

Constellation

A GalileoMobile project



An IAU Cosmic Light Programme



In collaboration with ATU, GTTP and UNAWE



Official 2015 Proposal

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1 ABOUT GALILEOMOBILE

GalileoMobile is a non-profit, itinerant, science-education initiative that brings astronomy closer to young people in areas with little or no access to outreach programmes. We perform astronomy-related activities in the schools and communities we visit, and encourage follow-up activities through teacher-training workshops and the donation of telescopes and other educational resources. GalileoMobile also extends its impact to a worldwide audience through documentaries, photobooks, and a wide range of internet resources (e.g. our official website and blog, Facebook page, Twitter and Vimeo).

The key goals of the GalileoMobile initiative are:

- To inspire young people living in remote areas through astronomy, and to instill in them a life-long passion for learning.
- To provide their teachers with the tools and knowledge required to continue running science education programmes independently for years to come.
- To demonstrate to young people the power of critical thinking, so that they can apply these skills in their daily lives.
- To promote cultural understanding and interaction across borders, by enabling young people from diverse communities to exchange both scientific and cultural ideas about the cosmos.

Since its creation in 2008, GalileoMobile has embarked on five expeditions to a total of seven countries: Chile, Bolivia and Peru (2009), Bolivia (2012), India (2012), Uganda (2013), Brazil and Bolivia (2014), and Colombia (2014), as well as extended actions in Portugal (2012, 2013), Nepal (2013), and the United States (2013). We have reached over 8,800 pupils and 860 teachers, and our efforts and activities have been shared with the public in over 60 conferences and talks, including a TEDx talk. Along with the generosity of many private donors, GalileoMobile has benefited from the support of 38 scientific, educational, and/or governmental institutions worldwide. Today, we continue our efforts with the support of Universe Awareness (UNAWA) [1], and the collaboration of Galileo Teacher Training Program (GTTP) [2] and A Touch of Universe (ATU) [3].

GalileoMobile is an unprecedented initiative, promoting science knowledge through astronomy, raising awareness of cultural diversity, and spreading the message of “unity under one sky”.

To find out more about GalileoMobile, visit www.galileo-mobile.org



Figure 1: Children during the GalileoMobile visits in India, Uganda and Perú

2 OVERVIEW AND OBJECTIVES OF *Constellation*

With *Constellation*, GalileoMobile aims to establish a South American network of schools committed to the long-term organisation of astronomical outreach activities amongst their pupils and local communities.

We are aiming to transform the schools in the Constellation network into ‘science lighthouses’ within their communities, which have no access to alternative science-outreach programmes. These schools can then regularly involve students and the local community in astronomy-related activities and sky observations for years to come.

Each school in the network will benefit from:

- the donation of educational material and telescopes,
- a tailored, distance-training programme for all teachers,
- the *Space Exploration* programme, including activities to be carried out at the schools over four months,
- a two-day visit by the GalileoMobile team, involving outreach activities and teacher-training workshops,
- access to an online platform created especially for the network, which will allow the schools to share their work with each other and the world.

The project will involve twenty-one schools in seven countries (Perú, Brazil, Bolivia, Colombia, Ecuador, Chile and Argentina), directly reaching at least 100 teachers and 6,000 pupils. Thanks to the long-term sustainability of the project, more pupils will benefit from the project through events organised independently by the schools. The network can also be easily expanded to include more schools through future GalileoMobile expeditions.

In this proposal we discuss: the plan and timeline for the development of *Constellation* (sections 3 and 4), the different activities that will take place during the project, the material that will be used and donated to the schools (section 6), the procedure that will be followed to evaluate the outcome of the project (section 7), and finally the estimated expenses (section 8).



Constellation is a major Cosmic Light programme of the IAU's International Year of Light 2015

3 PROJECT PHASES

3.1 Preliminary phase

The preliminary phase of *Constellation* covers all stages before teaching to the pupils begins. These include:

Contact with local collaborators established. GalileoMobile has built up a wide network of local educators, scientists, and community leaders during previous expeditions, and continues to expand this network into regions where new visits are planned. Contact with these local collaborators will be established early-on, so that they can aid communication between the schools and the GalileoMobile team, and monitor the schools' long-term commitment to science education after *Constellation*.

Selection and preparation of the schools to take part in the project. Selection will be made according to the following criteria:

- The school and its local community have limited or no access to alternative science-outreach programmes. This is assessed via prior contact with the schools and/or local collaborators.
- At least one qualified science teacher from the school is interested in taking part in the project.
- The school has either direct access to a reliable internet connection, or has access to one in its vicinity at least once a week.

Start of the distance-training programme. Once the schools have been selected, the distance-training programme will begin. Teachers will receive electronic documents and online support from GalileoMobile, following an initial assessment of their understanding of astronomical concepts. The schools will also receive the material required to later carry-out the *Space Exploration* programme activities.

Creation of the online platform. This will include both an internal domain (forum, chat) accessible to schools in the network, and an external domain (blog, webpage, social media) aimed at bringing the project's progress closer to the wider public.

Recruitment of assistant educators to accompany GalileoMobile on visits to the schools. Two young, local scientists (graduate or undergraduate students) will be recruited per country to directly assist GalileoMobile members during the expeditions. We will first advertise the opportunity to participate in local universities and research institutes, and then select the most qualified and enthusiastic applicants, providing them with the relevant information and training before they join-up with the team.

3.2 Main phase

The main phase of the project covers those stages involving interaction with pupils, including:

The *Space Exploration* programme. Once the distance-training programme is under way, the schools will begin the activities that form the *Space Exploration* programme. These are designed to be carried-out over a four-month period as part of each school's science curriculum. The GalileoMobile team will assist the teachers throughout this stage, and schools will be encouraged to share and discuss results of each activity cycle with each other via the online platform (see section 5.2).

Visits to the schools. GalileoMobile will visit each network school for two days. During the visits, we will organise teacher-training workshops to supplement the distance-training programme, activities with the children, and public talks and sky observations involving the local community.

3.3 Follow-up phase

The follow-up phase includes all stages after the *Space Exploration* programme has been completed and the school visits have taken place. It is crucial that the progress made at the schools during the main phase is consolidated through continued science education activities. This will be achieved in the following ways:

- Keeping the online platform open and maintained after completion of *Constellation*. Schools can then build on their previous work by collaborating on future educational activities.
- Suggesting follow-up activities that best suit the interests of each school, drawing on our previous experience from former expeditions.
- Monitoring the progress of schools after we leave via the online platform and local collaborators. This is essential if we are to ensure that schools remain motivated and effective.
- Providing the assistant educators that have accompanied GalileoMobile with the skills required to take part in future science outreach programmes.

4 PROJECT TIMELINE

Oct- Nov 2014: A list of local collaborators to help in the selection of the schools is compiled, and direct contact with them is established. Plans for the design of the online platform are made.

Dec 2014: Design of the online platform begins. The list of schools to take part in Constellation is finalised.

Jan 2015: *First progress report: official list of schools in Constellation and assessment of the teachers' initial level of understanding of astronomical concepts. Detailed plan for the tailored distance-training programmes is made. Overview of the online platform's current stage of development.* The activity material is shipped to the schools. Testing of the online platform begins.

February 2015: The distance training begins. Electronic reading material is sent to teachers. Informal, weekly Skype meetings with a the GalileoMobile team are organised to clarify the content of the material. Teachers report on their pupils' level of interest and understanding of astronomy prior to beginning the activities.

March 2015: *Second progress report: Evaluation of the distance-training programme and the schools' readiness to begin the Space Exploration programme.* Feedback from the schools on the functionality of the material and access to the online platform. Official launching of the online platform and advertisement of *Constellation* on all of GalileoMobile's media channels. Advertising in local universities and research institutes to invite young, local scientists to participate in the programme as assistant educators.

April 2015: The *Space Exploration* programme begins.

Jul - Aug 2015: Planning of expeditions, including logistic planning (transportation and accommodation). Selection of GalileoMobile team members to travel. Assistant educators selected and provided with the relevant information and training.

Aug 2015: *Third progress report: assessment of the status of the Space Exploration programme thus far.*

Sept - Oct 2015: The three expeditions (one in Argentina and Chile, one in Colombia and Ecuador, and one in Perú, Brazil and Bolivia) take place simultaneously.

Dec 2015 - Jan 2016: *Fourth progress report: Global evaluation of Constellation.*

Jan 2016 onwards: Monitoring of the schools' follow-up activities and level of participation on the online platform. Yearly reports will be released assessing the level of participation of each school in the network.

4.1 Progress to date

The Constellation timeline is running to schedule. As of the 19th of November, 2014, contact with our local collaborators has been established in all countries involved. The following schools have already been selected to take part in the project:

- Colegio Insular Robinson Crusoe (Chile)
- Liceo Intercultural Bilingüe de Ralco, Comunidad Mapuche (Chile)
- Liceo Luisa Rabanal De Palma (Chile)
- Liceo Tecnico Profesional Colchane (Chile)
- Colegio Julio Garavito Armero (Colombia)
- Colegio Estrella Del Sur (Colombia)

The creation of the online platform has begun in collaboration with a professional website designer.

5.1 Teacher Training

The teacher training provided by GalileoMobile combines a tailored, distance-training programme with on-site, teacher-training workshops.

The **distance-training programme** has been designed especially for *Constellation* by professional educators. A key aspect of the programme is its flexibility; each teacher's training will be specifically tailored to suit their level of competence and degree of access to the internet. For this reason, an initial assessment of each teacher's level of astronomical knowledge is required.

Once an initial assessment has been made, teachers will receive personalised training, via online sessions and distributed reading material, on the four subjects covered in the *Space Exploration* programme handbook, the *Space Explorer's Guide* (see section 5.2). The training will focus on the core activities, but will be broad enough to also cover possible questions from the pupils on related topics. The online sessions will take place either once a week or every two weeks, according to the teachers's availability. After the teachers have begun carrying-out the *Space Exploration* activities in the classroom, there will be follow-up sessions once a month to clarify any doubts and discuss progress.

The **teacher-training workshops**, which will take place during the school visits, will allow the GalileoMobile team to identify and solve any problems which may have arisen during the distance-training phase, and help the teachers consolidate and expand on the topics covered. The workshops will take place on the morning of the first day at each school. In the first part of the workshop, we will introduce the teachers to star wheels and computer software. They will learn how to mount the telescope, point at a distant source, and perform safe solar projections. In the second part of the workshop, teachers will focus on any issues they may have, and provide feedback on the progress of the activities thus far.

5.2 The *Space Exploration* programme

Space Exploration is a four-month programme of astronomical outreach activities, to be carried-out at the schools under the supervision of the teachers. Through their participation, pupils will:

- become familiar with astronomical concepts such as stars, planets, constellations, and galaxies,
- learn how to design an experiment, conduct it and judge its results using scientific methods,
- learn how to communicate and debate their findings to their local team and others,
- learn more about their cultural heritage and about other cultures through astronomy.

The activities are grouped into the following subjects: 1) the Sun and the Moon, 2) planets, 3) stars and constellations, and 4) galaxies and the Universe.

In every participating class, the pupils will be divided into four science teams. Each team will focus on one of the above subjects, and carry out the activities relevant to that subject only. Each team will be given that subject's version of the *Space Explorer's Guide* (described in section 6), team badges, and instructions for each experiment.

Throughout the experiments, pupils will be instructed to have meetings within their team to discuss their findings. They should agree on their conclusions and present their progress to the whole class once every two weeks. The findings from each experiment should also be regularly uploaded onto the online platform, to allow teams to compare their results with those working on the same subject in other *Constellation* network schools. Finally, during GalileoMobile's visits to the schools, one representative from every team will present their results to the public, during public talks organised by the GalileoMobile team.

The activities will therefore allow the pupils to learn how to collaborate within a team, organise and present their scientific findings, cross-reference their results with those obtained by other teams, and collaborate with peers from different countries.

The *Space Exploration* programme also has a secondary focus on cultural exchange. Each group will be given, as a non-experimental activity, the task of collecting myths and folk stories related to astronomy as well as astronomical terms in local native languages. Each team will then report and discuss their findings to their class, and upload them onto the online platform for other network schools to see. They will also present the results from other schools, learning about astronomical culture in other countries in the process.

5.3 School visits

As with the *Space Exploration* programme, the structure of the school visits has been carefully developed over the years by the GalileoMobile team. Since 2008, these core aspects of the project have been widely tested, improved, and expanded, drawing on our experience from previous expeditions. Our school visits have proven very effective in helping us accomplish the key goals of the GalileoMobile initiative (see section 1).

GalileoMobile will visit the *Constellation* network schools for two days each. During the visits, we will organise teacher-training workshops, activities with the children, and public talks and sky observations involving the local community. These expeditions play a very important role in *Constellation*, by:

- allowing the GalileoMobile team to identify and solve any problems which may have arisen during the distance-training programme, and help the teachers consolidate and expand on the knowledge they have already acquired,
- helping to strengthen the bonds between the individual network schools, by allowing us to link what has been achieved at schools we have previously visited with those we visit later on. An important aspect of *Constellation* is to ensure that all schools feel they are active members of a wider community,
- providing the teachers and pupils with an opportunity to celebrate their achievements and share their work with the visiting GalileoMobile team, local community, and other network schools. This will allow the schools to be recognised as a point-of-contact for anyone in the community wishing to learn more about astronomy, and will help inspire young people through astronomy, and encourage schools to carry-out science education programmes in the future.

Assistant educators will also be recruited to accompany the GalileoMobile team on the school visits and assist with the activities. This has the dual benefit of giving these young scientists first-hand experience at science outreach in their local communities, and reducing the number of GalileoMobile team members that are required to travel long distances to take part in the expeditions.



Figure 2: School visits in India, Uganda and the Dominican Republic

6 RESOURCES AND MATERIAL

The material donated to schools as part of the Constellation project includes:

- the *Space Explorer's Guide*,
- 2" mountable telescopes with observing guide,
- inflatable globes,
- digital resources,
- planispheres.

All material will be provided in the official language of the countries visited. A computerised telescope, which will be provided by one of our members, will be used during night-sky observations.

The *Space Explorer's Guide* is structured to function as an instruction manual for the four-month *Space Exploration* programme, described in detail in section 5.2. It comprises a series of hands-on activities of increasing complexity to be carried out by the pupils, with the help of their teachers. The activities are tailored to middle and secondary schools, have been carefully selected to be interactive and playful, and require only low-cost and easy-to-find materials.

Teachers will receive a general guide covering all four of the subjects included in the *Space Exploration* programme: 1) the Sun and the Moon, 2) planets, 3) stars and constellations, and 4) galaxies and the Universe. Pupils will receive an adapted guide covering only the specific subject to which they are assigned. Pupils are then required to collaborate within their team to complete their specific activities, as well as with other teams working on the same subject at other *Constellation* network schools. They will also discuss their results with the rest of their class, reporting their findings. The teacher's guide includes a description of each activity's educational goals and the evaluation procedure. Training for these tasks, as well as ongoing support, will be provided by the GalileoMobile team (see Section 5.1).

7 EVALUATION AND FUTURE ACTIVITIES

Four progress reports will be released at different stages over the course of the *Constellation* project (see section 4), and yearly reports from January 2016 onwards will be produced to monitor the follow-up activities. In addition, information will be compiled and shared both across the network and through all GalileoMobile media channels to highlight the activities organised in each school and to share astronomical interpretations and folklore from the various cultures in the participating regions.

The assessments made in the first two progress reports will be performed following a detailed evaluation plan designed especially for *Constellation* by professional educators. This plan primarily ensures that the initial level of astronomical knowledge of each teacher is carefully evaluated before training begins.

The plan also provides clear guidelines on how the educational outcome of each activity should be evaluated. This assessment will be performed both by the teachers themselves and by the GalileoMobile team at the time of the visit.

After the completion of *Constellation*, its long-term success and legacy will be assessed via yearly reports on the number and nature of the follow-up activities organised by the network schools. We will monitor this with the aid of the online platform and local collaborators, and include statistical results in our yearly reports.



Figure 3: Assembling a Moon puzzle in Perú, building planets in India, and studying sunspots in Uganda

8 BUDGET PROPOSAL

The *Constellation* budget has been carefully drawn-up to eliminate unnecessary costs and minimise essential ones. The total costs estimated for the project amount to 35,433€. Table 1 summarises these, including forecasted travel expenses.

Travel-expense estimates were made assuming that three GalileoMobile team members and two assistant educators attend each expedition, with a total of fifteen participants at any given time. By recruiting and training assistant educators, and utilising the expertise of local collaborators, we are able to minimise the number of GalileoMobile team members that are required to travel long distances to participate. Those GalileoMobile team members that do take part in each expedition are essential for the success of the *Constellation* project, as they are responsible for the tasks carried-out at the schools and provide vital experience obtained from previous expeditions.

Of the nine GalileoMobile team members taking part, seven will be travelling from Europe or North America and two will already be located in South America. It is predicted that the flight costs for GalileoMobile team members will be covered by their affiliated home institutions (see Appendix B). Travel expenses for non-GalileoMobile participants are also included in the *Constellation* budget, so that personal financial constraints do not preclude their participation.

Estimates for material expenses were made assuming that a total of twenty-one schools will take part in *Constellation*. All material acquired for the project will be donated to the schools.

Trip		
Material		
	Galileoscopes	21 × 22.06 €
	Tripods	21 × 30 €
	Workshop material	21 × 200 €
	Space Explorer's Guide	21 × 80 €
	Basic material	21 × 100 €
	Online-platform	500 €
	Maintenance of online platform	100 €
	Shipping	1,000 €
	Total	10,673.26 €
Travel		
	Medicines	9 × 100.00 €
	Vaccinations	9 × 110.00 €
	Insurance	9 × 30.00 €
	Flights (continental)	2 × 400.00 €
	Flights (intercontinental)	7 × 1,400.00 €
	Local transportation	15 × 300 €
	Food and lodging	15 × 500 €
	Total	24,760.00 €
Total Budget		35,433.26 €

Table 1: Estimated expenses for the Constellation Project

- [1] Universe Awareness (UNAWA) website, www.unawe.org
- [2] Galileo Teacher Training Programme (GTTP) website, www.galileoteachers.org
- [3] A Touch of Universe (ATU) website, <http://observatori.uv.es/astrokit/>
- [4] Traditional Knowledge, Innovations and Practices Programme (UN-CDB) website, <http://www.cbd.int/traditional/>.
- [5] Astronomy for the Developing World, Strategic 2010-2020, George Miley.
- [6] International Year of Astronomy 2009 (IYA2009) website, www.astronomy2009.org
- [7] The GalileoMobile 2009 – 2011 report, http://astro.ufsc.br/galileomobile/sites/default/files/2009-2011_Report.pdf
- [8] Instituto Nacional de Ciência e Tecnologia de Astrofísica webpage (INCT-A), <http://www.astro.iag.usp.br/~incta/>
- [9] The GalileoMobile Handbook of Activities, galileo-mobile.org/files/Handbook_GalileoMobile_English_PF.pdf
- [10] The International Year of Astronomy 2009 (IYA2009) final report, p. 268-282, www.astronomy2009.org/resources/documents/detail/iya2009_final_report/
- [11] Under the same sky (Bajo un mismo cielo), GalileoMobile documentary.
- [12] The GalileoMobile Pando report 2012, http://galileo-mobile.org/files/Pando_Report.pdf
- [13] The GalileoMobile Khagol Rath Expedition report 2012, http://galileo-mobile.org/files/Khagol_Rath_report.pdf
- [14] Office for Astronomy Development (OAD) website, www.astronomyfordevelopment.org

A. PREVIOUS AND CURRENT SUPPORT

GalileoMobile has benefited from the support of a large number of scientific institutions and sponsors, including (in alphabetical order):

- Açaí Palace Hotel
- Associação Pamaur do Clã Makor do Povo Paiter Suruí (Makor-ey)
- Associação Metareilá (Gamebey)
- A Touch of Universe (ATU)
- Café Scientific Uganda
- Committee on Space Research (COSPAR)
- Costruzioni Generali Marescalchi (Co.Ge.Mar.)
- Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)
- Dirección Departamental de Educación de Pando (DDEP)
- Direction of Education of Pando (SEDUCA)
- Deutsches Zentrum für Luft- und Raumfahrt (DLR)
- Education Secretary of Cobija
- European Southern Observatory (ESO)
- Galileo Teacher Training Program (GTTP)
- Gobierno Autónomo Municipal de Cobija
- Indian Institute of Astrophysics (IAA)
- The Infosys Science Foundation (ISF)
- Instituto de Astronomía Terica y Experimental (IATE)
- Instituto Federal de Educação, Ciência e Tecnologia do Acre (IF-AC)
- Institute for Molecules and Materials of the Radboud University Nijmegen (IMM)
- The International Astronomical Union Office of Astronomy for Development (IAU-OAD)
- International Inner Wheel (IIW)
- Jawaharlal Nehru Planetarium,
- Max Planck for Astrophysics (MPA)
- Max Planck for Extraterrestrial Physics (MPE)
- Max Planck for Solar Physics (MPS)
- Max Planck Gesellschaft (MPG)
- Museu de Astronomia e Ciências Afins (MAST)
- Nordic Institute for Theoretical Physics (NORDITA)
- Optical Society (OSA)
- Regione Molise
- Universe Awareness (UNAWAWE)
- You are Galileo!
- Secretaria de Estado da Educação de Rondônia - Cacoal
- Stockholm University
- Swissnex Brazil
- Universe Awareness (UNAWAWE)
- Universidade Federal de Rondônia (UNIR)

B. TEAM MEMBERS

Here are listed the names, nationalities, and affiliations of the current members of the GalileoMobile project in alphabetical order by first name.

- **Dr. Bárbara Rojas-Ayala**, Astronomer (Chile)
Centro de Astrofísica da Universidade do Porto, Porto, Portugal
- **Dr. David Bühler**, Astrophysicist (Germany)
Max Planck Institute for Solar System Research, Göttingen, Germany
- **Eduardo Monfardini Penteado**, Astrophysicist (Brazil)
Institute for Molecules and Materials, Nijmegen, Netherlands
- **Eleftheria Tsourlidaki**, Astronomy Outreach (Greece)
Ellinogermaniki Agogi, Research and Development Department, Pallini, Greece
- **Dr. Evangelia Ntormousi**, Astrophysicist (Greece)
CEA (Commissariat à l'Energie Atomique), Gif sur Yvette, France
- **Dr. Fabio Del Sordo**, Astrophysicist (Italy)
Yale University and NORDITA
- **Dr. Jorge Gustavo Rivero González**, Astrophysicist (Spain)
Astrophysicist/Science Communicator
- **Lina Canas**, Astronomy Outreach Content (Portugal)
Developer Navegar Foundation, Centro Multimeios de Espinho, Portugal
- **Dr. Linda Strubbe**, Astronomer (United States of America)
Canadian Institute for Theoretical Astrophysics, Toronto, Canada
- **Margherita Molaro**, Astrophysicist (Italy)
Max Planck Institute for Astrophysics, Garching, Germany
- **Dr. María Dasí Espuig**, Astrophysicist (Spain)
Imperial College London, UK
- **Maya Barlev**, Astronomy Outreach (United States of America)
- **Dr. Mayte Vasquez**, Space physicist (United States of America)
Deutsches Zentrum fuer Luft- und Raumfahrt, Munich, Germany
- **Dr. Megha Bhatt**, Astronomer (India)
Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany
- **Milagros Varguez**, Journalist (Mexico)
Humanistic Studies in Science and Culture, Monterrey Institute of Technology and Higher Education, Nuevo León, Mexico
- **Nuno Gomes**, Astronomer (Portugal)
SIM, Porto, Portugal and ESO, Garching, Germany
- **Dr. Patrícia Figueiró Spinelli**, Astrophysicist (Brazil)
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