	Discover the COSMOS Deliverable

PROJECT'S PORTAL

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Code:	D 3.6	**Approved by:**	<Review Committee>
Version & Date:	**01, 02, 1/9/2013, 16/9/2013**	**Process Owner:**	IASA

Short Description:

This deliverable describes the Discover the COSMOS portal which provides the project's support environment. Its development process, structure and basic technical information. It also informs about how the portal will be maintained during the project's life time.

The version of the deliverable delivered at the end of the project (M24) includes the additional information asked for by the technical review report on October 2012.

The portal currently (August 2013) supports a community of about 5700 teachers. It includes about ~86,500 educational objects organized in the form of educational content and educational scenarios (lesson plans). The most important characteristics of the portal are the organization of the content according to a science education vocabulary (connected with the school curriculum) that provides easy access and retrieval of the educational materials, as well as the support of the on-line users community and communication between themselves.

List of Recipients:

All the partners, EC

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1. Executive Summary

The project's portal is the main platform for collecting the learning resources and the e-science applications, the so called demonstrators. Thus teachers are able to access their colleagues' resources/tools, share their own, exchange best teaching practices and communicate between themselves-through several blogs- with the stakeholders as well as with general public.

The development of the *Discover the COSMOS* portal in conjunction with the website, allows for constant online presentation and dissemination of the project progress and results. The portal is a rich source of high quality teacher generated course material, lesson plans and applications about High Energy Physics and Astronomy. The portal which has been already released more than one and a half year ago in the production infrastructure is acting as a unique repository of the material previously included at "COSMOS" as well as "ATLAS@CERN" portals/databases.

2. Scope

The scope of this deliverable is to describe the structure and the content of the portal, the information that it contains and the ways in which it is maintained and updated. Also, we shortly describe the technologies that were used in its development. We are also describing the multilingual approach of the system and the community support tools.

Furthermore, we benchmarked the Discover the COSMOS web usage against the law of surfing. As the quantitative results demonstrate, new users follow a typical surfing pattern. However, returning users (who comprise more around 50% of all Discover the COSMOS visitors) outperformed this pattern substantially, by "foraging" frequently, deeper and longer for the science education content offered by the Discover the COSMOS Portal.

Such studies may improve our understanding of the most effective ways of organizing and using digital resources in the teaching practices. It may provide a more comprehensive basis for designing more efficient educational digital repositories that could support innovative teaching practices. Such findings also serve a critical role by providing information for the next design cycle for such systems. Moreover, by focusing on teacher practice, the present work advances the role of digital libraries in supporting teacher collaboration and community-building activities.

In particular, involving teachers as designers of learning activities that are relevant to their classroom needs helps them participate in the emerging education cyber-infrastructure: first they become users of online resources and eventually they "close the loop" by contributing new learning activities using online resources to education digital libraries. This method can also be used for a number of interesting web applications. Because of the web's digital nature and widespread use, it is relatively easy to obtain online data that could reveal more novel patterns of information foraging, and one could extend the method to determine the distinct characteristics of different user communities.

3. Domain name and hosting

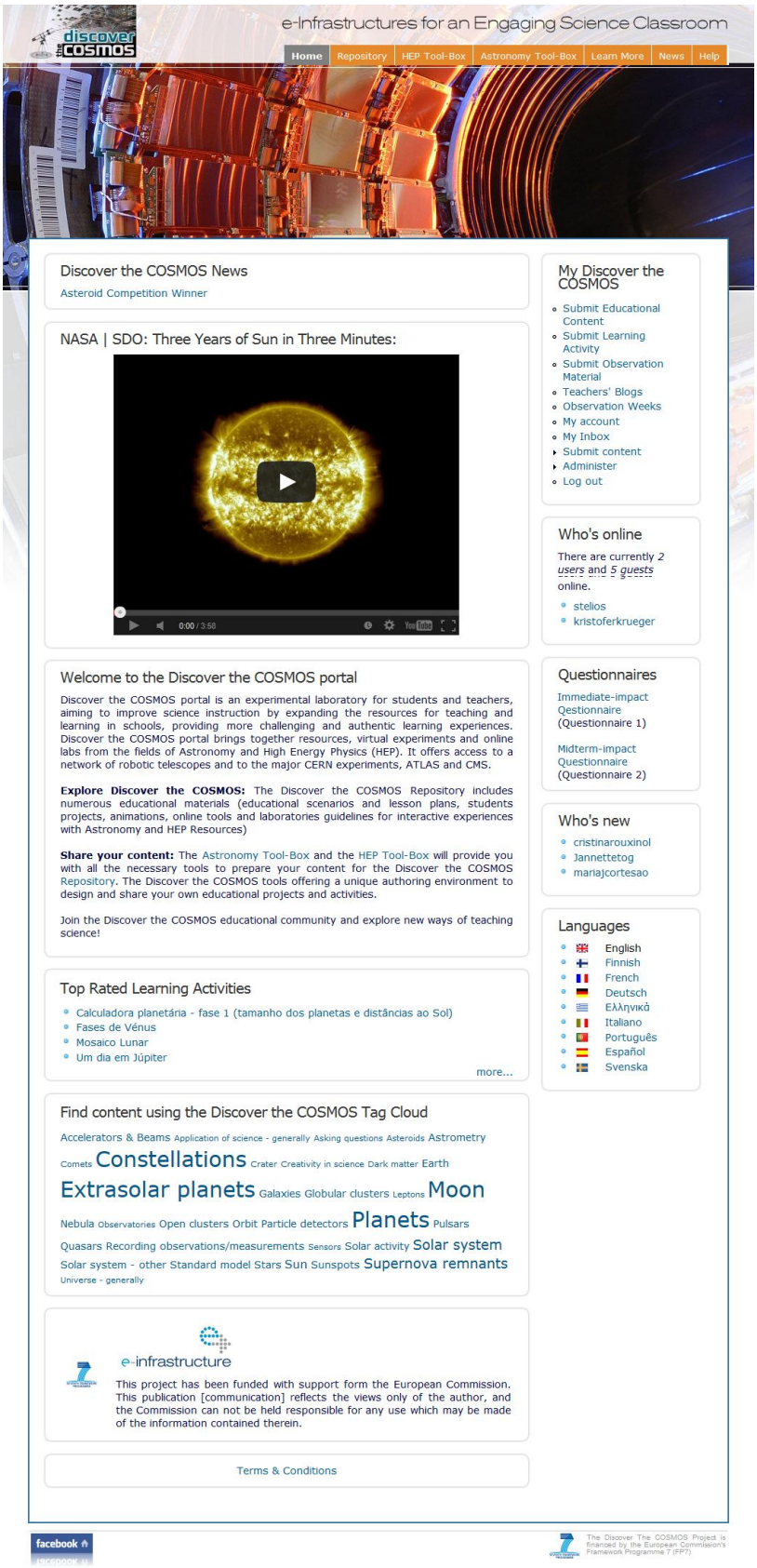
The project's portal can be reached at : http://www.portal.discoverthecosmos.eu/ This is a subdomain of the official domain name that was booked by the dissemination Co-Leader, Science View.

The 'Discover the Cosmos' portal is hosted on a single Virtual Machine (VM), following XEN[1] technology for virtualization and it is physically located at the IT/Grid Data Center at IASA[2]. Furthermore, both the 'Learning with ATLAS@CERN'[3] and the 'COSMOS'[4] portals, have also been migrated on the same physical location and following the same virtualization techniques.

The Coordinator's data center offers a highly reliable environment with advanced levels of redundancy, 24×7 support and monitoring facilities, daily back-ups and it is being operated by a team of professionals with more than 10 years of experience on delivering high quality, great value of IT solutions to numerous projects and activities.

Below we present the first page (home page) of the portal.

[1] http://www.xen.org/
[2] http://it.iasa.gr/
[3] http://www.learningwithatlas-portal.eu/
[4] http://www.cosmosportal.eu/


e-Infrastructures for an Engaging Science Classroom
Home
Repository
HEP Tool-Box
Astronomy Tool-Box
Learn More
News
Help
Discover the COSMOS News
Asteroid Competition Winner
NASA | SDO: Three Years of Sun in Three Minutes:
0:00 / 3:58
Welcome to the Discover the COSMOS portal
Discover the COSMOS portal is an experimental laboratory for students and teachers, aiming to improve science instruction by expanding the resources for teaching and learning in schools, providing more challenging and authentic learning experiences. Discover the COSMOS portal brings together resources, virtual experiments and online labs from the fields of Astronomy and High Energy Physics (HEP). It offers access to a network of robotic telescopes and to the major CERN experiments, ATLAS and CMS.
Explore Discover the COSMOS: The Discover the COSMOS Repository includes numerous educational materials (educational scenarios and lesson plans, students projects, animations, online tools and laboratories guidelines for interactive experiences with Astronomy and HEP Resources)
Share your content: The Astronomy Tool-Box and the HEP Tool-Box will provide you with all the necessary tools to prepare your content for the Discover the COSMOS Repository. The Discover the COSMOS tools offering a unique authoring environment to design and share your own educational projects and activities.
Join the Discover the COSMOS educational community and explore new ways of teaching science!
Top Rated Learning Activities
Calculadora planetária - fase 1 (tamanho dos planetas e distâncias ao Sol)
Fases de Vénus
Mosaico Lunar
Um dia em Júpiter
more...
Find content using the Discover the COSMOS Tag Cloud
Accelerators & Beams Application of science - generally Asking questions Asteroids Astrometry Comets Constellations Crater Creativity in science Dark matter Earth Extrasolar planets Galaxies Globular clusters Leptons Moon Nebula Observatories Open clusters Orbit Particle detectors Planets Pulsars Quasars Recording observations/measurements Sensors Solar activity Solar system Solar system - other Standard model Stars Sun Sunspots Supernova remnants Universe - generally
e-infrastructure
This project has been funded with support form the European Commission. This publication [communication] reflects the views only of the author, and the Commission can not be held responsible for any use which may be made of the information contained therein.
Terms & Conditions
My Discover the COSMOS
Submit Educational Content
Submit Learning Activity
Submit Observation Material
Teachers' Blogs
Observation Weeks
My account
My Inbox
Submit content
Administer
Log out
Who's online
There are currently 2 users and 5 guests online.
stelios
kristoferkrueger
Questionnaires
Immediate-impact Questionnaire (Questionnaire 1)
Midterm-impact Questionnaire (Questionnaire 2)
Who's new
cristinarouxinol
Jannettetog
mariajcortesao
Languages
English
Finnish
French
Deutsch
Ελληνικά
Italiano
Português
Español
Svenska
facebook
The Discover The COSMOS Project is financed by the European Commission's Framework Programme 7 (FP7)

4. Structure of the Portal & work performed

The Discover the COSMOS portal is acting as a common repository for teacher generated course material, lesson plans and applications about High Energy Physics and Astronomy. The content populated through the portal is the outcome of a migration process took place during the first year of the portal and contains all the educational material (educational content and learning activities) as well as the persons profiles, included at the "COSMOS" and the "ATLAS@CERN" portals/databases.

The table (Table 1) below, provides a detailed analysis on how many items, educational content, learning activities and persons profiles, have been migrated from the "COSMOS" and the "ATLAS@CERN" portals respectively, how many items were posted/created from the beginning of the Discover the COSMOS project and what is the total number for each item type at the end of the project exist into the system.

Table 1: Discover the COSMOS Educational Content and Learning Activities (from the portal merging up to 31/08/2013)

	#Learning activities	#Educational content	#People profiles
Migrated from 'COSMOS' portal	353	80,686	2,020
Migrated from 'ATLAS@CERN' portal	43	132	206
Newly posted/created during both years of the 'Discover the COSMOS' project. (metrics taken, on 31st of August 2013)	227	5,682	3,474
Total number of items included in the 'Discover the COSMOS' portal:	**623**	**86,500**	**5,700**

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4.1 Work performed

4.1.1 First project year

In general, the migration phase consisted of the following actions:

- Merging all the people profiles from the two source repositories "COSMOS" and "ATLAS@CERN", hence, creating a unique/common pool of users.
- Migrating all the content related items (and each 'revision' item of it) such as educational content and learning activities.

- Make all the necessary adjustments to the ATLAS LOM wizard tool (http://portal.discoverthecosmos.eu/online-atlas-lom/) in order to address all the project specific needs.

This phase consumed a big amount of effort and required deep knowledge of Drupal's database structure and internals as well as special migration software to be designed and developed.

In more details, based on the ATLAS@CERN setup we created a new instance/database with no data in it (only configuration data retained) and we performed basic configuration actions on it. For instance, hostname changed to portal.discoverthecosmos.eu, 'ATLAS' related strings with Discover the COSMOS related ones, etc. The produced database, called **discover_initial** for short, was also acting as a third input database for the whole migration process we have followed.

The reproducible and thus repeatable process of migrating and merging the three databases consists of 10 discrete steps. A script named "*migrate*" initiates this automated process and performs all the necessary steps, which are textually described below and graphically presented in figure 1:

1. Execute the updater script "*drupal5-updater*" on primary mysql databases. This script creates a new database which contains the data of the second input drupal database (ATLAS@CERN), but with the configuration options of the first input drupal database (discover_initial).
2. Use the standard "mysqldump" tool in order to dump the mysql database produced by step 1, as well as the COSMOS database.
3. Use the "*mysql2pgsql*" script to transform both of the above mysql dumps into postgresql dumps. This script takes care of translating certain datatypes and commands from the MySQL specific dialect into the PostgreSQL dialect. We will be using PostgreSQL for the next steps since the difference in performance can be measured in orders of magnitude for the bulk of data we must process.
4. Use the standard "psql" tool in order to create a new PostgreSQL database which will hold the merged data in its public schema. Also create two additional schemata, which will be filled with the source dumps.
5. Use the standard "psql" tool to feed the transformed dumps of step 3 into the according schemata of the new database of step 4
6. Run the merger script "*drupal5-merger*" in order to merge the COSMOS database with the product of step 1. This script merges data from two input drupal databases into a new one, preserving all configuration from the first input drupal database.
7. Use the standard "psql" tool to dump the public schema of the database of step 6

8. Transform the PostgreSQL dump into a MySQL dump, by inversing the " *mysql2pgsql*" script
9. Use the standard "mysql" tool in order to feed the MySQL transformed dump of step 8 into the new, final drupal database.
10. After deploying the final database of step 9 on-line, run the "*rebuild_search.sh*" script in order to invalidate and re-create drupal search cache and indices.

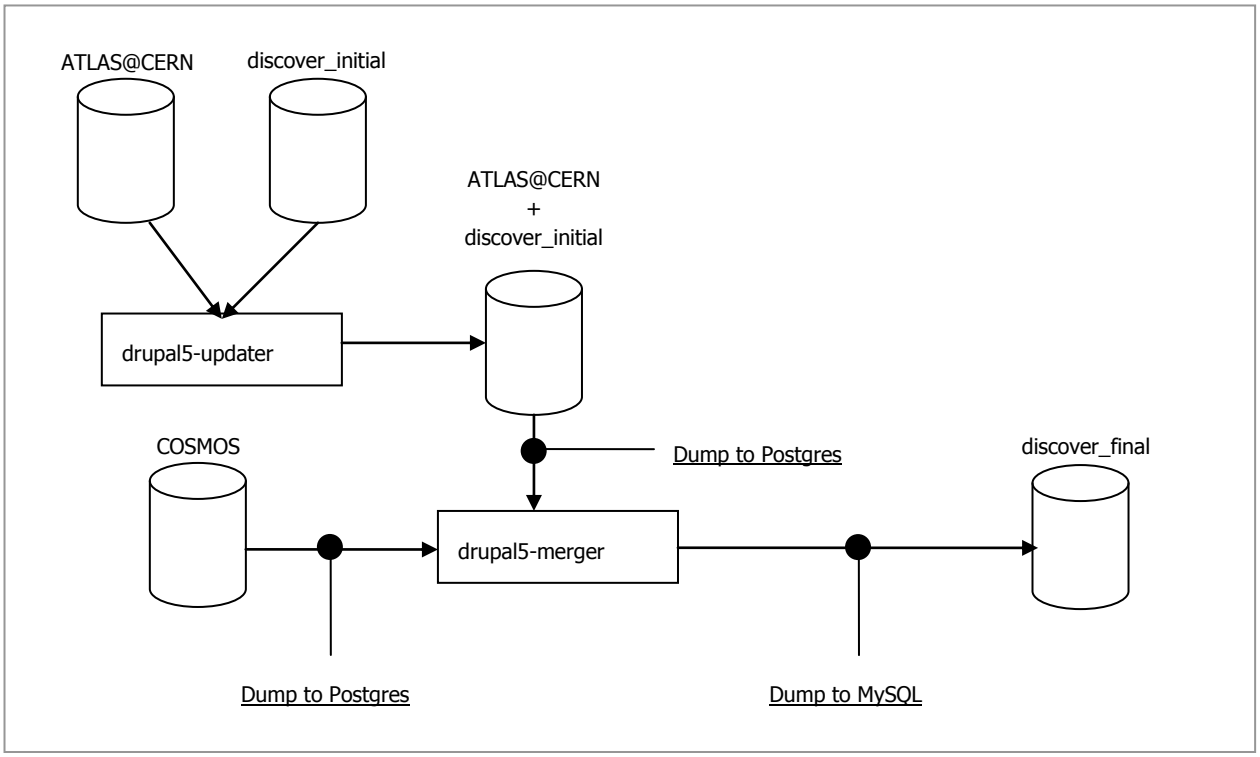


Figure 1: Graphical representation of the migration process.

After the migration process completed, some manual post-migration operations were required regarding user accounts. These comprised of identifying accounts that belonged to the same person (registered on both systems) and keeping only one, while updating cross-table references to the second account and mapping them to the first one, before deleting it.

It is worth to be mentioned that, due to the big amount of the data being migrated, the execution time of the aforementioned process was about two (2) calendar days per run, without using PostgreSQL. After introducing the PostgreSQL intermediate steps, each run was reduced to 10-20 min.

Finally, all the scripts involved in this process, are available upon request.

Another, task that took place during the reporting period, was the development of a custom software module, capable of aggregating 'news' posts from external sources, such as the Discover the COSMOS web site and populate them into the portal's 'News' page. The main operation of the aforementioned module is to periodically read the news from RSS feed exposed by the project's web site, evaluate whether each 'new' entry, is about a new insertion, update of an old entry or even to recognize if a 'new' has been removed from the feed and perform the necessary action into the database, insert, update or delete respectively. The full code of this module is available for inspection upon request.

Furthermore, the portal's 'News' page has been extended with a new set of views, capable of retrieving the aggregated entries from the database and present them to the end-user, in a teaser and in a details format/layout. It worth to be mentioned that, this extended 'News' page, offers a unified combined view of the 'news' entries aggregated from the project's web site, as well as the entries published using the portals internal 'news' publishing mechanism.

- stylistic interventions to the overall layout, in order the look & feel to be as close as possible to the one followed by the project's web-site
- additional information offered to the end-user, by the populated material (educational content and learning activities) details view. For example, number of reads, an image tag that indicates the certification state/level ('None', 'Certified by COSMOS', 'Certified by Learning with ATLAS', 'Certified by Discover the COSMOS' and 'Demonstrator') of each educational material, etc.
- the list of supported languages has been extended to Finish, French, German, Greek, Italian, Portuguese, Spanish and Swedish. However, the translations of the static content/pages of the portal, is still an on-going process.
- the lists of the most recent, most popular, top rated items, available under the portal's search page, have been expanded thus providing the full list of every the educational item in an ordered manner based on the insertion date or number of visits or scoring (rating) collected so far, respectively.

Last but not least, the necessary software was deployed for supporting the surveys that will be organized by the project. The software selected was based on LimeSurvey[5] technology and the first live questionnaire was focused on Participatory Engagement Activities[6].

[5] http://www.limesurvey.org/
[6] http://surveys.iasa.gr/index.php?sid=11281

4.1.2 Second project year

During the second year of the project, a number of enhancements, changes and extensions have been applied to the portal. Below the most significant of them, are listed.

- many stylistic interventions to the overall layout, quite a few improvements performed to the current functionality and a number of bug fixes have been identified and corrected
- the most popular lesson plans as well as the tag cloud are listed on the home page. Furthermore a very interesting 3min video from NASA, about the Sun, is displayed on the home page
- the list of the top rated items is now also provided under the portal's home page, thus motivating visitors to start navigate through portal's content beginning from the most significant entries
- A 'follow it' button was implemented and is available for every educational item (content or learning activity) which exists in the database, thus offering the ability to the authenticated users to receive email digest notifications about any update performed to the corresponding item, with just one click.
- A new 'tutorials' section has been introduced providing a set of video tutorials produced by the COSMOS community, concerning astronomy and astrophysics subjects. Their aim is to introduce users in a series of themes like Photometry, Analysis of Astronomical Images, Classification of Elliptical Galaxies, Mass and Star Formation Rate in Galaxies, Globular and Open Clusters.
- The account registration process has been improved and secured. The current process includes:
  - an e-mail verification when a visitor creates an account
  - a CAPTCHA mechanism that has been applied in order to distinguish bots from humans
- In order to improve the performance of the portal, we upgraded the hardware that hosts the DtC portal/repository, thus it now lays on a modern and significantly faster node and from the other hand the upgrade of the operating system, RDBMS and PHP performed at the beginning of the PY2, offers a considerable positive impact to the overall performance of the portal.

Furthermore, significant changes were made to the portal during the second year of the project, in order to address the comments received from the 1st year review. These changes were both

structural and functional and were agreed upon by the consortium based on the experience of the first year as well as from user feedback and partner events (e.g. Astronomy contest).

- Support for the Discover the COSMOS Contest for Teachers
  - The new content type was added, titled as "Observation Material"
  - The 'Observation Material' content has been grouped per country and provided individual layout for those entries originated from Portugal
  - Filtering mechanism per scientific subject (i.e. GAM, Sun, Moon, Jupiter etc) is available for better searching

- Integration of the portal with public and facebook blogs

  On this context, three blogs have been integrated into the DtC portal
  - Portuguese and Spanish Teachers Facebook Blog. The Spanish and Portuguese speaking community -teachers and trainers- share good practices in astronomy, suggest tools and resources, ask for support and participate in our challenges and events
  - Galileo Teachers Facebook Blog. This blog offers the opportunity to the teachers to discuss on the use of the Discover the COSMOS resources in the framework of their every day practice. The Galileo teachers' community consists of astronomers, educators, teachers and students around the world reaching more than 100 nations. Fifteen thousand teachers have already been trained.
  - The ATLAS virtual visit: Using web-based video conferencing tools, students talk with an ATLAS physicist, receive a tour of the control room, and get answers to their questions. This tool is widely used in almost every e-masterclass performed in schools

- Participation on the harvesting process of the Open Discovery Space project
  - Setup the DtC Open Archives Initiative (OAI-PMH) target/end-point
  - Perform initial communication tests with the harvester mechanism
  - Support of the first harvesting phase that consists of providing ready for being harvested contents (metadata) based on IEEE LOM standard, through the DtC OAI-PMH target/end-point

  - Normalize and transform the existing XML files/records in order to comply with the ODS AP specification
  - Support of the second harvesting phase that consists of providing contents (metadata) based on ODS Application Profile schema, through the OAI-PMH target/end-point.

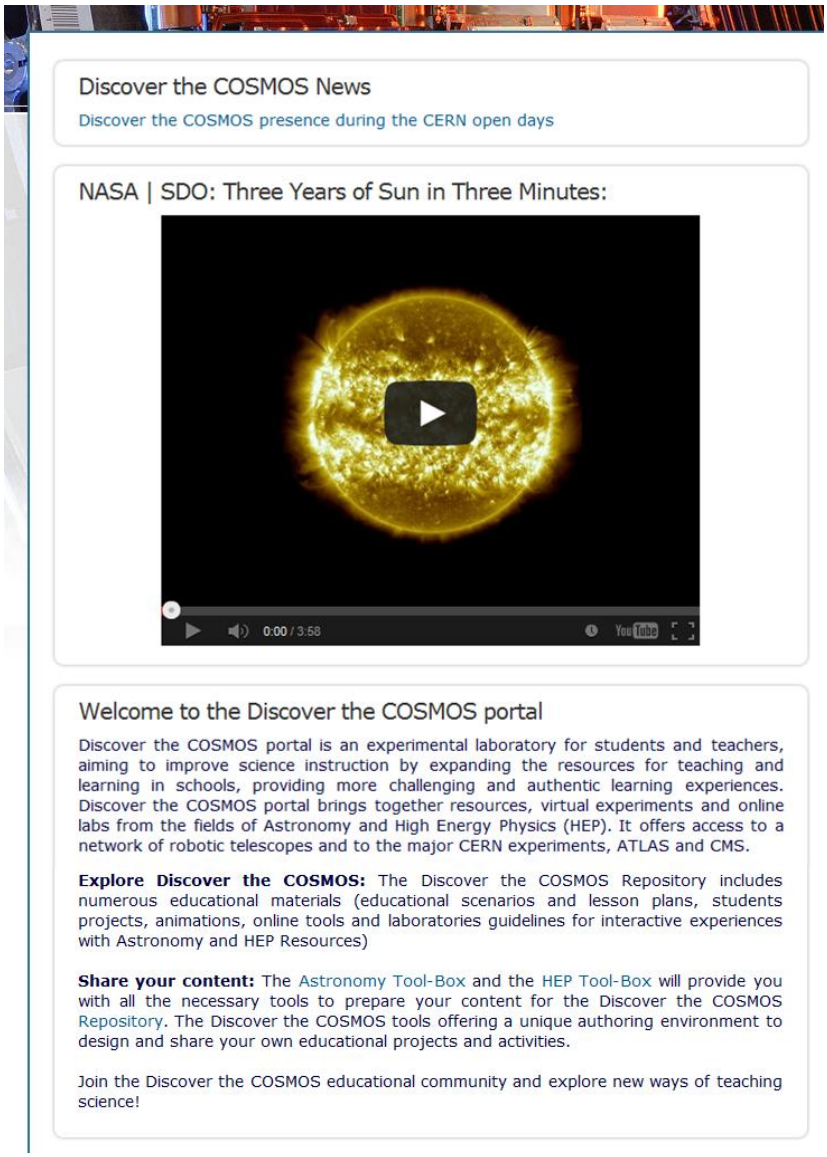
- Changes on the layout of the available search forms
  - New tabular forms that differentiate the advanced/structured search capabilities offered by the portal from simple text based searches

4.2 Structure of the portal

Moving forward to the structure/map of the portal, it consists of seven main areas, accessible from the main tabular navigation pane (Tabs: HEP tool-box & Astronomy tool-box are accessible after a successful login):

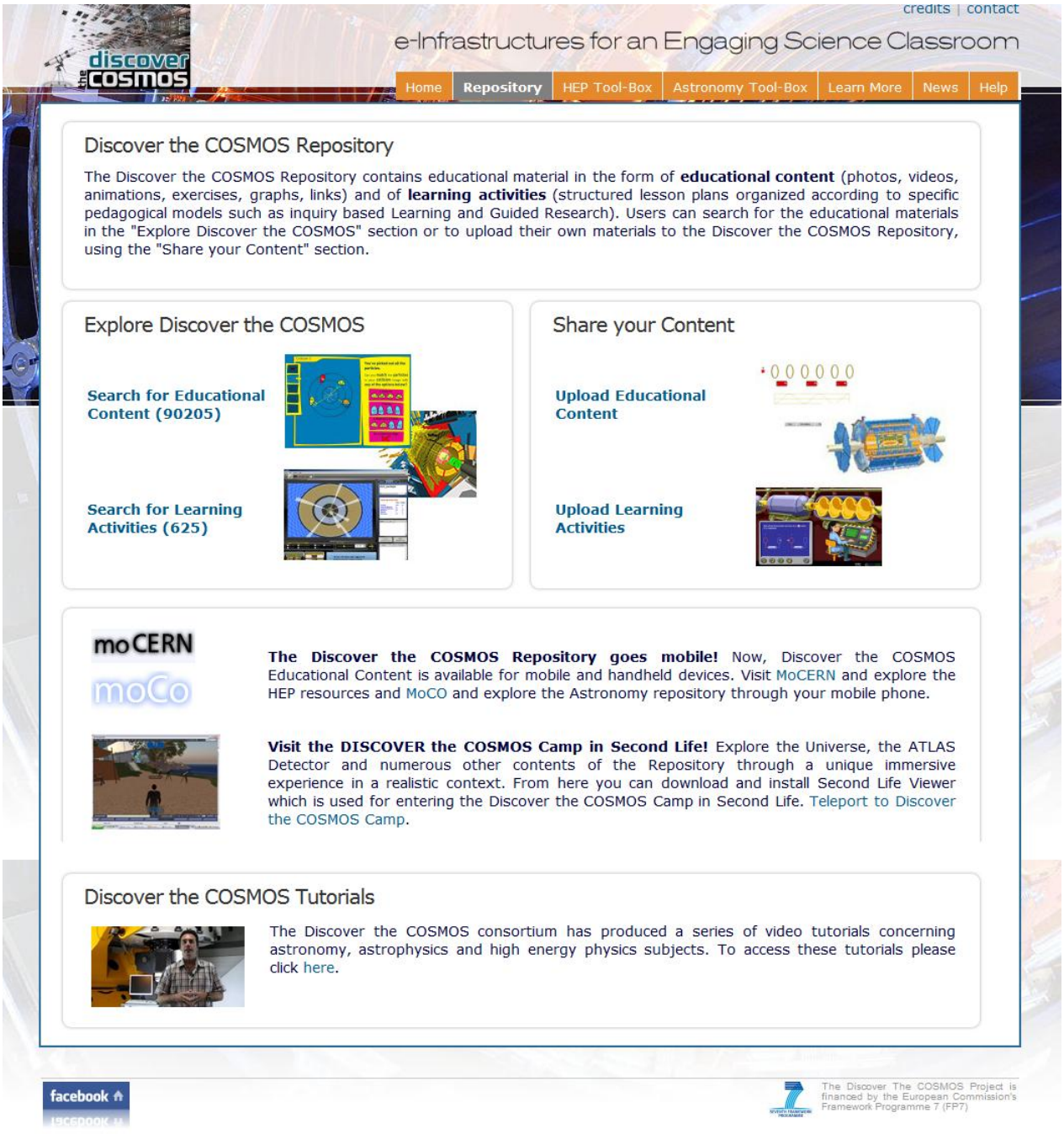
4.2.1 Home

Provides a high-level description of the project's main aims



4.2.2 Repository

Here the user can upload Educational Content or Learning Activities. He can also search for Educational Content or Learning Activities based on criteria reflecting his needs (material language, knowledge level, duration, popularity etc.).



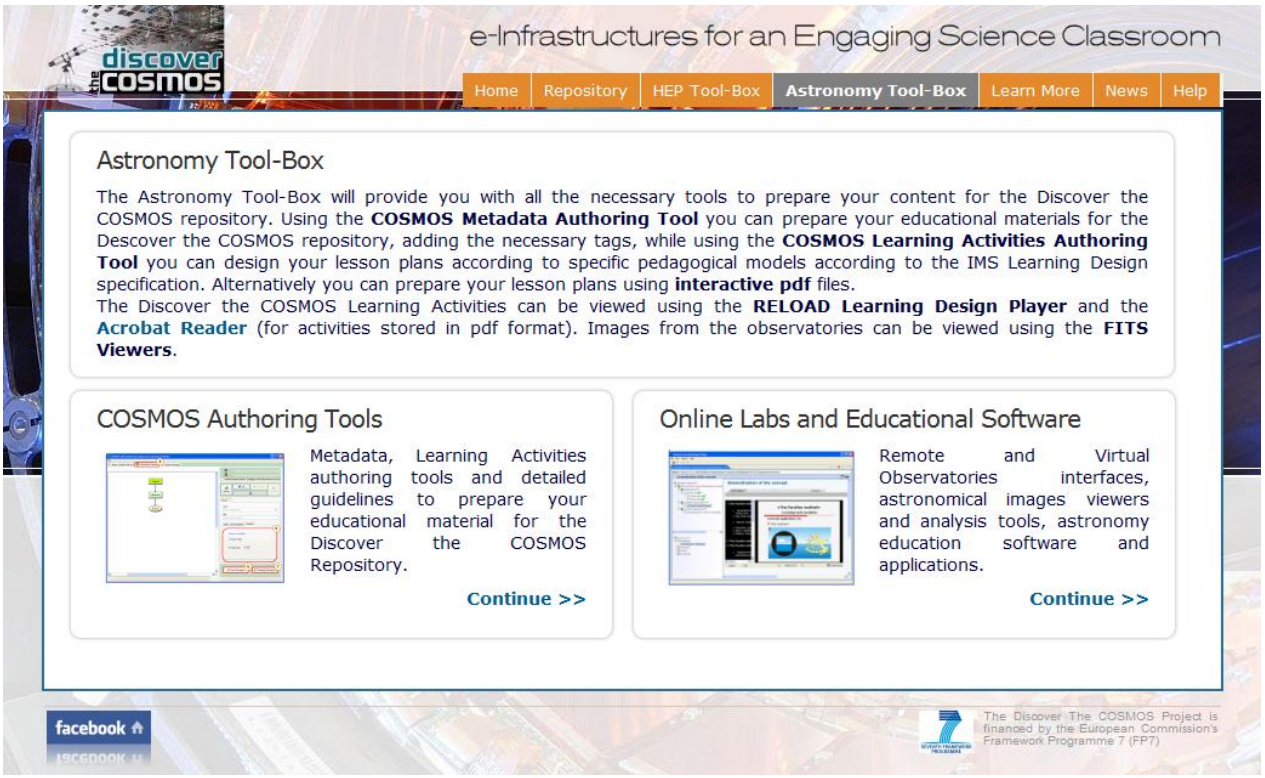
4.2.3 HEP Tool-Box

The HEP Repository offers access to three High Energy Physics tools (AMELIA, HYPATIA and MINERVA) which have been developed for educational and scientific use and can be freely downloaded and used.

4.2.4 Astronomy Tool-Box

Offers access to the COSMOS Authoring Tools, a collection of utilities that provides the user with all the necessary tools to prepare his content for the Discover the COSMOS repository.

Also to the Online Labs and Educational Software which provides a series of tools that will help the user realize the Discover the COSMOS Learning Activities by offering access to remote and virtual labs, to view the FITS images that are provided from the network of telescopes, to analyze the data, to create your own video sequences of astronomical events, to calculate the light intensity of the stars, to create his own plots and diagrams.

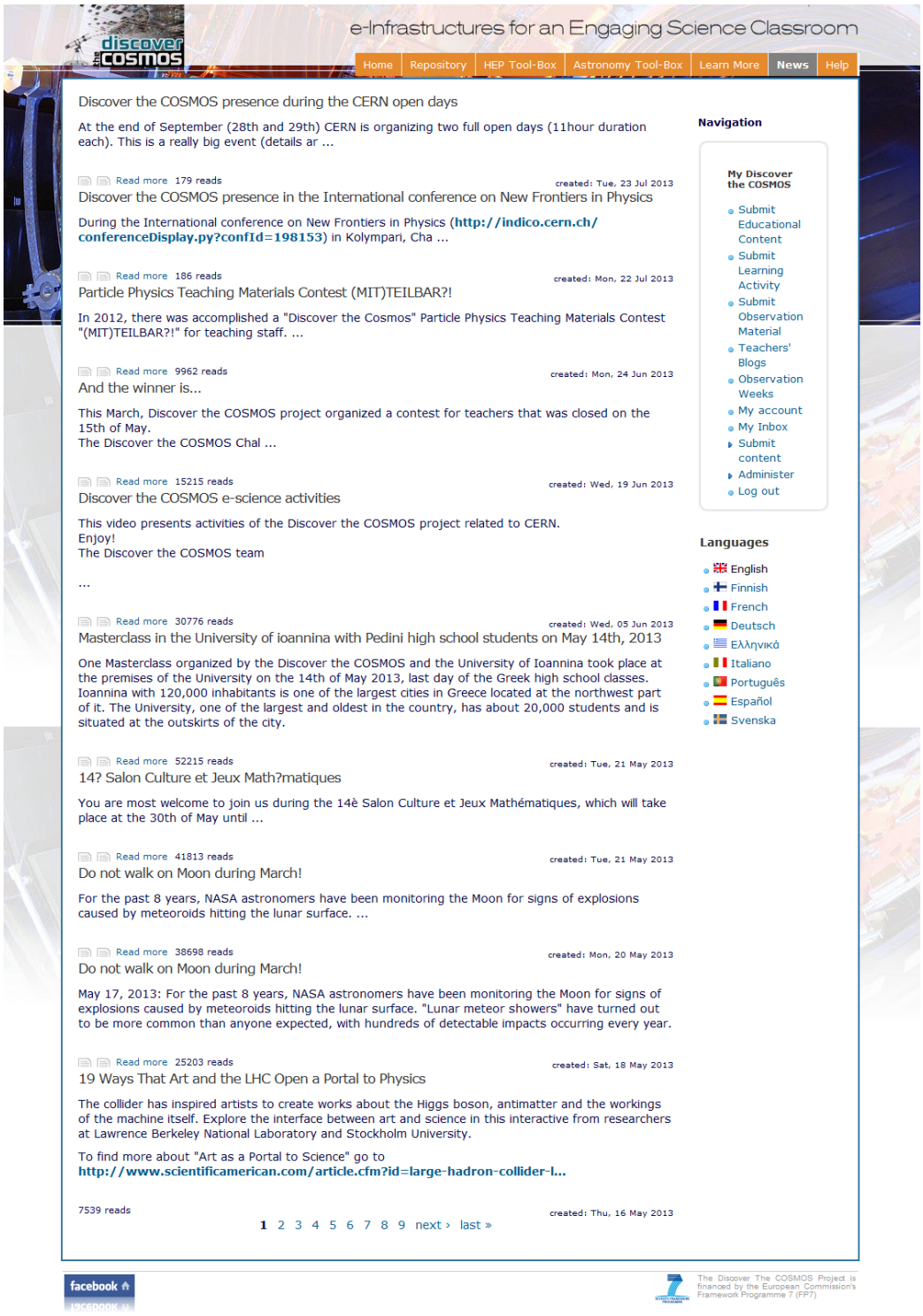


4.2.5 Learn more

Redirects to the Discover the Cosmos web site.

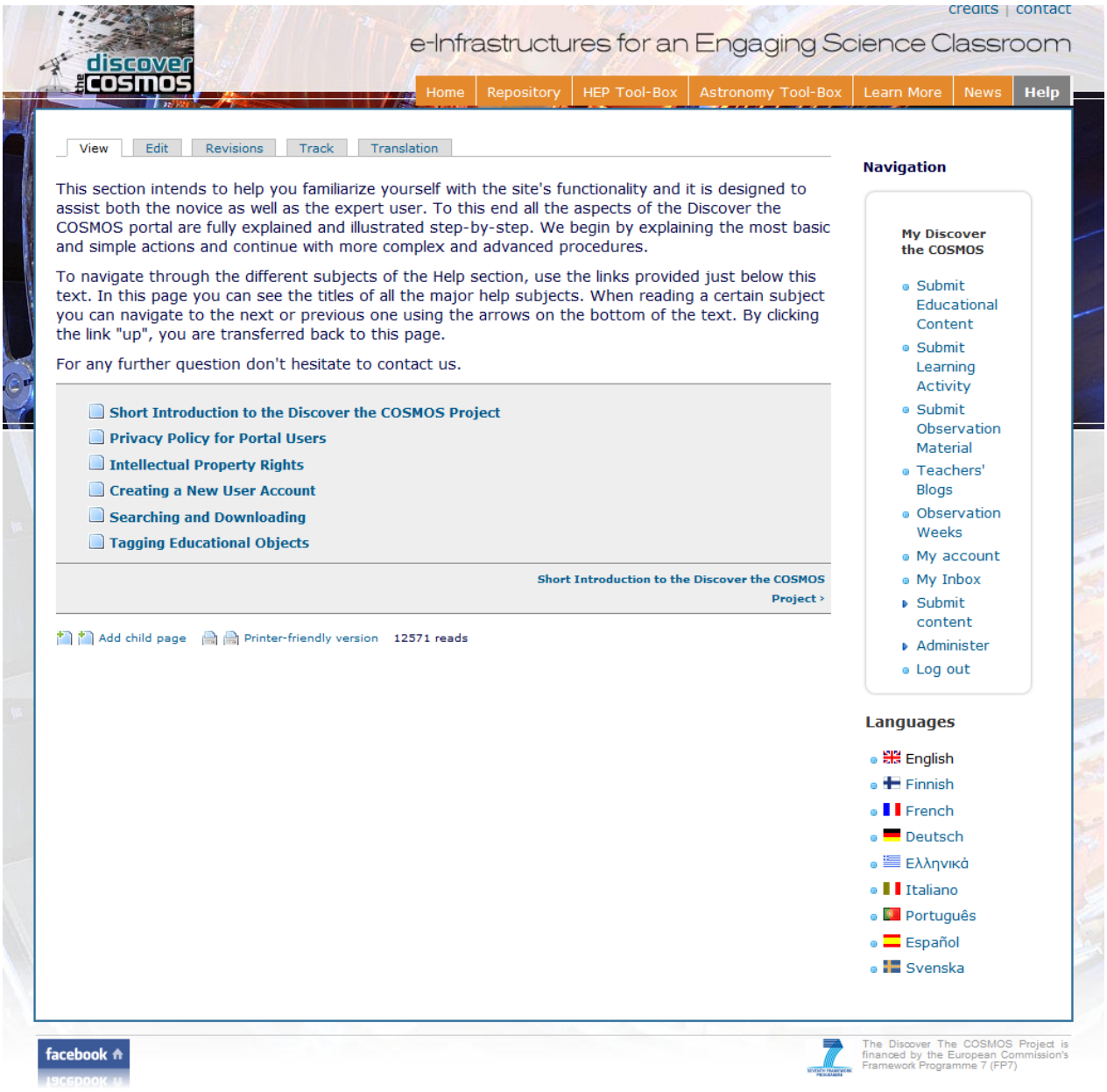
4.2.6 News

A dashboard with the latest news and project activities and events.



4.2.7 Help

Detailed assistance on the portal's functionality.



5. Supporting User Communities

Research undertaken for many years on the development and support of online communities of teachers clearly illustrates the criticality of being responsive to teachers' perceived needs. Discover the COSMOS portal is a web-based resource for teacher professional learning that offers its community a range of resources and tools for creating, sharing, and improving inquiry-based pedagogical projects and practices that can help teachers to introduce frontier research in their classrooms. Teachers can use each others' projects and lesson plans through the use of the portal search mechanism to observe and discuss approaches to teaching science topics (mainly in astronomy, space and high energy physics) and to share their work. In these activities, teachers get an overview of the lesson context, the lesson plans, examples of student work, and connections with the educational standards. They also hear or read the presenting teacher's reflections on the lesson. There is a discussion area within the portal where teachers can engage in dialogue with each other regarding that lesson or pose questions to the contributing teacher.

The Discover the COSMOS Portal provides content translation-nodes and taxonomy- interface translation for anonymous users -with a Drupal module- and browser language detection. It includes a block for language selection and will manage translation relationships for nodes and taxonomy terms. To address the multi-lingual issue, a standard translation key has been created for all important science terms allowing the easy translation to 9 different languages. The content organization scheme is based on an IEEE Science Education Application profile that was used in the COSMOS project and it was enrich with HEP terms during the merging of the "COSMOS" and the Learning with "ATLAS@CERN" repository. The Science Education AP is presented graphically in Figure 2.

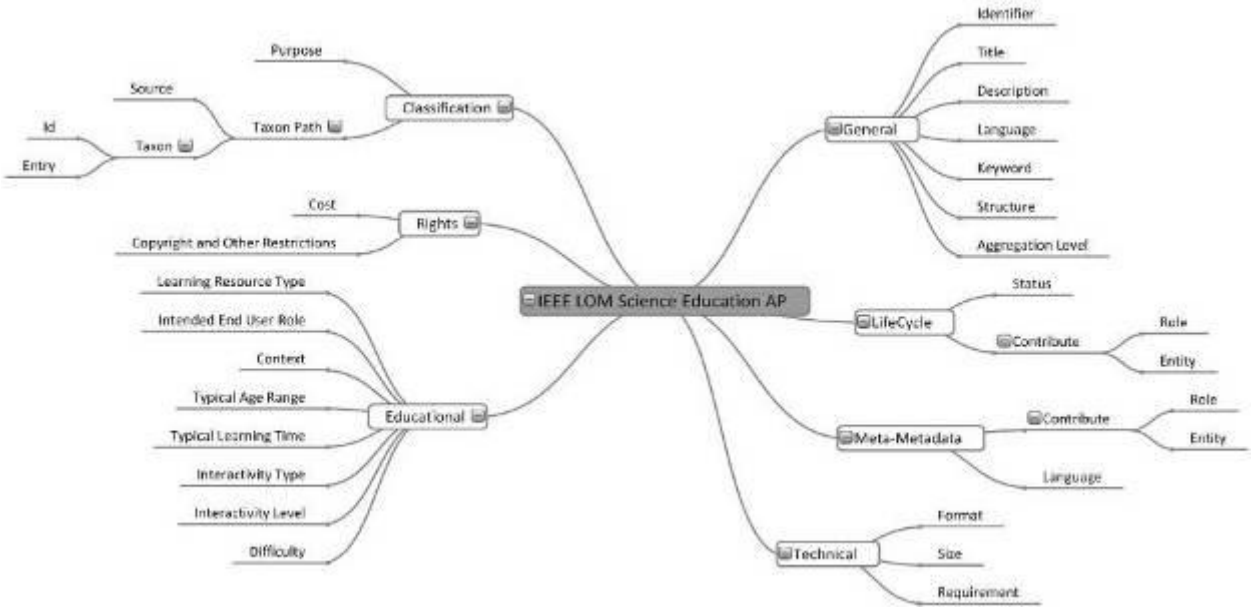


Figure 2: The IEEE LOM Science Education profile that is used to support the search and retrieval of the educational content. The taxonomy terms are translated and matched in the 9 langauges of the target groups.

The system supports communities of users allowing for user interaction and exchange of ideas. The portal provides functionalities as follows:

Community managed taxonomy (vocabularies that are updated and administered by the community and also terms that are promoted to the live vocabulary when they collect a specific number of votes). Community-managed taxonomy (CMT) opens categorization of content to the site's community. Users can influence both what terms nodes are tagged with and how these terms are themselves organized. It can also be used to make structured tags on the fly.

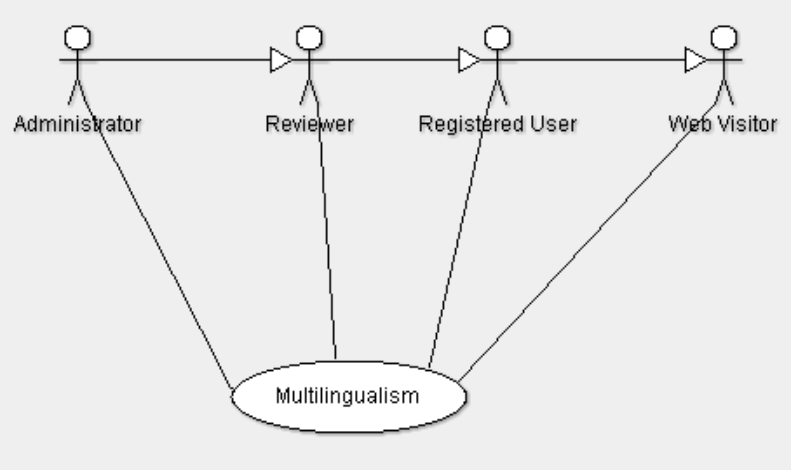
Micro Communities support, user blog maintenance, news, Creative commons licensing on the portal content, Free tagging for nodes, personal messaging capabilities and email communication through the portal.

The voting and rewarding system provides the ability for users to vote on various nodes, assigning a score to each one. The average overall score and number of votes are displayed below each node. The module is useful in many situations, for example, to rate articles, forum posts, stories. Several blocks are provided to display top voted for nodes, top scored nodes. Permissions are used to determine which roles can vote, as well as which roles can see the results. Voting can be limited to one or more node types (e.g. image, page, etc).

In the following the use cases for the Multilingualism and the Virtual Communities Support are described.

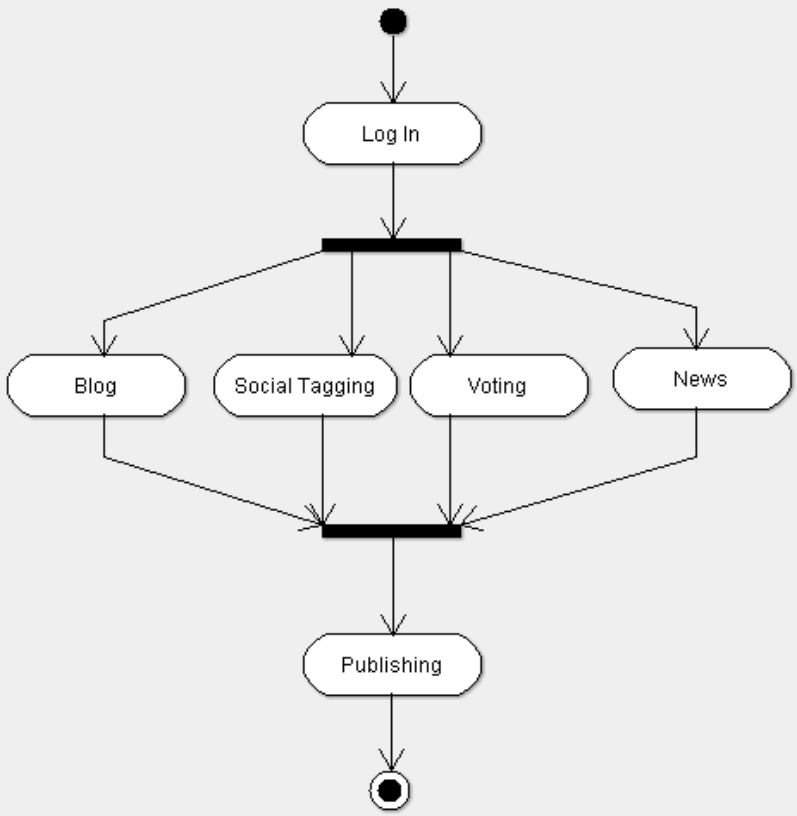
Multilingualism

Use case name:	Multilingualism
Unique use case ID:	UC-01
Actors:	All Actors
Brief Description:	The Discover the COSMOS Portal will be a truly multilingual service and it will be so by design. To that end we will take the following actions: • Metadata tags will be multi-lingual • Multi-lingual portal • Multi-lingual content and educational scenarios The portal will allow for: • The ability for site visitors to set language preferences themselves, so they can control what language the site is in when they visit. • Support for both left to right and right to left languages out of the box. • Most importantly, the ability to manage pieces of content in multiple languages.

Context Diagram:	
Trigger:	The user can use the multilingual functionalities by clicking on the respective language flag.
Preconditions:	NONE
Postconditions:	The user interface changes the language.
Normal Flow:	The actors click on the respective language flag.
Alternative Flows:	NONE
Exceptions:	NONE
Interface	The actor utilizes the user interfaces exposed to the Discover the COSMOS Portal.

Virtual Communities

Use case name:	**Virtual Communities**
Unique use case ID:	UC-02
Actors:	RU
Brief Description:	The Discover the COSMOS Portal registered user actor can follow this use case in order to participate to virtual communities.

Context Diagram:	
Trigger:	The Discover the COSMOS Portal registered user actor can use these facilities
Preconditions:	User Registration and login
Postconditions:	
Normal Flow:	The actor once he/she has logged in to the Discover the COSMOS portal he/she will have available the following facilities: • Look in the teachers blog section • Look in the Discover the COSMOS portal's news page • Social tag educational resources • Use the voting system
Alternative Flows:	NONE
Exceptions:	NONE

Interface	The actor utilizes the user interfaces exposed to the Discover the COSMOS Portal.

5.1 Communities Support Activities

Asking teachers to follow introduce advanced and complex activities (as well as new actors like researchers from major research infrastructures) in their everyday teaching practice constitutes a major behavioral change and at the same a significant professional development opportunity for them. The task at hand in the framework of the Discover the COSMOS project was to manage this change in a uniform way, allowing teachers to realize the potential of the opportunity offered by the Discover the COSMOS Demonstrators, take ownership of their contribution by developing their own scenarios through simple to use (and share) tools and maximize the output for both the project and themselves. In the framework of the project the project team has worked with numerous teachers in different countries. The aim of the consortium was to offer the opportunity to teachers to play a greater role in the process by involving them in the scenario development procedure. In such a way teachers can develop the ability to bring changes among their colleagues and to their teaching practice as well. These teachers are expected to act as leaders in their communities and support the integration of the innovative approach or of the relative tools. In the framework of the Discover the COSMOS project the consortium effort was also harmonized with national initiatives (e.g. introduction of project work in the science curricula in Greece and in Portugal) and international efforts in the field of science education. The use of the IBSE model for the development of the Discover the COSMOS demonstrators has supported the effective integration of the project approach in the framework of the training activities that were performed all over Europe. Creating an effective community of Discover the COSMOS ambassadors, promoters of the introduction of the scientific literacy and the use of online resources in the framework of advanced educational scenarios was a key parameter for the success of the project implementation. The "teacher as a leader" strategy can provide an effective mechanism for disseminating innovative practices and instructional strategies like IBSE.

In our approach the **central agents of this operation are "teacher-leaders"**, who head the transformation processes at the local level. This model has been used in networks involving national and regional teacher centers. The leader teachers undertook a variety of regional activities, such as, guiding teachers in regional centers or in schools, and providing guidance for both teams and individual teachers. Pratt (2001)[i] suggested that that there are four basic skills relevant to effective leaders in science education namely; (1) technical skills, (2) conceptual skills, (3) interpersonal skills, and (4) self-learning skills. Professional development programmes for teachers-leaders are designed to help acquiring these skills and help them choose and/or design models for programs they will run later with other teachers. The professional

development program can also provide the teachers with a framework for the initial preparation of tools necessary for running their own activities. When teachers-leaders participate in professional development programs that deal with innovation, as with other teachers they experience the innovative strategy both as learners and as teachers, but in addition acquire guiding skills in the particular area.

In all cases of these programs there is **special emphasis on building a network of the teachers that would form a community of practice**. In a review paper (Lawson and Price, 2003)[ii], McKinsey management experts identify four key prerequisites for accelerating and establishing change in the school environment:

- **A purpose to believe in:** "I will change if I believe I should" The first, and most important, condition for change is identifying a purpose to believe in. In our case, we must persuade teachers of the importance of scientific literature in terms of social value, importance to their students and personal achievement through learning and teaching these important subjects. We have carefully craft a series of "change stories" underlining the benefits that the project (and the use of the proposed resources) can offer to all the involved actors. The idea to develop a series of demonstration lessons that are emerging from real school settings and active teachers offered a unique starting point in this process. Furthermore, we have cultivated a sense of community, making the teacher feel part of a cohesive multi-national team. This sense of belonging was very important for motivating teachers and asking them to take then next, possibly "painful" steps, of learning new skills.
- **Reinforcement systems:** "I will change if I have something to win". From a pure behavioristic point of view, changing is only possible if formal and informal conditioning mechanisms are in place. These mechanisms can reinforce the new behavior, penalize the old one or, preferably do both. In our case, we have used informal reinforcement patterns in order to make teachers commit more to our project. A list of such methods (presented in the next session) includes competitions, challenges, promoting the best teacher created project or lesson plan, offering e.g. the participation to a summer school as reward.
- **The skills required for change:** "I will change if I have the right skills". A change is only possible if all the involved actors have the right set of skills. In the case of the Discover the COSMOS project, we have designed the training programme in such a way that teachers acquire all the skills they will need, both technical and pedagogical. Online materials and easy to use tools were developed and presented to the teachers. Training courses or school visits were also organized. Large scale events (like the presentation of the CERN exhibition in Greece and in Spain) were enriched with relative training courses and seminars to help teachers understand the full potential of the proposed intervention.
- **Consistent role models:** "I will change if other people change". A number of "change leaders" were trained (mainly coming from the existing teachers communities like Galileo

teachers), acting as role models for the Discover the COSMOS community of teachers. These very active and competent teachers were a proof of concept for their colleagues that the change is indeed feasible, acceptable and beneficial for them. To achieve that we had to identify the high flyers among the participating teachers and pay special attention into motivating them, supporting and encouraging them.

All four areas were specifically addressed in the implementation phase of the Discover the COSMOS project. Additionally the consortium team collaborated closely with teachers to develop a set of support services which help teachers to implement the necessary changes, to develop the diagnostics and intervention skills necessary to best plan and then diffuse the proposed approach and the scenarios of use in their own contexts. An effective training approach provided the starting point for equipping teachers with the competences they need to act successfully as change agents, developing a language/terminology necessary to describe the dynamics of change processes, and making them able to recognize different forms of resistance and addressing it in their own context. At the same time it provided a common basis/experience for "connecting" teachers across schools, within and across national boundaries – engaging them in an ongoing exchange of experiences across school, regions and countries.

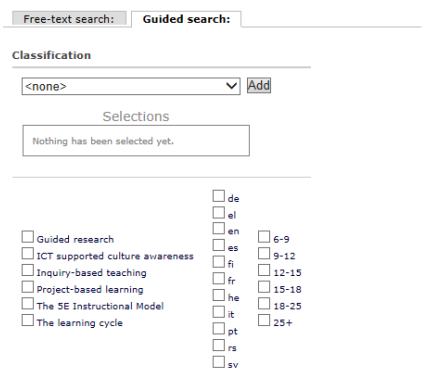
5.1.1 Activities for developing and supporting online Communities

The Discover the COSMOS consortium has organize a series of activities to support the active involvement of the teachers on the portal use. The most important issue in the design and development of the presented activities was the development of trust among the users of the Discover the COSMOS community. Creating a community in which teachers are willing to engage in critical dialog about their lesson plans and their pedagogical practices, whether that community be online or face-to-face, requires that a culture of mutual emotional support, empathy, and trust be established among the participants. Teachers do not collectively come into such a culture of trust and mutual support spontaneously. In nearly all cases, teachers' pre- and in-service training and the institutional structuring of their teaching practices acculturate them to assume an individualistic and autonomous orientation in their professional activities.

Isolated in their classrooms, they are reluctant to share their practices with unknown colleagues for fear of exposing any possible lack of skill, and are equally uncomfortable about criticizing the teaching methods of their peers in public or semi-public spaces. These attitudes and inclinations are well documented in the teacher interviews and observations of forum dialogues analyzed in studies of several online teachers' communities. Critiquing becomes especially difficult when participants do not know other members of the community or have not met them in person. Even when the teachers did know their fellow community members, they were worried that critiquing these peers would damage friendships. Teachers also expressed a fear of being

critiqued in a space where the criticism could be permanently recorded. The problem of developing meaningful discussion was to a large extent a problem of defusing the perceived threat of sharing so that teachers would come to trust one another enough to risk making mistakes, revealing problems in their practice, or critiquing another's teaching.

In the following we are presenting the main activities that were designed by the consortium in order to offer to teachers high quality resources, success stories and best practices developed by other teachers, multiple ways of interaction and communication and effective training and support in order to develop a community of practice that is based on trust through the teachers professionalism.



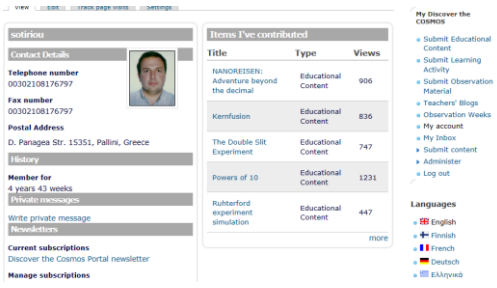
Creation of an effective mechanism for sharing high quality resources and user generated lesson plans. As it was discussed in the previous chapter a science education vocabulary was use to facilitate the access to the portal resources. Additionally the online resources were characterized as most popular, most resent, top rated in order to help teachers to locate them easily. A tag cloud that presented the profile of the portal contents was added in order to help users to have direct access to the content – without following the proposed step by step search process. The aim of the consortium is to give community members access to a rich suite of professional learning resources that are directly relevant to their professional needs, and do so in situated ways that maximize the likelihood that users of the portal will use those resources to enrich their contribution to the community discourse as well as improve their professional practices. For example, rather than just uploading a lesson plan to a website or a teachers blog, teachers can use the Discover the COSMOS metadata authoring tool to let a community member locate and view the use of innovative practices in a situated classroom context with specific educational objectives directly relevant to that users, and enrich the lesson plan with contextual information and reflections provided by the contributor. Other users can include questions to provoke reflection, and provide seamless links to a lesson plan. Designs of this type will minimize the barriers impeding contributions to relevant community discussion areas, increasing communal knowledge building.

Presentation of the Discover the COSMOS Demonstrators in different languages and adopted to local settings. A specific area was created to host the Discover the COSMOS Demonstrators and all the lesson plans and educational activities that have been developed following the IBSE model. In this way the "success stories", the best scenarios developed by the consortium and the teachers' community had a central place on the portal. The demonstrators were translated in the languages of the partner institutions. This activity has supported the

development of national communities. The provisioning of resources for a teacher community has been demonstrated to require a careful balance, ensuring that the materials being utilized by the community are of acceptable quality, are adopted to the local settings and that they support its goals without dampening the creative enthusiasm of contributing members or limiting the community's self-determination

Development of teachers' blogs and other communication channels. A series of blogs were created to facilitate the process of the creation of scenarios and to support their implementation in local settings. Additionally a blog was created to support the realization of the virtual visits to the ATLAS Control Room that was one of the main activities of the e-masterclasses that were organized in the framework of the project.

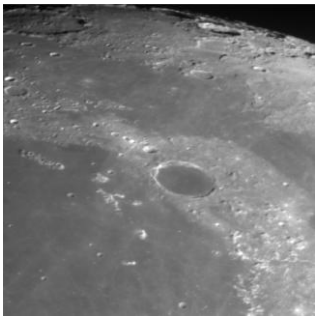
Organisation of face-to-face sessions between the teacher leaders to establish the social presence and connections needed for online community success. Discover the COSMOS team has organized many face-to-face sessions with the support of external resources (COMENIUS programme, CERN teachers programme, GTTP network) and has managed to bridge the transition from the co-present event to the incipient online learning community by creating a new private subcommunity for that groups and sign all participants up for it; The team has assigned tasks aimed at building on the face-to-face events and establishing online social presence for participants to pursue over the next period following the event. The group of teachers were properly moderated from the start, either by a teacher leader or a consortium member.



Discover the COSMOS approach offers a range of new member induction supports and activities. New members are welcomed by a member of the Discover the COSMOS team, questioned about their interests, and given guidance customized to their responses. New members are asked to provide some profile information to build their social presence, and they are provided with a personal work area where they can assemble bookmarks to resources and discussions of interest and receive alerts about new contributions to discussions they are participating in or resources that they are following.

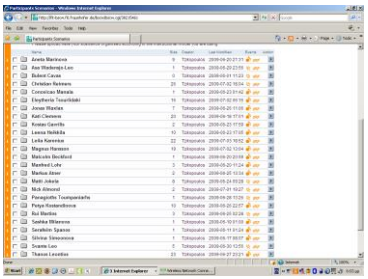
Support of the organization of the e-masterclasses events. A series of virtual collaboration activities, called e-Masterclasses were designed and implemented, promoting inquiry based and problem solving processes in complex scientific problems like the Higgs Discovery. In this case students performed the assigned tasks from their schools, allowing for more schools to be involved in the process. Collaboration in the framework of e-Masterclasses has demonstrated the potential of e-Infrastructures to meet the large computational demands of the proposed on-line collaborative learning processes.

Organisation of online Observation weeks. In the framework of the project implementation four (4) observation weeks were organized. Users of the portal had to use the network of telescopes offered by the Discover the COSMOS consortium and perform observations of specific targets each week. Then they had to design their own scenarios and educational activities, implemented in their classrooms and upload them to the portal. Specific guidelines and support was offered while the users had the opportunity to use ready-made scenarios prepared by the consortium.



Organizing campaigns to promote the use of the portal resources. Discover the COSMOS consortium has cooperated with different organizations in the design and implementation of numerous challenges to promote the use of the portal resources. The Discover the COSMOS Challenges were open to teachers and students from all over the world. The challenge were designed to encourage collaborative work between teachers, trainers, scientists and students, with a view to promoting the exploration of online scientific resources in the classroom – i.e. e-Science tools, resources and e-Infrastructures. The educational activities that were created during these challenges, and enriched by the use of Discover the COSMOS tools

and resources, were designed to promote the introduction of the scientific method into the classroom.



Provide sufficient technical training and support resources to ensure that community members are proficient at using the communication and collaboration tools a community has chosen to employ so that technical barriers to participation are minimized and members have the confidence needed to collaborate and contribute. This support had many forms depending on the complexity of the processes involved, ranging from face-to-face training to brief how-to documents or online manuals. It has to be noted that additional tools were also used to support numerous events organized by the consortium. For example the BSCW server, an advanced collaborative platform was used for the preparatory work of the teachers in the framework of the summer schools and the international training events. This tool offers unique capabilities for collaborative work and it was used to introduce teachers in the idea of sharing resources in a closed environment.

The team has employed a participatory design approach to the development of portal interfaces and community services, the selection of resources, and the choice of the available tools. The team has included practicing teachers from the GTTP programme in design groups to provide advice and feedback from the practitioner perspective. Usability tests were contacted (mainly to the interface of the search mechanism) to ensure that an average teacher will be able to use these resources effectively with minimal training.

5.1.2 Sustainability

The Discover the COSMOS Consortium has managed to mobilize an extended community of users in a period of about one year (September 2012-August 2013). Taking into account that the main areas of the Discover the COSMOS intervention were Astronomy and High Energy Physics that are not part of the school curricula in many European countries we can claim that the consortium has made a major achievement. Table 2 presents the Discover the COSMOS statistics as they are provided by the system and the google analytics service.

Table 2: Discover the COSMOS Portal Statistics (31st of August, 2013)

Discover the COSMOS Portal Statistics - All Users	
Registered Users	5,700 (31st of August, 2013)
Educational Content	~86,000 (viewed 4,256,329 times)
Educational Activities	623 (viewed 770,100 times)
Unique Visitors	9,919 visitors (unique)
Portal Visits	17,241 visits
Page Views	103,143 (total)
Time on Site	5.47 minutes (for returning visitors: 9.0 minutes)
Pages per Visit	5.98 (for returning visitors: 8.41 pages/visit)

The project scenarios and approaches were tested in more than 2,000 schools with more than 40,000 students. About 10,000 people have visited the portal performing more than 100,000 page views. These achievements are demonstrating the effectiveness of the community support mechanism that was designed and implemented in the framework of the project.

Several guidelines and recommendations for the operation and sustainability of the Discover the COSMOS community can be proposed based on the study of the parameters impacting the effectiveness of the community. Underlying many of these guidelines is a key principle: the sustainability of the community should have as a major goal the fostering of a high degree of internal community ownership through the provision of a flexible and extensible set of tools, resources, and supports that optimally facilitate members in collectively pursuing their professional learning interests and activities. To this end, the Discover the COSMOS consortium aims to continue the support to the community by providing with multiple interaction formats and technologies, new educational materials and resources and further community building initiatives. These should allow users to communicate synchronously or asynchronously as the need arises, to host their own self-created groups, and to create, store, and share discourse objects and teaching materials. Discover the COSMOS infrastructure is now hosted in new and high-speed servers at the central system of the University of Athens while all the necessary procedures were made in order the technical infrastructure of the system to be linked with the Open Discovery Space eLearning platform that aims to be the central European educational content aggregator in the next two years. This is a very important evolution for the Discover the COSMOS initiative. It is expected that this cooperation will facilitate the further development of the current teachers' community.

An additional essential step for building community member ownership and identification and providing the right mix of affordances in the tools, resources, and communication spaces brought to the community is to make use of a participatory design methodology. If the community for which the environment is being designed is to truly —own it, it must participate

in its development. Teachers need to be part of the planning team; experienced practitioners are in a position to articulate the perspectives and needs of those of their peers who may be less advanced. Undertaking a systematic mapping of user needs is but the first phase of participatory design; it must also incorporate ongoing work with community members to user-test and revise structures as well as evolve the norms and rules for participation. Flexibility in the overall design is required so that community members can customize their space to meet local needs and interests; this allows the group's identity and focus to emerge from its membership rather than being imposed by designers of the system. This approach was adopted in the framework of the Discover the COSMOS system. The plans of the consortium include the development (in cooperation with the Open Discovery Space initiative) of light-weight portals that could be installed in school servers and facilitate the process of development of a distributed system that will include numerous school-based portals. Teachers will have the chance to share resources with their colleagues at school level or at local level. Such a process will help the development of a culture of sharing of resources among more and more teachers. These school-based portals could popularize and promote the effective use of digital resources, introduce freely available technologies and software, and share good practice, as well as practical information on how to set up new eLearning initiatives and how to attract more users. The opportunity offered by such an approach, to test the infrastructure and the methods in the local setting, could promote acceptance of the proposed approach by even the most traditional institutions and could help to break down barriers to knowledge sharing, promoting a truly democratic sense of access and ownership.

6. Portal Maintenance and technical information

The implementation of the 'Discover the Cosmos' portal[7] is based on Drupal[8] technology combined with MySQL RDMS back-end. In general, Drupal is a framework for building dynamic web sites offering a broad range of features and services including user administration, publishing workflow, discussion capabilities, news aggregation, metadata functionalities using controlled vocabularies and XML publishing for content sharing purposes. Moreover, the Drupal technology is comprised of a mix of core and contributed modules.

[7] http://portal.discoverthecosmos.eu
[8] http://drupal.org/

7. References

[i] Pratt, H. (2001). The role of the science leader in implementing standard-based science programs. In J. Rohton & P. Bowers, (Eds.). Professional development, leadership, and the diverse Learner, Washington DC: NSTA Press.

[ii] Emily Lawson and Colin Price. A synopsis of: The Psychology of Change Management The McKinsey Quarterly, 2003 Number 2 Organization.