indirectly through educators, teachers, and families. The project involved a coherent suite of activities that: (1) Acquainted young people with topical cutting-edge research and “role-model” engineers, (2) Demonstrated to teachers the power of space as a motivational tool and the opportunities offered by space careers, (3) Provided a repository of innovative peer-reviewed educational resources, including toolkits highlighting aspects of the Galileo and Copernicus navigation and Earth observation programmes and (4) Set up a online “space career hub”. The project also developed a special toolkit showcasing the history and accomplishments of Islamic science and technology, telling the story of a shared history based on tolerance and respect for other cultures.

High-quality educational resources were compiled, developed, and distributed through an extensive dissemination and partner network in 23 countries. Among these resources are Space Scoops, career stories, citizen science projects, and an extensive repository of educational activities aimed at both primary school and secondary school education. Activities also include educator support and professional training through workshops and Massive Online Open Courses (MOOCs), as well as high-impact events for teachers and policy-makers at the European Parliament. Professional evaluation and sustainability have been high priority aspects of the project. Results aimed for a better understanding of the career aspirations of space-related workers, the vision that children have of space and space science, and the identification of best practices towards stimulating the next generations of space scientists.

Space Awareness was a three-year project consisting of ten partners and 24 national contact points across Europe and Africa. It exploited extensive international networks of schools and science museums to reach teachers, educators, and the general public and worked closely in the implementation of the project with the European Space Agency. The project started in March 2015 and was coordinated by Leiden University.

Since its launch, Space Awareness has reached more than 230,000 people directly, including 4,014 students and 5,799 education professionals. More than 150 activities were organised during the project, including: 34 local teacher training, 4 Massive Online Open Courses, 1 international Space Education Conference, and 2 summer schools. The Space Awareness website was published in 12 languages and received more than 110,000 visits. Over 300 resources were developed, selected, reviewed and distributed by Space Awareness.

The project evaluation indicated that all the intended outcomes were achieved. The Space Awareness activities were considered interesting and useful. Participants also expressed a range of other positive emotions associated with their teaching and/or learning of space science. They reported greater appreciation of the relevance and diversity of space science contributions and gained substantial factual knowledge relating to the specific topics covered. The interdisciplinary relevance of space science was highlighted by many participants as one of the most stimulating and liked aspects of the activities, resources and training sessions.

2. SPACE AWARENESS IN NUMBERS

2.1 NETWORK AND EVENTS

The Space Awareness network consists of a total of 24 nodes. All nodes have carried out a set of core tasks including national communication and dissemination (through social media, newsletters, articles) and the support of the evaluation activities by distributing surveys amongst their network.

Through the use of this Space Awareness network, 160 public events have been organised within the project period, with over 100 public events and more than 40 activities focused on the professional development of teachers and education experts in the use of space in their classrooms.



Figure 1. Number of activities organised by Space Awareness throughout the project period

2.2 PROFESSIONAL DEVELOPMENT

In collaboration with teachers who have prior experience in designing inquiry-based activities, the project team developed 12 didactic teacher training courses, 4 for each theme category in the project, namely: „*Our Wonderful Universe*“, „*Our Fragile Planet*“, and „*Navigation Through the Ages*“. For each theme category, two didactic courses were focused on teachers from primary school education, and two were focused on teachers from secondary school education. During the project, Space Awareness partners organised a total of 34 face-to-face teacher training courses in 15 countries, which together trained nearly 500 teachers and education experts.

To further enrich the everyday practice and use of space-related topics and resources in the classroom, the project team also developed and implemented 4 Massive Online Open Courses (MOOCs): one introductory MOOC named „*Teaching with Space and Astronomy in your Classroom*“ (2016), and three thematic MOOCs, aligned with three Space Awareness theme categories: „*Our Wonderful Universe*“ (2017), „*Our Fragile Planet*“ (2017) and „*Navigation Through the Ages*“ (2017). The overall results of the evaluation were very positive as far as the MOOCs endeavour and implementation is concerned. This success is reflected in the high retention and completion rates of the MOOCs, with the Space Awareness' MOOC completion rates being approximately 6 times higher than the international norm. This suggests that the Space Awareness MOOCs were far more successful than other equivalent courses in retaining participants until the very end. In total, 2,400 teachers from 68 countries participated and completed the professional training of at least one of these MOOCs.



Figure 2. Space Awareness Navigation Through the Ages teacher training (Credit: Digidaan)

In collaboration with the European Space Agency and the Galileo Teacher Training Programme, the Space Awareness project organised a successful international space education workshop in October 2016 in Leiden (the Netherlands). 100 professional educators participated in this 5-day conference that offered a mixture of presentations and workshops.

Additionally, two 6-day courses involving approximately 50 teachers from several countries took place in Marathon, Greece in July 2016 and in July 2017. The Space Awareness project assessed the usefulness and impact of the project-developed materials from teachers within the framework of these courses.

2.3 EDUCATIONAL MATERIAL

A significant focus point of Space Awareness has been to develop, improve and distribute high-quality space-related educational resources to be used in primary school and secondary school classrooms, in addition to more informal settings, such as science centres. During the course of the project, a total of 305 resources were developed and released by the Space Awareness consortium. This includes more than 70 educational activities aimed specifically at primary school and/or secondary school education, more than 100 Space Scoops¹, as well as several videos, interviews and webinars (figure 3).



Figure 3. Educational resources developed and reviewed by the Space Awareness project

¹ <http://www.spacescoop.org/>

2.4 SPACE AWARENESS REACH

The Space Awareness project was active on both international and regional levels. During the project's three years, Space Awareness reached 4,014 students directly through workshops and events, 5,799 teachers through its teacher trainings, MOOCs and workshops, and almost 30,000 members of the general public. Furthermore, we know from survey results that the project reached at least another 31,000 students directly, via their teachers through the implementation of Space Awareness activities.

Through the Space Awareness online channels, a high level of engagement with the project was maintained, with over 95,000 people visiting the Space Awareness website and more than 66,000 people visiting the Space Scoop website over the project period. Furthermore, the Space Awareness Facebook page is being followed by over 1,500 people.



Figure 4. People reached directly by the Space Awareness project

3. EDUCATIONAL MATERIAL

Designing, producing and reviewing high-quality resources and training material for teachers using a user-centric approach have been key aspects of the Space Awareness throughout the project. To streamline this process, the project team initially conducted an extensive study of the primary and secondary school curricula of 10 European countries² and South-Africa at the beginning of the programme. Using this study, the project team identified key entry points to introduce space topics and designed project resources and didactic courses to support those topics. Out of this curriculum analysis, a pedagogical framework was established together with a selection of theme categories, in which the Space Awareness programme would focus their resource and workshop developmental efforts in the four categories mentioned in the proposal: (1) *Our Wonderful Universe*, (2) *Our Fragile Planet* and (3) *Navigation through the Ages* and (4) *The Islamic Heritage Kit*, later renamed *The Journey of Ideas*.

Within these four theme categories, the Space Awareness project has reviewed and/or developed a total of 68 educational resources and didactic courses suitable for use in primary and secondary school education. Of these, the project developed 15 completely new resources for *Our Fragile Planet*, 5 new resources for *Navigation through the Ages*, and 22 new resources for *The Journey of Ideas*.



Figure 5. Space Awareness Climate Box being used in action (Credit: W. Schrier)

² Republic of Ireland, Northern Ireland, the Netherlands, Bulgaria, France, Belgium, Spain, Czech Republic, Germany
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A new hands-on educational toolkit called *The Climate Box* was conceived for the activities that were developed for *Our Fragile Planet*. It consists of items that are relatively easy to obtain and can be found in common households. Besides a short description of the inventory, the manual for *The Climate Box* summarises the context for each of the activities and links them to the scientific topics of climate, climate change and habitability. The aim of this kit is for easy reproduction of *The Climate Box* by other educators, even with limited resources or budget.

A second educational suite of activities with hands-on materials, *The Journey of Ideas*, was developed and is conceived as a comprehensive handbook that highlights the continuous evolution of science and its contributions from several cultures throughout history, particularly from the ancient Islamic World. The manual provides background information and 22 hands-on educational resources to familiarise students with the immensely important contributions made to space science by these cultures. It is particularly relevant as a tool for reaching out to migrant communities with Islamic backgrounds.

All of our educational resources were peer-reviewed by educational and content specialists within the framework of the *astroEDU* portal hosted by the International Astronomical Union (IAU). In order to support the testing of the new resources by teachers, it was decided to publish preliminary prototypes on the project websites prior to finalising the reviewing process. The majority of the peer-reviewed feedback and subsequent improvement of these resources were concluded in April 2018. This ensured that the resources are of high quality, both from a didactical and scientific point of view.

To make the Space Awareness educational resources more widely available, the project team collaborated with 4 external online repositories for the hosting of the majority of the educational resources. Offering Space Awareness educational resources through these external online repositories resulted in a substantial increase in the project's reach and the usage of its educational resources, while simultaneously strengthening the project's sustainability.

4. CAREERS

Throughout the project period, substantial efforts were made to develop attractive and high-quality material and resources that offer students and teachers easy and direct access to information related to currently available space-related careers. These efforts were consolidated into the *Careers Hub* on the Space Awareness website, which includes webinars, interviews, brochures and other resources related to space careers.

The main goal of the Careers Hub website section was to display a broad variety of space careers and to inform the target audience on the wide possibilities of working in the space sector. By the end of the project, a total of 19 English video interviews have been produced and published by the Space Awareness team on the Careers Hub. Each video interview is accompanied with a mini profile of the space professional. In addition to these English interviews, 9 more interviews were produced in Portuguese, featuring Portuguese space professionals, which have been published on a dedicated subpage on the Careers Hub.

Following the same structure and set of interview questions, an additional 16 written career profiles have been produced and published on the Careers Hub, providing an in-depth view in different career paths that can be pursued within the space sector.

Over the course of the Space Awareness project, the project team has developed and held 10 different live webinars featuring engineers and space professionals discussing a variety of topics and showcases of working in space sciences. Each of these webinars had a duration of approximately 60 – 90 minutes, and featured a broad selection of presentation tools, also allowing the participants to interact directly with the speaker hosting the webinar, for example through live chat functionality and online meeting rooms. The number of participants for each live webinar averaged approximately 70 people, ranging from students, (STEM) teachers, science educators and communicators and project representatives. After each live webinar, a video of the webinar was posted to the Careers Hub, providing easy access for other interested parties who could not participate in the live event.

A special highlight within the Careers Hub is the Space Careers Booklet, which provides a compilation of information about space careers, space employers and space facts. The booklet has been developed as a means to stimulate young people to follow STEM careers and is aimed at students, teachers and parents. The 32-page booklet comprises of three sections, featuring career profiles of professionals working as *scientists*, *engineers* and working in *other profiles* in space careers. In addition to availability in English, the booklet has been translated into 8 additional languages³, which have all been made available as downloadable high-quality PDFs in the Careers Hub. In addition to these digital versions, 5,000 physical copies of the English version have been printed and distributed among the Space Awareness network, as well as a total of 5,000 physical copies in the 8 additional languages of the booklet.

In line with the scope of the booklet, a poster was also created to bring more visibility and emphasis on the exciting career opportunities in the space sector. It was aimed to be an eye-catching resource and followed the same objectives of raising awareness and inducing excitement towards space careers. A digital version of this poster has also been made available online on the Careers Hub.

³ Dutch, French, German, Greek, Italian, Portuguese, Romanian and Spanish

5. LESSONS LEARNED FROM EVALUATION

Throughout the project, an extensive *Evaluation Framework* was embedded in all project resources and activities and embodied within a dedicated work package. This enabled all aspects of the project to be continuously tested against the intended outcomes, provided information about the effectiveness of the various Space Awareness resources and activities and allowed them to be improved, where necessary.

The combination of a centralised framework and distributed data collection has resulted in a set of consistent and comparable evaluation data from within Europe and beyond about our key activities, such as the educational classroom resources for teachers, face-to-face teacher training workshops and the Massive Open Online Courses (MOOCs).

An important aspect of the evaluation framework involved two large-scale Europe-wide surveys that enabled a baseline measurement of existing attitudes and opinions relating to space science. The first survey recruited 450 self-identified 'space scientists' from over 30 countries, to retrospectively reflect on which aspects influenced their decisions relating to space and technical career choices. Analysis of the results of this survey showed that, in general the interest in science in this group emerged at a very young age, usually before the age of 13 years old. Several factors influenced a spark, such as books, magazines, space-related events and the influence of teachers and parents.

The second survey involved 8,283 current pupils aged 9 – 16 from 11 countries across Europe, exploring their attitudes and opinions towards science in general as well as space science in particular. The survey showed that, although there was general enthusiasm from space among the entire sample, the survey found that younger students (9 – 11 years old) expressed a more positive attitude towards space science and were more likely to aspire to careers in space science, compared with older students. Also, many students, particularly girls, had the perception that Space-related professions are very challenging. Given the links between identity and the choices students make related to their aspirations, it is important to support individuals, particularly girls, in being able to imagine a future for themselves in the field or to consider a career in space science as a 'possible self'.

A further substantial achievement within the evaluation effort was the implementation of a longer-term strategy, in which educators were invited to register their contact details for potential involvement in follow-up research at a later date. Invitations to participate were distributed at every stage of the evaluation data collection processes, resulting in a broad pool of registered teachers and other educators that will enable dedicated longitudinal follow-up to occur in due course (subject to appropriate funding). This is a unique feature of the Space Awareness project.

We ascertained that the majority of teachers were able to access and use Space Awareness activities confidently and incorporate related content which they created or adapted into their classes. They – and their pupils – were inspired by the project to learn more about space science. Teachers and their students were energetic in sharing their improved understanding of (and enthusiasm for!) space science with others, including colleagues, friends, family and/or the wider community. Teachers also indicated that they had actively encouraged their students to pursue careers in space science or related areas, especially girls and ethnic minorities.

Our evaluation indicated that many young people throughout Europe and beyond were greatly inspired by their involvement and interactions with the Space Awareness programme. There is also evidence that it had a profound impact on their likely future aspirations and career-related decisions. Projects such as Space Awareness also play a fundamental role in ensuring that teachers remain up-to-date, effective and enthusiastic, and have a wide influence long after the project ceases. The evaluation therefore shows that Space Awareness was highly cost effective and provides the Commission with strong arguments for continuing to fund such projects. In addition, follow-up of the Space Awareness project itself would be extremely valuable for at least two reasons:

1. Space Awareness offers a unique opportunity for robust longitudinal (long-term) evaluation of the outcomes of such a project due to the existence of a baseline of pupils' attitudes and experiences, as well as a cohort of 180+ educators located throughout Europe who have registered their contact details for potential follow-up work.
2. There appears to be a gap in the current provision of international-level support to trainee and newly qualified teachers. Further opportunities to work with national-level teacher training / accreditation organisations would be particularly complementary to the audiences already reached within the programme.

6. CONCLUSION AND LEGACY

Space has proved an extremely effective tool for education and public engagement in science, technology and innovation. It has great appeal for large sections of the public for several reasons. First, the idea of space travel exploits widespread excitement around exploration and adventure. Secondly, space images are spectacularly beautiful, as demonstrated most notably by the NASA/ESA's Hubble Space Telescope and many other solar system missions, like ESA's Mars Express and recent images of the Earth from the EU's Copernicus Sentinel satellites. Thirdly, space sciences deal with the origins and evolution of the Solar System, our Galaxy and the Universe as a whole – topics of broad scientific and philosophical interest. Fourthly, the possibility of life in outer space is deeply embedded in social imagination, especially of young people (*Graham, 2002*). There are other aspects of space that make it particularly suitable for outreach and education. For example, the enormity of space was illustrated by the image of our place as seen as a pale blue dot beside the rings of Saturn. The understanding that we are all made of stardust also gives young people a broad perspective that transcends national boundaries and can help stimulate partnerships between diverse cultures and communities. During the last half century, the space sector has become a dynamic economic sector with expensive innovative space technologies and facilities – which require European and even global collaborations to fund them.

Space Awareness used diverse topics for outreach and education, by developing activities that touches on relevant themes such as *Our Wonderful Universe* (Space Sciences), *Our Fragile Planet* (Earth Observations), *Navigation Through the Ages* (spatial geo-positioning) and *The Journey of Ideas* (highlighting the importance of historic contributions from the global communities to the development of modern concepts of space and the Universe).

Through these activities, Space Awareness has reached more than 230,000 people directly, including 4,014 students and 5,799 education professionals. More than 150 educational activities were organised during the project, amongst them, 34 local teacher training events, 4 Massive Online Open Courses, 1 international Space Education Conference, 2 summer schools and one high-level event at the African Union. Over 300 educational resources were developed, selected, reviewed and distributed by Space Awareness. By the end of the Space Awareness project, the project coordinator, Leiden University also established the IAU Regional Office of Astronomy for development, which will carry out and coordinate relevant space-for-development activities in 3 sectors — (1) Universities and Research, (2) Children and Schools and (3) Public Outreach, focusing on accomplishing the United Nations Sustainable Development Goals in Europe.

Due to the nature of the European space sector, there is a need for coordination and consolidation of efforts in space education. It is important to create opportunities, and find sufficient funding, to enable key aspects of space education to be implemented. These include: (a) the creation of an integrated approach to space education, with joint high-level science-related literacy goals; (b) the consolidation of experiences, lessons and best practices for pre-university education in astronomy and other sciences; and (c) the creation of standardised open-access space-related educational resources. Among possible measures that can be taken to stimulate such activities are (i) devoting a small fixed percentage of space research budgets (including EU framework programmes) to education and outreach; and (ii) extending the one-dimensional measure of publication impact in citations to a second dimension for the measurement of education and outreach activities in the career development of the space professionals from researchers to engineers.

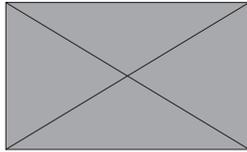
In summary, public engagement is critical to the future of research: a society that does not care about science will not fund it, and society will not care about science unless it engages with the subject matter.

The space community, like other research communities, must engage with the public, not only by communicating knowledge of space that they derive from research, but also by contributing to culture, philosophy and economic growth through scientific and technical innovation. It also needs to promote the processes and values of science — including rational inquiry, scientific method, global citizenship and the paramount importance of evidence.

The Space Awareness' partners are committed to pursue these ideas and contribute to a strong and vibrant European Space sector.

7. PARTNERS

7.1 SPACE AWARENESS PARTNERS



Ciência Viva

Portugal



ELLINOGERMANIKI AGOGI

Ellinogermaniki Agogi

Greece



Ecsite

Belgium



EUN

Belgium



Haus der Astronomie

Germany



National Research Foundation

South Africa

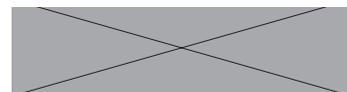


**Universiteit
Leiden**

The Netherlands

Leiden University

The Netherlands



Nuclio

Portugal



The Open University

United Kingdom



University College London

United Kingdom

7.2 DISSEMINATION NODES

- **Universe Awareness**, Tanzania
- **Al Akhawayn University**, Morocco
- **Armagh Observatory**, United Kingdom
- **Israel Center for Excellence through Education**, Israel
- **Department of Physics and Astronomy**, University of Nigeria, Nigeria
- **School of Education, Trinity College Dublin**, Ireland
- **Googol National Cultural Association**, Italy
- **Municipal Center for Extracurricular Activities**, Bulgaria
- **Telescope Technologies**, United Kingdom
- **NEMO Science Centre**, the Netherlands
- **New Space Foundation**, Poland
- **Norwegian Centre for Space-related Education (NAROM)**, Norway
- **Observatoire de Paris**, France
- **Planetarium of the Royal Belgian Observatory**, Belgium
- **Romania Space Agency (ROSA)**, Romania
- **Royal Observatory Edinburgh**, United Kingdom
- **University of Valencia, Astronomical Observatory**, Spain
- **Deep Space Industries Latvia**, Latvia
- **Ars Electronica Center**, Austria
- **Turkish Astronomical Society**, Turkey

8. APPENDICES

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