

Astronomy Communication: the REAL knowledge hub

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Abstract—May 2014 saw the launch of a new online environment devoted to astronomy education and outreach, called REAL, Educational Resources for Laboratorial Astronomy, hosted on edu.inaf.it. (<http://www.edu.inaf.it>). It was created, within the project "Astronomy and Society, Between Tradition and Technological Innovation", funded by the Ministry of Education, University and Research (MIUR). REAL was implemented by the Institute of Educational Technology of the National Research Council of Italy in collaboration with the National Institute for Astrophysics (INAF), the Astronomical Observatory "G. Vajana" in Palermo and the Astrophysical Observatory in Turin. The system was designed to satisfy both the need to reach a wider public and people interested in astronomy, and the need to establish a communication channel between scientific facilities and schools of every grade.

Keywords—Astronomy, e-learning, online platform, didactics and outreach.

I. INTRODUCTION

ASTRONOMY has a great appeal for the young because it concerns the great themes of life and because the objects and investigations can be represented with images, videos and simulations, which are captivating and engaging [1].

To exploit the advantage that astronomy has over other sciences, it is important to use astronomy communication activities as a tool to raise public awareness of science [2]. The Internet has made astronomy more accessible to teachers, students and the public, allowing them to carry out experiments and observations easily and cheaply.

Even though the internet has made many resources available online, public access to them frequently remains limited [3]. In practice, a complex infrastructure is needed to collect and distribute the multitude of astronomical data that are stored in different formats and according to different standards.

Introducing young people to the world of science and research and, in particular, to the study of astronomy is a necessary undertaking if our aim is to train a new generation of citizens to be more attentive to research, and to recognize that the development of a society also depends on the transfer of know-how and technology from the world of scientific research to the general public.

To achieve this aim, it is necessary to define a teaching and

learning methodology with long-term effects that identifies appropriate means of communication and suitable educational goals for achieving the target.

Within the framework of a project funded by the Italian Ministry of Education and Research, the Institute of Educational Technology of the National Research Council of Italy (ITD-CNR) in collaboration with two Astronomy Observatories of the National Institute for Astrophysics (INAF) has designed and developed a knowledge hub called Educational Resources for Laboratorial Astronomy (REAL) hosted on the website EduINAF. This system is an online platform, which aims to share and spread educational resources and educational activities in the field of astrophysics.

REAL was designed and developed to store in a simple, consistent and structured way the astronomical teaching and dissemination material compiled by INAF institutes over the years, and to allow teachers and experts to submit contributions to the repository, after appropriate validation of their scientific and educational quality [4,5,6]. REAL aims to:

- establish a communication channel between scientific facilities and schools of all levels;
- satisfy an increasingly vast and varied public, also using new communication technologies;
- introduce young people to the world of science and research, and in particular to the study of astronomy;
- train a new generation of citizens to be more sensitive to research issues and to appreciate how important the transfer of know-how and technology is for the development of the society to improve living conditions.

To achieve these educational and training aims it is necessary to define teaching and learning methods with medium and long-term effects that use appropriate media accessible to a wide audience [7].

This paper will describe the REAL system as a web space to promote courses, workshops, experiments and teaching materials using interactive tools, and will suggest educational methods to adopt in both curricular and extracurricular activities, combining traditional didactic approaches and innovative methodologies. These include training and

upgrading for students, curricular and extracurricular laboratory activities, and teacher training courses.

II. REAL: FUNCTIONALITY FOR THE USER

The REAL platform provides the user with a very quick and easy tool for finding information and news about astronomy. Access to real-time data about events open to public, direct contact with astronomers and the opportunity to connect the world of education with the world of science offers a valuable opportunity to spread and improve scientific knowledge [8].

The Home Page supports users in accessing different sections: News, Events, Educational Resources, Educational Courses, Astrokids (section dedicated to children), Books and Reviews and Contacts.

The **News** section contains update articles, related to astronomical events, research, educational activities and dissemination.

The **Events** section presents dates and venues of astronomical events organized by INAF which are open to the public; here it is also possible to book night time observations, visits to INAF planetariums, observatories and institutes (17 locations nationwide), and other local initiatives.

The **Educational Resources** section contains astronomical topics of interest, which can be located using a keyword search. The educational resources search is achieved by two mechanisms: A Search Widget, or graphic that facilitates user interaction with the system, and a search page accessible through the menu "Advanced Search". The Widget allows a full-text search (search engine style), both within metadata and attached files. The search page allows a targeted search using specific search filter such as author, title, keywords, and target audience. The Educational Resources include pages, schema, pictures, videos, photos, tests, research papers and instructions for carrying out experiments at home or school. The topics so far developed include the study of constellations, the earth's gravity, lunar phases, the seasons, solar phases, the solar system, space missions and cosmology.

Teaching Courses, which will start operating soon. A teacher can select the educational level of his students, primary middle or high School. The resources are managed according to the levels with appropriate language for the students' ages.

Astrokids is the section dedicated to astronomy laboratories for children aged 6 to 12. The link leads to a subsection of the portal dealing with easy astronomy topics accompanied by colorful pictures, models for games, puzzles and crosswords, like the laboratories that Astrokids INAF has successfully produced for many years at a national level [9]. The section also includes the online book "Astrokids. Adventures and Discoveries in Space" [10], periodically updated and integrated.

In the **Books and Reviews** section users can find a selection of astronomy books for children and teenagers edited by INAF - Arcetri Astrophysical Observatory. This bibliography identifies Italian publications since 2005, indicated by Liber Database published by Idest as the best on the market. The publications are organized in alphabetical order by title, and

are divided according to age groups. They include a number of works out of print before 2005, reported as not for sale, but available in public libraries.

III. THE REAL KNOWLEDGE HUB SOLUTION –TECHNICAL FEATURES

REAL is an online platform for teaching and disseminating educational resources managed by the National Institute of Astrophysics. According to Mortera-Gutierrez [11] and J. Knight [12], Real has been implemented as a knowledge hub website that offers information and training services, aimed at sharing educational resources and learning initiatives created by scientists and astronomers [13,14,15]. REAL acts as collector of astronomical experience of both professional and amatorial user and thanks to the characteristics of Web 2.0 supports communities of practice in astronomical field.

REAL is composed by (Fig.2):

- Web Site;
- Content Management System;
- Learning Management System;
- Event Manager (customized using WordPress plugin Events Manager).

The website represents the access point to the Knowledge Hub. From a technical point of view, it has been realized by customizing one of the most popular solutions for the creation of websites: Wordpress. Wordpress is a web-publishing platform based on the concept of blogs and it is the perfect solution for creating sites to "build" users' community in which people can create space for discussions, analysis and comment all the resources (pages, posts, etc.). Each resource in the website is linked through trackbacks and pingbacks mechanism, to allow information to circulate in other sites, blogs or social networks.

The core features offered by the Wordpress has been enriched to allow:

- integration with the most important social networks
- management of dissemination events by means of a recording mechanism.
- definition of an interface to access the repository of educational resources.

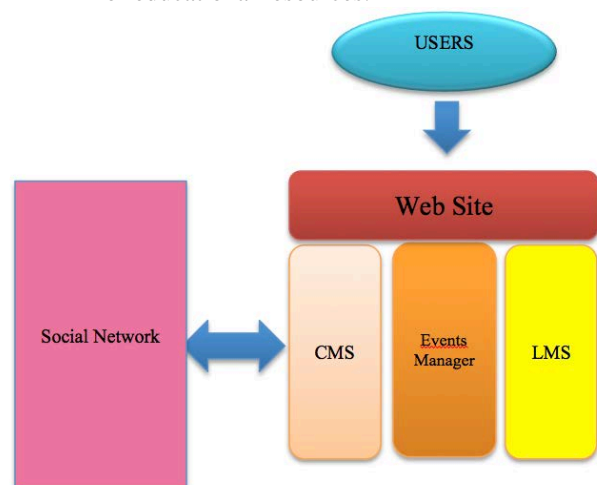


Figure 1 : The real architecture

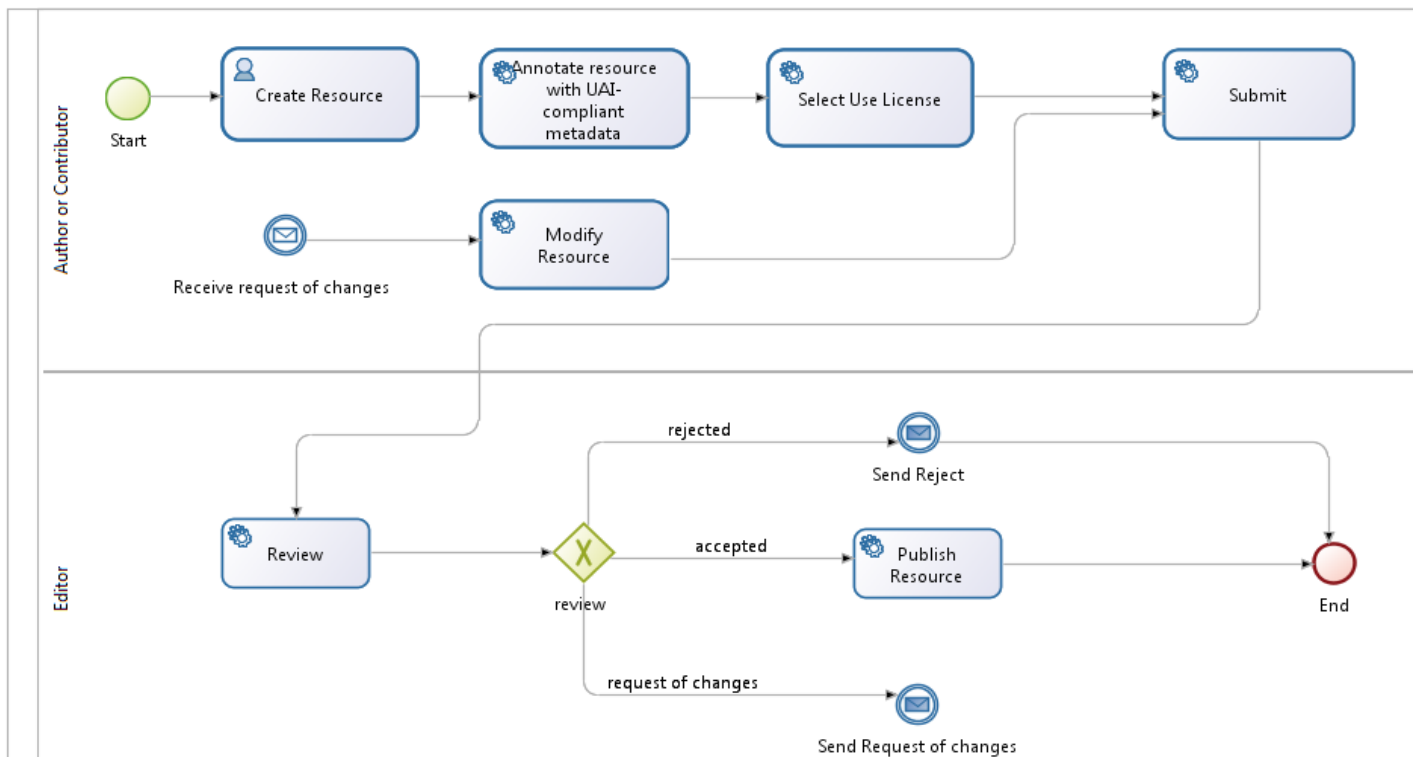


Fig. 2 Graphical user roles

The CMS has been developed using Modeshape a distributed, hierarchical, transactional, and consistent data store. Modeshape is compliant with the Java Content Repository 2.0 standard and provides built-in features useful for the realization of an efficient and intuitive system to search resources. The CMS has been implemented as a back-end web service accessible directly from the web site through an ad-hoc plugin developed for Wordpress. The plugin defines a set of "shortcodes" (keyword linked to specific code) that allows flexible integration of CMS features in the portal pages. Thanks to the shortcodes, any changes in the REAL web site organization can be performed directly by the site system administrator without requesting further developments or depth IT skills.

For the quality assurance of published material in the REAL platform a review process has been integrated into the CMS through the implementation of a workflow. The workflow allows the "publishers" to check the quality of contents proposed by users and eventually the notification of change request for approval.

REAL customizes the default roles defined within Wordpress, extending with specific permissions and privileges, as detailed below (Figure 3):

- Guest: can view all approved learning resources.
- Collaborator: can create and modify teaching resources and introduce them into the validation flow, he can view approved teaching resources.
- Author: special collaborator that can insert and manage events through the event manager plugin.
- Editor: participates in the review process and can create, view, edit, approve or reject all learning

resources.

- Administrator: has all the privileges / permissions described above and can customize both the system and the pages, which can be made visible to any user or restricted to users who have been assigned a specific role.

The figure 4 summarizes the process of integration and validation of educational resources in REAL.

Users with the role of author or collaborator initiate the insertion process of educational resources. The "Add educational Resources" menu item in the "Educational Resources" menu, allow the user to enter the data and the metadata of an educational resources through a form compliant with metadata scheme suggested by the International Astronomical Union.

All data associated with the educational resource, including attached files, are automatically indexed by the document repository. Moreover, a thumbnail for all types of files known (eg: pdf, ppt, doc, docx etc.) with visual preview of contents of attached files is created.

Each new resource is inserted with the status "Pending", meaning it is not yet indexed and visible to the public. The Publisher uses a special section called "Manage Educational Resources" to approve, reject or request for change of educational resources submitted.

When a resource is approved, immediately change his status in "Approved" and will be visible to the public; in addition, a message from Wordpress will communicate availability in the News section of the web site.

A rejected resource, will be deleted from the repository and

a notify of rejection will be sent to authors. Finally, a resource that needs some changes will be notify and sent back to the author; the review process will start again from the beginning.

In order to further ensure the quality of educational resources publications, each resource will be tagged by the metadata scheme of suggested International Astronomical Union (IAU) (<http://astroedu.iau.org/>). This scheme will allow further reflection by the author on the characteristics of the educational resource proposal, and will facilitate the search and retrieval in the platform.

This environment has been integrated with the other elements of the Knowledge Hub and, in particular, with the repository of learning resources. The LMS provides users a collaborative learning space for follow standard learning paths already defined or test new paths that use educational resources inserted in the repository.

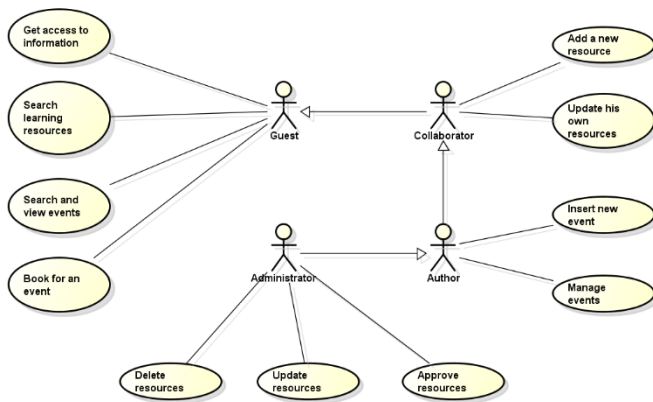


Fig. 3 Schematic of the review process

The final element of the Knowledge Hub component is the Event Manager. Real hosts a network of observatories that organize training days open to the public. The event manager provides the administrator of the website, a private section in which to place the training events, attaching information of interest such as event location, minimum and maximum number of participants, time and topics. Users will be able to view events and book a visit to the observatory chosen.

IV. CONCLUSION

The bar chart of accesses to REAL (fig. 4), (May 2014/June 2015) shows a growing trend confirming that Astronomy is a science that appeals to everyone, adults and children, experts and the general public. Many of them, however, do not have a critical approach and consider all the information found on the web to be true.

Through the REAL knowledge hub, INAF intends to provide certified public resources. Some of these resources have been developed over the years by the Institute and are now included in a format that follows international standards. Other resources may be submitted for publication directly by teachers and enthusiasts. The materials presented will still have to go through a process of review and evaluation by a committee of experts to ensure that the information made available to the public is accurate and authoritative. Such

monitoring will ensure that over time REAL takes the form of an archive containing reliable, validated and relevant data.

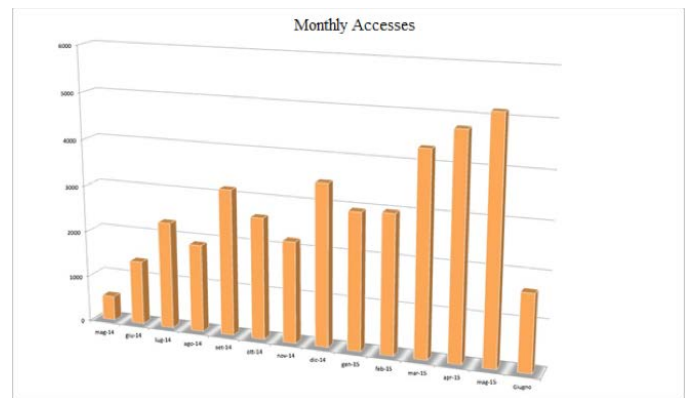


Fig. 4 Monthly accesses trend.

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