Go-Lab

Global Online Science Labs for Inquiry Learning at School

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Specifications for the Go-Lab user communities support

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Legal Notices

Executive Summary

This document is a deliverable meant to define technical specifications for the Go-Lab Portal and community building systems in terms of satisfying different user groups' needs and providing easy access to the projects' tools and materials as appropriate. The deliverable is aimed primarily at the project's technical team and national coordinators, so that their work will be guided by the results and experiences already gained by the partners both with the activities carried out so far in Go-Lab and by the analysis of research documents from the field.

The report develops along two main topics, in particular the first half of the document focuses on the target groups of the project and their needs, while the second half focuses on recommendations, ideas and tools to ensure that those needs are met through the portal and materials provided.

Strong synergies exist between the work carried out in WP6, also in preparation for this deliverable, and WP3, WP7 and WP9. These will be pointed out in the appropriate places within the text.

Concerning the ongoing Participatory Activities and the planning phase of the new cycles of workshops, work is ongoing with the national partners to enrich the planning of the new cycle of activities so that they will better fit the needs and expectations of the target groups. I order to advance in the work and take into account the work previously carried out while soliciting higher level and more in-depth feedback, it was decided to open a discussion with the practitioners in the field, in this case the national coordinators in the project, and co-create an updated version of the Participatory Activity Planning. In this perspective, it was deemed redundant to produce a new version of the D-6.1, where these activities are described. Instead, a working model will be elaborated in the month following the delivery of this document and this will be used as a guideline for the second cycle of Participatory Workshops in the second project year. In the same way, a flexible approach will be favored in order to ensure that new information is being gained in each cycle of workshops, and better formats are being used to elicit this information.

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1 Introduction

The target groups and the main stakeholders in the Go-Lab project have been identified and described in the work of the Dissemination work package (WP9) and related deliverables. In this document, however, the approach is more practical and focused. Where dissemination reaches out to new potential contributors and users, this document aims to create guidelines and recommendations for the use of the Go-Lab repository. Once potential users are drawn in, the materials and the infrastructure available must support the use and contribution of the different groups of potential users so that they can easily find their way through the interface and locate resources of interest, whether these are Apps, Labs, Inquiry Learning Spaces or Learning Materials, according to their needs and profiles. The aim is to predispose the Portal so that the user may quickly be able to perform the steps needed to create a new resource, share their materials and opinion, and take any other step they may need to make the best use of the Portal.

For this reason, though the target groups of the project are several, in this report the focus is on school teachers, who will be the main users of the Go-Lab Portal and educational support systems. Teachers' needs and challenges have been gauged using a variety of methods that have given rich elements to start the work of designing the Go-Lab Portal. Special care will be taken throughout the design of the support services of Go-Lab to create an easily accessible platform and the necessary mechanisms to assist teachers in contributing materials and sharing their best practice with other colleagues. Sharing lessons and experiences, together with classifying resources in a meaningful way and being able to easily locate the topics they need at any given time, have emerged as the main practical elements of added value of a Europe-wide interaction in designing an online system for educational purposes.

Cooperation of the WP6, WP7, WP9

In the Communities Cluster which is in charge of outreach activities and implementation of the Go-Lab project, the activities of WP6, WP7, and WP9 are closely connected to each other. This section describes the interconnections between these three work packages in order to clarify the information and communication flows and to coordinate the organization of different kinds of activities, as well as their timely promotion and conduction of the follow-up actions.

WP6 concentrates on building a community of stakeholders, who will accompany the development of the project from the early phases of participatory design up to the full deployment of the project results into long term sustainability planning. The three main categories of the user communities that are identified are:

- school communities (teachers, learners, schools administration, teacher trainers),
- students (who will participate mostly through their teachers),
- lab owners (universities, research centres, enterprises), and
- policy makers involved in science education and research.

To create these communities, WP6 conducts a wide range of activities. Firstly, **online participatory engagement activities** were organized (e.g., online surveys aiming to summarize stakeholders' vision of how to integrate online labs in school practice (targeting all stakeholder groups), how the Go-Lab Portal and scaffolds should be designed (teacher survey in cooperation with WP3), and how to integrate external online labs into the Go-Lab infrastructure and make it sustainable (online lab owner survey in cooperation with WP9).

Secondly, WP6 conducts different **series of workshops** supporting the teacher community (Visionary Workshops (M3 – M8), Practice Reflection Workshops (M13 – M21 and M25 - M33), Summative Workshops (M37 – M40), as well as at least six in-service support seminars throughout the project). These workshops aim to prepare the implementation of the project in scope of the WP7, support teachers in understanding the Go-Lab approach, and gather their feedback contributing to the project development and evaluation of the results.

In conjunction with these workshops, WP7 starts the implementation of the project in European schools. The first group of pilot schools (100 schools) is identified in the second half of the first project year (after Visionary Workshops are completed); the second group of schools (400 schools) is defined during the first cycle of pilots (M16 – M21). The first and the second groups of schools also participate in the second cycle of Practice Reflection Workshops (M25 – M33). The full sample of 1000 schools will be available in M30 and it will form the field basis for the third cycle of implementation.

Engagement of schools as pilot sites in the project is cleared with the relevant **Ministries of Education** to ensure buy-in from policy makers and appropriate authorization procedures. Political stakeholders are also addressed by WP6 and WP9 in order to support the mainstreaming of Go-Lab around Europe and make it sustainable beyond the project's lifecycle.

Establishing contact with the teachers participating in WP6 workshops and WP7 implementation activities, WP6 creates a **live international network of schools** with exchanges and collaborations within communities of practice and the whole network (technically supported by the Go-Lab Portal). Finally, WP6 establishes a **teachers' support mechanism,** which is based on the presentation of techniques for motivating teachers with real world learning activities, as well as a **professional development programme**, which is designed to provide support to the teachers and guide them during the implementation of inquiry in the classroom.

In order to disseminate and exploit the project's results and to transform them into sustainable products, as well as to support community building and implementation activities, WP9 creates an **online infrastructure** addressing all Go-Lab stakeholders and providing target group specific information. This infrastructure includes the project's website and blog, social media channels, a quarterly newsletter, as well as a range of forums and blogs the project contributes to, which are used by European and international communities of teachers (such as the Scientix portal). In cooperation with WP6 and WP7, WP9 organizes and promotes upcoming workshops and events, publishes impressions from these events, their results and collected best practices.

Stakeholders addressed by WP6 and WP7 wanting to stay in contact with the project and receive up-to-date information are welcome to enter Go-Lab social media groups and receive project newsletters. And vice versa, people attracted to the project via WP9 communication channels are recommended to participate in the events organized by WP6/WP7, as well as other work packages. Thus, WP9 aims at establishing an effective communication framework towards internal and external project stakeholders raising awareness of the project's results and attracting potential users.

Also **offline dissemination** channels are used. WP9 contributes to international and national scientific conferences targeting educators and researchers by publishing papers, organizing booths, workshops and round tables, and presenting the project to a broad public. Events organized in WP7 (Summer Schools, Masterclasses, Teacher Trainings, etc.) also increase the visibility of the project in the European teacher community and, thus, contribute to the dissemination. WP9 provides a variety of hardcopy dissemination materials and giveaways to promote the project.

Further, WP9 establishes **contacts to other research projects** and institutions in order to create mutual benefits by using intermediate results for enhanced developments. Within the scope of this cooperation, joint research on pedagogical and technical aspects of inquiry learning

implementation in schools can be conducted and synergies in addressing teachers and other stakeholders (WP6), as well as finding pilot implementation organizations (WP7), can be used. Finally, this kind of cooperation serves mutual promotion of the research projects by means of participation in online communities, organization of joint events, and publishing scientific papers.

Finally, in order to extend the Go-Lab federation of online labs and to make these labs available to various educational institutions (primarily schools, but also universities and training institutions), WP6 addresses **organizational stakeholders**, who might be interested in extending their pedagogical and technical framework providing and getting access to the online labs, offering and receiving tutoring and support services, as well as enriching existing educational programs. WP9, in its turn, cooperates with European **associations** like SEFI (the European Society for Engineering Education) or worldwide associations like GOLC (the Global Online Laboratory Consortium), the IEEE Education Society, IGIP (the International Society for Engineering Education), IAoE (the International Association for Online Engineering), etc. in order to ensure sustainability of the project results and established community.

Thus, work packages 6, 7, and 9 work in close cooperation with each other to promote Go-Lab among teachers, researchers, online lab owners, and other stakeholders by sharing contacts and providing them with different kinds of activities and materials, organizing this stakeholders in a community supported by the Go-Lab Portal and WP9 communication channels. The collaboration will extend to organizing and promoting workshops and their results among community members. Contacts to political decision makers and worldwide associations are established to mainstream the project results and make them sustainable and exploitable after the project time. Of course, the project is a team effort overall and of course the interaction extends to all different WPs, so the description here proposed relates to the close collaborations and is not exclusive. WP3 and WP8 activities, for example, also get in touch with teachers, so their activities must also be coordinated.

2 The teachers' community

School teachers who want to implement inquiry-based learning activities alongside their current teaching methods are the most important target group of the Go-Lab project. For this reason, it was crucial at the start of the project work to collect needs, challenges and recommendations from this user group and from partners and organizations that have a vast experience in working with teachers. A comprehensive range of methods was used to collect and analyse information about teachers and translate it in the present document into a practical list of recommendations to help implement the Go-Lab vision. A full range of visionary workshops was set up in the countries of the project with the aim of informing teachers about the Go-Lab approach and gaining information about them in a hands-on environment.

Bringing teachers together and informing them about the project goals and objectives represents the first step in forming the community of users that will uphold Go-Lab and enrich it with content. The following section details the measures that will be implemented to support the teachers' use of the instruments provided by Go-Lab, as an example we can cite training workshops aiming at creating practice-oriented scenarios that can be implemented in schools, as well as evaluation workshops gathering best practices and experiences from users.

2.1 Intrinsic and external challenges teachers face in using online labs

Although several advancements related to the internet and the communication technologies are now widely adopted in most European schools, still the use of online and virtual labs by teachers and students in their everyday practice is lagging behind due to many barriers. Thus, managing to engage teachers in the use of new tools and systems is a highly challenging task. Teachers are often sceptical towards investing in new technology-enhanced teaching tools as they believe that the familiarization with these tools is a time-consuming process, while in many countries they also seem to feel that they lack the necessary ICT skills. Teachers also feel that the lack of infrastructures in their schools is another big disadvantage while they state that the time they have at their disposal to make use of such tools is on average very limited. To ensure that the connection between Go-Lab content and school curricula is as continuous and seamless as possible, much work has been carried out and is reported in D-1.2.

When looking at the most common organizational barriers in the adoption of online labs in schools, some difficulties were found to represent the core barriers in adopting not only online labs but also inquiry teaching in general in schools. Such difficulties include the lack of financial support and lack of correspondence between curriculum and the use of online labs, lack of time and motivation from the teachers and lack of regular training schemes. Additionally, as already mentioned, technical barriers and challenges pose further problems, as for example availability of computer-equipped classrooms and high speed internet connection, availability of technical support and training, user friendly interface and integrated learning environment, etc.

However, as we move on into an era where technology plays an increasingly significant role, it is imperative that teachers update their practices so as to be able to meet the needs of the future and provide their students with the necessary digital competence skills. Moreover, as today’s children and teenagers are well accustomed to the use of computers, the integration of technology-enhanced teaching tools in every lesson allows teachers to better tailor it to students’ habits and everyday life, thus making it more effective. The creation of innovative classrooms that are very close to scientists’ real work, where students will be able to use on-line labs to perform experiments and investigate for themselves, will also provide students with a more concrete idea of

how science works, which in turn could be crucial for inspiring them to consider science among their career choices. The use of on-line labs in the framework of teaching in class could also contribute towards increasing the collaboration between students and thus allow them to strengthen their social competences. During experimentation, students learn how to be part of a team and have specific responsibilities.

Conclusively, although teachers are often hesitant when it comes to trying new teaching methods and employing new teaching tools, it has become necessary for them to update their current teaching practices and allow the integration of ICT tools and new technologies into their everyday teaching habits. Thus, in order to do this effectively, teachers are in need of support not only by experts on the field but also by their local teaching communities. To foster this, the Go-Lab consortium aims to adopt a 'pull' rather than a 'push' approach when it comes to supporting teachers in deploying the Go-Lab tools by organizing a strong teachers' community that will motivate teachers to participate, to make an example of fellow teachers who have already been using the Go-Lab tools and in turn release their own professional imagination and become active practitioners and contributors.

The partners of the Go-Lab consortium have held a series of visionary and participatory design workshops where science teachers were able to express their views and elaborate on the intrinsic and external challenges they face in using online labs. In order to build a concrete support mechanism for teachers, the Go-Lab consortium has focused in particular on discussing with teachers during these workshops and recording their needs. The compilation of the results of the visionary and participatory design workshops confirm most of the findings of the scientific literature review that is documented in a comprehensive white paper identifying intrinsic and external barriers, which is included in D6.2 "Future Challenges Report".

Below are some of the most common barriers that teachers routinely face and the corresponding needs that must be addressed in order to be effective:

- Proper training on ICT tools in general and on the use of the Go-Lab tools.
    - Teachers are not sufficiently trained in using online labs and often they do not feel confident enough to even begin using them.
    - Some kind of direct short help (e.g., tooltips) needs to be offered explaining all functionality.
    - Go-Lab portal should also offer elaborate help in addition to easily accessible help.
- Most teachers have the preconception that online labs will be too complex to use and/or too difficult to be implemented in an average classroom.
- Online, virtual or/and remote, labs usually have no structuring and scaffolding to support the inquiry process.
- Existing online labs differ in interface and usage which makes them less usable in the classroom.
- Existing online labs are not organized by domain and so teachers cannot integrate more online labs into their lessons over a longer period of time.
- It is often unclear where online labs fit into science teaching curricula.
- The majority of science teachers is not aware of online labs and hence cannot benefit from their usage.
- There is no support for teachers from the online lab owners.

- Computer and network connection infrastructure in schools may not be sufficient for use of online labs by all students in the classroom.

The corresponding needs that must be addressed are the following:

- Increase of collaboration between teachers.
    - Allow the collaboration in making a learning plan.
    - Allow the sharing of work with other users.
- Provide concrete scenarios of use that can be carried out within 1 or 2 at the most didactical hours.
- Provide examples of use on how to implement an activity in class using the Go-Lab tools.
- Easy-to-use search engine of on-line labs and a user-friendly interface.
    - Design of the Go-Lab portal needs to be visually appealing to the students and teachers (e.g., by using colours and pictures).
- Access to a repository of complete ready-to-use learning plans.
- Assistance by experts in the making of new activities.

It should be noted that the list of needs provided above is a part of the outcome from the workshops that have been realized which mostly focuses on the teachers' needs that can be dealt with through the teachers' community support environment. More specifications have also been recorded that focus more on designing the actual Go-Lab platform and the pedagogical approach adopted. More detailed information on the outcomes of the workshops is presented in the deliverable D3.1 "Preliminary Go-Lab requirements specifications, needs analysis and creative options."

The Go-Lab project can provide support in addressing some of the barriers as identified by the teachers and students at visionary workshops through the series of training and professional development actions and activities for in-service and pre-service teachers as described in the previous section. These will also be complemented by the production and circulation of online and printed support materials in various languages such as practical guidelines for teachers, user's manuals of online labs, example best practices and learning activities. Also, the above listed technical barriers are already addressed by the project within the design of the Go-Lab integrated environment including the usability problems, online lab search and personalization of content. The users' interface offered to teachers will be by design intuitive, simple and easy to use and will offer access to ample support on basic and also more complex tasks.

General organizational barriers can also be reduced or policy changes may be influenced on some level with appropriate and intensive dissemination activities towards educational authorities and policy makers in the participating countries. Although some barriers seem to remain out of scope of the Go-Lab project, such as the lack of time and curriculum connection, insufficient funding and school support, these can also be addressed with indirect or direct project dissemination activities and communication actions, such as open letters or publications to high impact journals. Such activities will increase the awareness of political and public bodies and educational authorities about the Go-Lab approach and the need to support its implementation.

The teachers' community support mechanism will provide different hubs of support both on technological and on pedagogical issues. Different initiatives will be undertaken so as to inspire teachers to participate in the Go-Lab pilot phases as well as to ensure their proper training on the

tools and their professional development. The cornerstone for building the Go-Lab community is threefold; a) trust, b) ownership c) thematic distinction. The first key point is that we need to earn the teachers' trust and ensure that the service provided is tailored to their needs and that it will contribute substantially in the upgrading of their teaching practices. Secondly, teachers need to make sure that the work and the effort they put in is recognized and that their work is promoted as their own. Providing the means for teachers to promote their work and take pride in it is an essential element in order to increase their engagement. Lastly, it is common knowledge that when it comes to building communities, participants prefer the thematic area of the community to be focused and is not too broad so that the main bulk of information available is clearly targeted to their interest and not wildly off topic. In the following paragraphs, we present the approach that the Go-Lab consortium plans to adopt in order to build an effective teachers' community support mechanism following the three principles mentioned above. These measures will provide guidance on all aspects of Go-Lab, opportunities to participate in training activities and initiatives that aim to further engage teachers in the Go-Lab activities.

2.2 Motivating and supporting teachers in deploying the Go-Lab services

2.2.1 Demonstrations of the Go-Lab services

In most cases, the first contact with teachers is a presentation of the project in the framework of a conference or a workshop (local or international). The first impression teachers get of Go-Lab is important because it is crucial to inspire them from the beginning to test the service and participate in its use. To this end, special attention needs to be paid to demonstrate not only the highlights of Go-Lab but also the fact that the Go-Lab service is fully supported and that teachers will have ample guidance at all times. This will make teachers feel more comfortable and more positive towards trying out something new. One way to achieve this is to include in the initial presentation of the project a hands-on demo. Teachers can be given the opportunity not only to look at a demonstration of Go-Lab but also to engage in a short activity themselves. In the current version of the Go-Lab repository, explorative activities are available to users, where users are free to explore whatever an online lab offers. An interactive activity is a much more engaging experience than a simple presentation and it can give teachers a much more complete and concrete idea of what Go-Lab is about, offering teachers the opportunity to get the feeling of the Portal and motivating them to engage. Further, it is recommended to produce a demo activity in the Go-Lab environment in order to quickly give a concrete idea of the service. This demo activity has to be brief so it may be finished in the framework of a presentation (around 30 to 45 minutes). The activity also needs to focus on a subject that is among the most popular throughout different grade levels while also providing a suitable opportunity for the use of a lab. For example, a demo activity could focus on forces and motion or building an electrical circuit. These are indicative subject areas where the use of an online lab can boost the learning process in terms of achieving learning goals while making it more fun for the students. Finally it is also important to present the additional tools that teachers and students will have at their disposal, such as the templates that are foreseen for the Inquiry Learning Spaces. To achieve that, sample concept maps and experimentation plans can be prepared so as to present the set of scaffolds provided by the environment.

In order to further increase the participation of teachers it is advisable that a top-down method is also adopted. In order to organize a workshop with teachers (or an on-line course) the Go-Lab partners can make contact with stakeholders and local school advisors and collaborate with them for the organization of the event. The involvement of such stakeholders and the collaboration with them when organizing such events can increase the number of teachers attending the event as well as the event's impact on them.

2.2.2 Promotion of good practices and success stories

Aside from ensuring that teachers feel comfortable enough to test the Go-Lab Portal in their class in terms of usability it is also imperative that they are offered good reasons to do so. One way to achieve this is by presenting examples of use to teachers in the form of good practices. A good practice would include a brief presentation of a teachers work-pathway; from his/her initial contact with the Go-Lab service, moving on to the construction of a Go-Lab Inquiry Learning Space, implementing it with the students and closing with presenting the outcomes of his/her work. An example of such a good practice could be a teacher who won a contest for making educational activities and has been invited to participate in a Go-Lab training course during which he/she created a Go-Lab Learning Environment. After the completion of the summer school the teacher can implement the activity in his/her class and record the activity's outcomes. The teacher may also present the outcomes of his/her work in a national or an international conference and thus promote it even further. Such practicing teachers could become change agents, act as role models for their colleagues and inspire them in following their example. Thus, including an example good practice in the presentation of the project is also a good way to present the possibilities offered to teachers.

Additionally, such good practices can also be presented through the Go-Lab Portal and discussed in forums and blogs that teachers already use. The brief story of teachers who act as change agents can be presented through the Go-Lab website in order to inspire more teachers to participate to the Go-Lab activities.

2.2.3 Online courses

Online courses are an effective way to reach out to numerous teachers especially in the case of schools in rural areas. Such online courses can be materialized with the assistance of a web conference software which allows tutors to organize the content of the course using any kind of material that they see fit. The Go-Lab online courses could be a set of 3 or 4 classes each of which focus on a different subject. An example structure could be the following:

Module 1:

- Brief introduction to the Go-Lab project and the federation of labs.
- Introduction of the Inquiry Based Science Education (IBSE) approach, the Go-Lab inquiry cycle and the pedagogical model that can be deployed when working with students.
- Presentation of example learning plans from the Go-Lab repository.

Homework: The participants will be asked to prepare a learning plan based on the Go-Lab inquiry cycle (in the form of a simple document).

Module 2:

- Familiarization with the Go-Lab repository, the tools and the services provided.
- Demonstration on how to create a Go-Lab Inquiry Learning Space.
- Hands-on practice with contributing to the Go-Lab Portal.
- Discussion on the learning plans created by the attendees.

Homework: The participants will be asked to turn the learning plan they had prepared as homework into a Go-Lab Inquiry Learning Space.

Module 3:

- Working on the Go-Lab Learning Environments prepared by the participants, answering questions on the use of the tools.
- Discussion on the deployment of the Go-Lab Learning Environments in the classroom.

Homework: The participants will be asked to finalize the Go-Lab Learning Environment they have been working on.

After completing the course, the participants will receive comments from the tutors and they will have extra time to finalize their work. Once the course is completed and the participants have delivered their Go-Lab Learning Environment they will be provided with a certificate of participation. Aside from reaching teachers that have no prior familiarization with Go-Lab, all the teachers participating in the pilot phases will also be invited to attend these online courses should they need extra help in using the Go-Lab tools and services.

2.2.4 International training courses

Throughout the course of the project, the consortium can organize international training courses in the form of summer schools and winter schools in different countries in order to train the teachers who will be involved in the pilot phases of the project. These summer and winter schools can be a very effective way not only to train teachers properly but also to increase the collaboration between them.

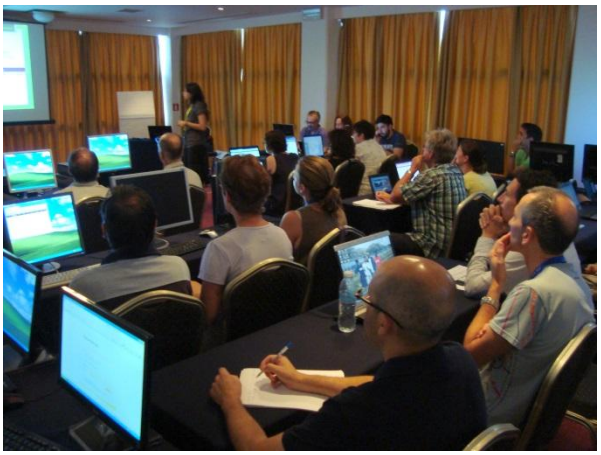

Figure 1. Workshop on the "Crashing Galaxies" activity

The "International Science Teachers Training Course" that took place in Volos, Greece between the 30th of July and the 4th of August 2013 is an example of such a training course.
Its main objective was to introduce teachers to the use of online virtual experimentations and remote laboratories as well as inquiry-based science teaching techniques and so help them upgrade their current teaching practices. The course included presentations followed by practical sessions (workshops) focusing on:

a) Introduction to the concepts and skills of learning-design, inquiry processes and scaffolding.

b) Introduction to preparing, uploading and sharing digital learning resources and scenarios.

c) Presentation of inquiry-based learning activities for use in the science classroom

d) Familiarization with on-line labs portals and educational digital repositories.

e) Presentation of popular social tools and science outreach websites.

f) Hands-on sessions working on on-line labs and resources related to science.

The tools and techniques presented facilitated the teachers to actively engage their students into science topics acquire scientific inquiry skills and experience the culture of doing science, under favourable circumstances, by undertaking active, guided experimentation, carried out at both basic and top-level scientific facilities. The course also strengthened its social cohesive and pan-European dimension by inviting participants to be part of a community of practice that will allow them to exchange ideas and materials with fellow teachers across Europe and introduce them to social tagging, educational metadata and on-line learning repositories.

The repertoire of online labs and experimentations, and the social tools that were presented in combination with the hands-on activities facilitated the participants in learning how to deploy the vast collection of existing eLearning tools and educational resources and also how to integrate their own work into educational repositories and share it within a European community of practice.

The program of the training course had 4 main branches:

a) Workshops

b) Plenary Sessions

c) Extra Activities

d) Participants' presentations and reflection.

Figure 2. Plenary session "Science Created by You" by Prof. Ton de Jong

During the workshops participants worked on the activity they had prepared beforehand (Prior to the beginning of the summer school all participants had received detailed guidelines on how to create an inquiry based learning activity) with the aim to refine it and add some more digital material to make it more interactive and interesting for students. To achieve that, they were introduced to repositories of digital educational material and online labs. The tutors worked with each of the participants in person, discussing their activity and proposing improvements and extra material. During the workshops, participants also had the opportunity to use some online labs and perform small tasks. Throughout the course, teachers enjoyed hands-on activities with three online labs; the Faulkes network of robotic telescopes, and the SalsaJ image analysis tool, the Crashing Galaxies applet and the HYPATIA analysis tool. During the last workshop, all participants uploaded their activities to an educational repository. Likewise, in future summer schools participants will be able to upload their activities to the Go-Lab repository.

The plenary sessions that took place aimed at introducing the participants to past and future initiatives that aim at improving science education, such as the "Science Created by You" and the "Inspiring Science Education" projects. One plenary session was dedicated to presenting to teachers the Go-Lab interface mock-ups and receiving feedback on them. The outcome of this session was recorded in detail and it is presented in the form of a Participatory Design workshop report (under the framework of the work done in WP3). As teachers involved in summer schools spend plenty of time working on the Go-Lab tools they are an ideal pool of practitioners to provide the Go-Lab team with valuable feedback on the usability of the service so as to allow us to further refine it. Thus, such reflection workshops are an essential part of a training course.

Figure 3. Go-Lab participatory Design workshop

Field trips and extra activities were also carried out during the course. These initiatives included an observation of the night sky at the mountain Pelion, a science café event at the village of Milies, a virtual visit to the control room of the ATLAS experiments at CERN and a visit to the archaeological Museum of Volos. These activities greatly contribute to the effectiveness of the interaction between teachers and increase the chances of collaboration between them after the completion of the course.

Figure 4. Science café at Milies Village

Figure 5. Participants' presentation

The detailed programme of the course, as well as descriptions of the events, are presented below.

Figure 6. The programme of the Summer School

Figure 7. Descriptions of the events carried out

2.2.5 Contests

Contests can be an effective way to intrigue teachers and inspire them into creating Go-Lab Learning Environments. Teachers will be provided with specific guidelines as to how to proceed and on what they are expected to do. The Go-Lab inquiry cycle can be used as a template that teachers will have to use to create a learning plan. They will also be provided with the list of labs where they will build their learning plan along with indicative examples of Go-Lab Learning Environments so as to give them a concrete idea of what they are expected to do. Directions and guidelines will also be provided to the teachers to facilitate them in creating a Go-Lab Learning Environment based on their learning plan.

Contests can be organized at a national level and the winning teachers (the ones with the best Go-Lab Learning Environments) will be awarded a prize. Example awards can be a trip to a Go-Lab summer school where they will act as tutors or to a conference to present their work.

3 The lab owners' and educational providers' community

Once the first communities of users are launched and become active, it will become highly desirable to collect the interest and active collaboration of owners of online laboratories outside the project consortium (*online lab owners*), such as universities, research organizations, and commercial companies. These groups must be motivated to be involved in the project and to provide access to their online labs via the Go-Lab Portal. While WP9 activities will be mainly responsible for collecting the interest of these users and contributors to the online instruments, WP6 will focus on providing them with appropriate tools to foster and sustain their interest once they join the communities.

Organizations that provide educational resources, such as universities and training organizations might also be interested in including inquiry learning activities in their educational programs. For example, they could use the Go-Lab Portal to gain access to the online labs. The services provided to lab owners (Cloud Services) are described in D-4.1 and will therefore not be treated in detail here. In general, these services will allow lab owners to plug their systems into the Go-Lab platform and therefore make them available to the Go-Lab community.

If an organization provides both educational programmes and online laboratories (which is the case, for example, of universities), we refer to it as a ***combined provider***. Such institutions might be interested in mutual exchange of online lab usage time, as well as in the exchange of supporting tutoring services, using the Go-Lab Bartering Platform. This exchange can be conducted as a "bartering", but also on a financial basis.

4 The other stakeholders' communities

Among the groups of stakeholders involved in Go-Lab, policy makers and networks connecting organizations that are active in topics related to the project, as well as other projects are among the most important to ensure that the project has a strong impact, especially in the last phases of dissemination. However, the description of these groups and of their needs is treated in less detail in the list of recommendations for implementation. The reason for this discrepancy is simple: while it is very important for such stakeholders to have an overall knowledge of the project and of its objectives, in order to persuade decision makers and support the initiative in many different ways, it is not expected that these groups will take time to explore the tools and resources in detail or even contribute any material themselves. It will be important to offer them some way to quickly gain an overview of the resources and the activities so that they are properly informed without spending too much time.

4.1 Students' direct engagement with online labs

Students and *lifelong learners*, in their turn, are expected to use the Go-Lab infrastructure in their learning activities inside and out of the classroom environment. The main idea of the Go-Lab project is to provide students the possibility to use online labs being guided by the teacher, for example, i during a school class. However, the Go-Lab Portal can be interesting also for the students who want to deepen their knowledge in particular science areas in addition to their school program. Lifelong learners might also be interested in using online labs in their self-regulated learning activities or in conjunction with Massive Open Online Courses (MOOCs).

4.2 Learning Designers and communication professionals

Another target group is *scientific researchers* and *learning designers* who may want to use the Go-Lab approach and technical infrastructure to extend (online) learning programs they create using practical experimentations and simulations. Methodological outcomes of the Go-Lab project may also be used by the researchers in parallel and follow-up projects. Although, there are no specific trainings offered by the project for these stakeholders, they may get support using the Go-Lab Portal and Bartering Platform, as well as supporting materials.

5 Operational specifications and tools

5.1 Synopsis of support services and target groups

Table 1 provides an overview of the different tools and mechanisms that will be implemented in the project to create communities and foster stakeholders' active engagement and participation in the communities.

Item name	**Target Group**
Online manual	Teachers
Online video	Teachers
Online manual	Students, Lifelong Learners
Online video	Students, Lifelong Learners
Online manual	Researchers and learning designers
Online video	Researchers and learning designers
Online manual	Lab owners
Online video	Lab owners
Training sessions courses	Teachers
Training sessions courses	Students, Lifelong Learners
Training sessions courses	Researchers and learning designers
Training sessions courses	Lab owners
Offline support	All

Table 1. Go-Lab Services

5.2 Online support for teachers

Manuals will be one of the most essential components of the support to teachers. Detailed manuals will be produced in order to assist the users to use the Go-Lab repository, its tools and its services. The manuals will be available online through the repository so that everyone may have access to them. In order to be successful in supporting the teachers even more effectively, a brief tutorial in the form of a video may also be created which will briefly demonstrate all the aspects of the Go-Lab repository and Portal. Thus, all users will be in position to easily navigate through the different components of the repository without having to spend more than 5 minutes to get accustomed to its main functionalities.

Specific information will focus on guidance for integrating live demonstrations and experiments conducted with remote and virtual labs in regular classroom activities and in providing students with the necessary support for their inquiry process. Furthermore, guidance should focus on

sharing good practices and methodologies as well as in communicating inside the pedagogic community, which is a part of the Go-Lab Portal.

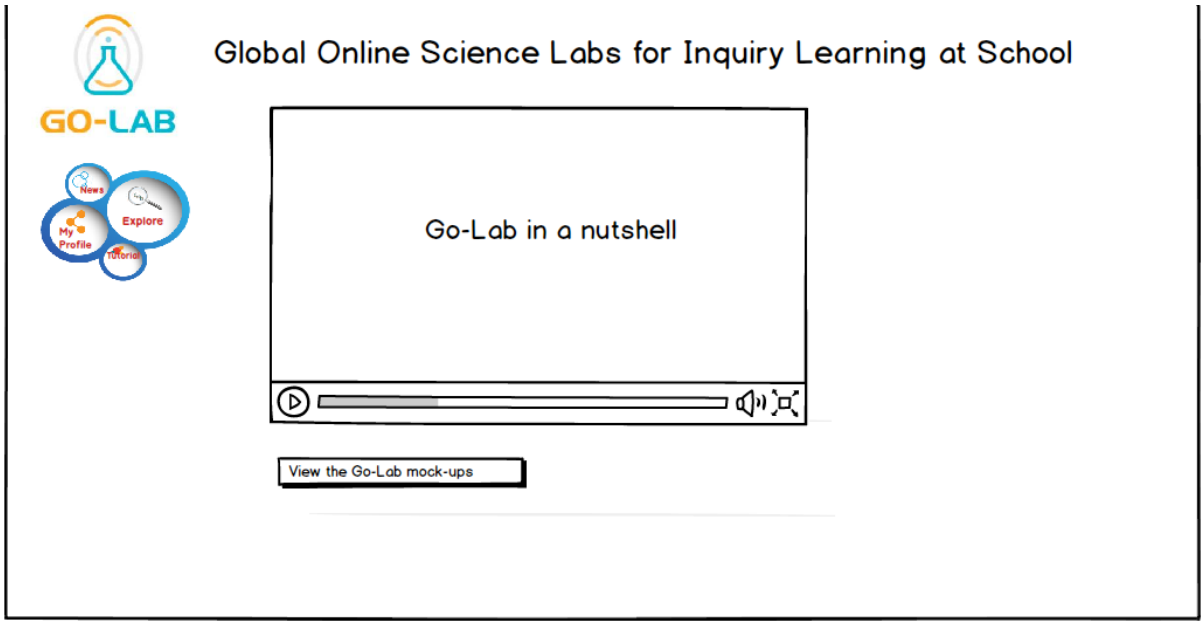

Figure 8. A simplified outline of the Go-Lab Portal demo page, where teachers and other users will find an overview of the Portal.

Online tutorials and manuals should provide clear information on:

- Publishing labs. Lab owners publish a lab and describe it with metadata.
- Creating ILS. Lab owners create ILS to demonstrate a lab and teachers create ILS for students.
- Modifying ILS. Teachers adapt existing ILS, e.g., localize the content to the mother tongue of their students or adapt it for a different age group.
- Publishing ILS. Teachers publish their ILS, which can then be saved by another teacher as a blueprint to be modified and saved in a different final form. This mechanism enables reuse or ILSs and saves time.
- Using ILS. Teachers run activities using ILS. Students use ILS provided by teachers to conduct experiments.
- Supporting Apps. Students practice inquiry learning through apps (e.g., a hypothesis app or online lab apps). Teachers monitor student progress through learning analytics apps.
- Supporting Learning Scenarios. Teachers create learning scenarios for ILS. Students use learning scenarios provided by the teacher when studying in ILS.
- Searching Labs & ILS. Teachers search for labs and ILS using various search filters, e.g., age and scientific domain.
- Social features. Teachers and lab owners tag, comment and rate labs and ILS, and share them on social networks.
- Recommendation. Recommendation of labs, ILS and apps are provided when searching, creating and editing ILS and labs.
- Scaffolding. Students receive assistance from scaffolding apps (e.g., prompts and feedback) based on learning analytics and teacher configurations.

5.3 Online support for other users

Manuals will be also the most essential support to other users such as students, life long learners but also researchers and learning designers. Manuals will be produced for each category of users in order to help them make the best use of the Go-Lab repository and Portal, its tools and its services. The manuals will be available online through the repository so that everyone may have access to them. The manuals for different users will be tailored to their needs and requirements, for example a simplified language will be used for students. In order to support different users even more effectively, a brief tutorial in the form of a video may also be tailored to their needs, briefly illustrating specifically the functionalities that they are most likely to make use of. Thus, users will be in position to easily navigate the different components of the repository without having to spend more than 5 minutes in getting accustomed to its main functionalities.

Specific guidance will be provided to access scientific instruments (remote and virtual laboratories) and use them for their investigations, for example, to control a telescope remotely and to take pictures of space objects – galaxies and planets. Furthermore, guidance should focus on accessing research data and archives, using advanced tools for data acquisition and analysis, as well as facilities and support communication on scientific topics. In this way, users will be encouraged to experience the culture of science and to practice science themselves by undertaking active guided experimentation carried out on the top-level scientific facilities offered in the Go-Lab portal.

5.4 Online support for lab owners

Detailed technical guidance notes will be provided to lab owners so that they can quickly learn about the technical details connected to plugging in their labs into the Go-Lab Portal. The technical requirements for this action will be clearly listed and a number of FAQs will be provided to deal with frequent questions or run through more complicated procedures. Appropriate tutorials, including screenshots and a contact person to write to in case of specific needs or difficulties, will be produced in order to help these specific users to contribute to the Go-Lab Portal and fully participate in all aspects. The guidelines and description of the procedures and requirements manuals will be available online in the repository.

Specific information will focus on bringing online real experiments conducted in their laboratory and creating a virtual community stimulating dialogue between scientists, instructors, students and other stakeholders, thus increasing visibility and attraction of their lab. In this way, their labs will have the benefit of bringing scientific experiments to a new level, which will allow conducting remote studies that involve multiple participants (e.g., international research teams). The manual should also provide detailed information on Intellectual Property Rights issues (see related information in Section 7).

5.5 Contact with technical teams

Online and offline videos and tutorials are an effective way to support the lab owners in their use of the Go-Lab services. However, if specific technical problems arise, lab owners need to be able to quickly contact a technical partner from the Go-Lab team in order to solve their difficulties and be able to seamlessly connect their lab to the Go-Lab Portal. Contact forms, chat functions and forum question and answer techniques are all typically used in this kind of situation. Online conference software can also assist technical users remain connected to the project and gain the information they need in an effective ad-hoc way.

5.6 Offline support

All online manuals and guides should be provided in downloadable and printable files so that the different categories of users can have access to them offline too.

6 Support in Contributing and Using Educational Content

About the Go-Lab Portal

A basis system used to create the Go-Lab Portal is the Web 2.0 platform Graasp developed by EPFL. Graasp serves simultaneously for networking and discussion, activity management, storage, aggregation and contextualization of resources. Graasp contains four types of constructs: *Actors* representing real people who can create collaboration spaces and add resources to them, *Activities* which are actions to reach specific objectives, *Assets* representing resources that can be e.g., text files, RSS feeds, wikis, videos or audio files, as well as *Applications* that are widgets or gadgets that can be executed within the collaboration spaces.

The user interface of Graasp mainly consists of two parts: the focal and the contextual part. The focal part shows the entity that is currently selected by the user. It can be a human (actor), an activity (space), an asset or an application (tool). The contextual part consists of the four columns of items, each of which represents one type of entity (actors, assets, activity spaces, tools) linked to the focal entity. Within a given space, users can post, share and link learning resources and tools, constructing personalized learning processes. Spaces allow learners to organize learning activities, aggregate data and resources and collaborate with each other.

Graasp offers contextualized and personalized recommendation of people, resources, and tools. It helps learners find suitable people to collaborate with and trustworthy resources to learn from, which sustains self-directed learning activities in open learning environments. Graasp allows learners to import resources and people from other social platforms, such as a video from YouTube, a slidecast from SlideShare, a book description from Amazon, etc. This feature provides a convenient way for learners to grab, aggregate and organize different learning resources, which facilitates the construction of their own personal learning environments.

Online tutorials and manuals should be easy to find from all related pages of the portal as well as in the user's profile.

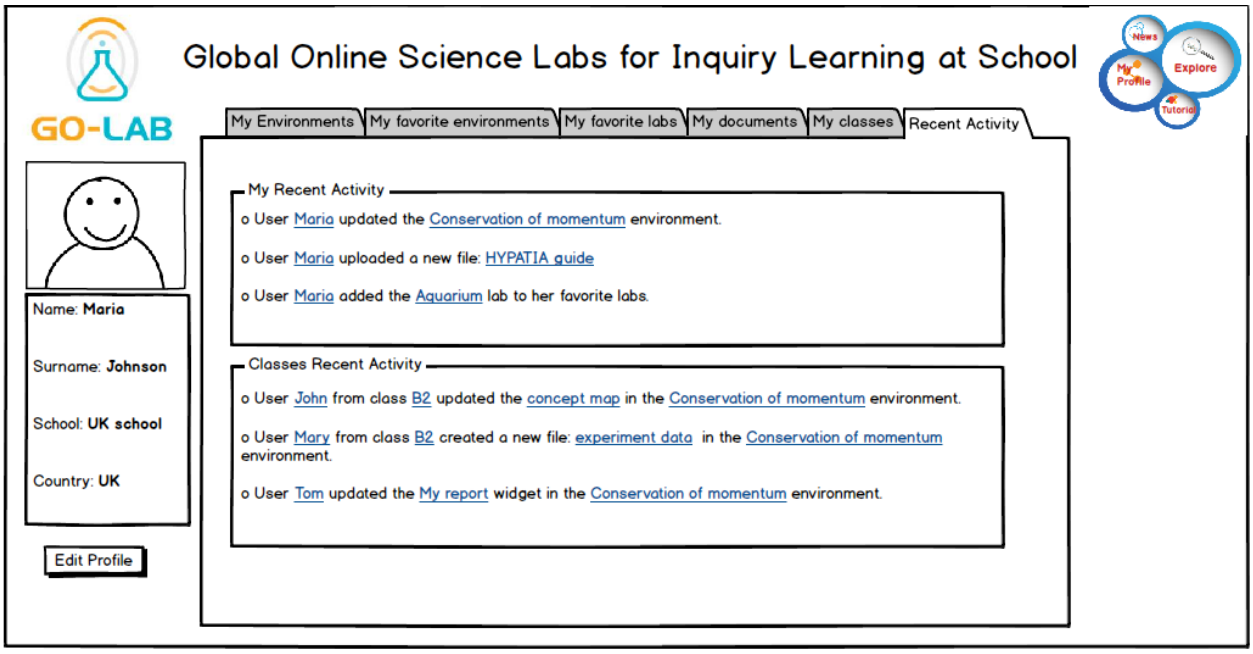

Figure 9. Example of a user profile in the Go-Lab Portal community building tools

Integral parts of the portal are the Inquiry learning spaces (ILS), learning environments that can contain labs, learning resources and apps to enable inquiry learning. Learning resources are typically texts, videos and other materials to assist and assess students. Teachers usually set up an ILS for their students. An ILS can be shared with other teachers who can then adapt it to fit their purpose.

7 Support in Creating Communities of educational practice

This section gives an introduction of the tools and guidelines that will be prepared and hosted on the Go-Lab Portal to encourage and foster the community building between teachers, lab owners and other potential users of the portal. Below, the main services are listed by target group.

Community Support Environment services	
Item name	**Target Group**
Digital Manuals for the use of the Go-Lab repository its tools and its services	Teacher
Video tutorial on how to make a Go-Lab environment for students	Teacher
News section for upcoming training courses, workshops, contests and other initiatives undertaken	Teacher
Forum	Teacher
Teachers personal **Blogs**	Teacher
Thematic groups of discussion and sharing of content	Teacher
Repository services for increasing collaboration	
Personal Profile	Teacher
Search and View other teachers' profiles and ILSs	Teacher
Share ILSs through Facebook and Twitter	Teacher
Share the edit rights of ILSs	Teacher
Commenting service on the ILSs	Teacher
"Like" button	Teacher
"Add to favorite" button for ILSs, Labs, tools	Teacher
"Follow" button for other teachers	Teacher
Communication via **Messages** between teachers	Teacher
Add photos from events in the personal profile	Teacher
Invite other teachers into Go-Lab and into thematic groups.	Teacher
Recent **activity wall**	Teacher

Star rating for ILSs	Teacher

Table 2. Specifications of the Go-Lab community support environment

The repository will be the main hub of teachers' support. All teachers' support related services and material will be accessible through a section integrated into the repository. This section will be the community support environment where teachers will be able to find out about the upcoming online courses and winter or summer schools, workshops at different countries and news on contests or other initiatives undertaken. To further increase the collaboration between teachers and between teachers and lab owners and the partners of Go-Lab, a discussion forum could also be created. Teachers will be able to discuss with other teachers about activities and their implementation or ask colleagues for help. The teachers' community environment can be organized into thematic areas so that teachers will be able to communicate more easily and find support based on the subject area (physics, chemistry etc.) they are interested in. Each area will focus on one subject and teachers will be able to retrieve information and footage (good practices, related labs and Go-Lab Learning Environments, forum topics) based on their subject of interest.

In order to further develop the peer-to-peer collaboration, different elements can be adopted in the Go-Lab repository. For example, teachers may share the edit rights of a Go-Lab learning environment so as to collaborate in its making. Additionally, teachers can also be enabled to leave comments to each other either through their personal Go-Lab profiles or by leaving comments in a Go-Lab learning environment. Teachers will be able to look at other teachers' profiles and view the Go-Lab learning environment they have created.

In table 2 the specifications of the Go-Lab community support environment are listed. In addition community support services available through other parts of the portal (like the use profile page) are also presented.

7.1 Content sharing

The Bartering Platform will offer the possibility to get personal support from other teachers (such as with an exchange of tutoring time between the users). The additional support materials offered by the project have been described in the previous sections.

The value of sharing in forming, sustaining development and further expanding a strong community of teachers has been proven in various EU funded projects on science education, like "Discover the Cosmos", "Open Science Resources", "Pathway to inquiry based science teaching" to name only a few. Through well-structured, organized, easy to use portals and repositories that these projects have set up, the communities of participating teachers can access, upload and share educational resources, learning activities, teachers' experiences and best practices with other fellow teachers at local, national and international level. Furthermore, the teachers themselves have the possibility to evaluate the quality and effectiveness of the educational content providing in this way an indirect multiplication factor for the widespread use and adoption of the best practices on offer. This cascading effect is one of the key features that underlines and gives a practical essence of the value of sharing content, experiences and practices within a community or among communities.

This model of proven success is also adopted within the framework of Go-Lab where a portal dedicated to the use of online labs will be developed and gradually expanded and become self-sustained by the teacher communities. The Go-Lab Portal, developed under WP5, is the main entry point for teachers to get an overview of available online labs, obtain access to the labs, numerous Inquiry Learning Spaces (ILS) and educational material. Through the Go-Lab Portal, both teachers and other users will be able to search, find and use recommended online labs in

personalized and scaffolded spaces. The portal will serve as a gateway to online labs and associated inquiry learning activities for teachers and students. Through it they will also be able to download, modify, upload and share learning plans and other educational content related to the use of online labs and inquiry science teaching.

It is envisaged that during training events offered to teachers there will be specific session for hands-on practical training, guidance and support on how to use the portal and exploit its functionality and services to the maximum possible level even by inexperienced users. Teachers attending these sessions will experience firsthand the advantages and added value they can get from sharing and collaborating with others, they will learn to do metadata authoring in a standardized way to the educational content they use or produce facilitating its further adoption by others.

In order to become an effective community building tool, the Go-Lab portal must be able to offer continuity to the teachers and other users, so that they may feel that their investment of time and energy is justified and useful. In relation to this need, some of the sustainability issues of the Go-Lab Portal (which will be discussed in greater detail further on in the project) is here mentioned. The Go-Lab portal will stay operational and in use after the end of the project. Most specifically the partner EPFL is part of several international initiatives to standardize the technological baseline for lab construction and increase the usage of labs in education. EPFL is committed to maintain the Go-Lab portal after the end of the project, to keep the momentum in this field and keep its own leading position within these international initiatives. In addition the ownership of the portal will be open to share with a foundation like Global Online Lab Consortium (from which organization the consortium already received a letter of support) and will evaluate during the project whether this is the best option to ensure a broad branding and support for the portal.

7.2 Intellectual Property Rights (IPR) support

IPR support is of vital importance of users of the Go-Lab Portal and more specifically of those creating new material or sharing their own material.

It is clear that all labs connected to the Go-Lab portal remain the property of their respective organizations. The terms of use should be clear and a memorandum of understanding should be in place between the lab owners and the consortium.

For teachers creating and sharing materials online, international standards like Creative Commons and Open Educational Resources Support can be adopted.

Online and offline (files for download and printing) support resources should focus on:

Introduction to IPR and Licensing Issues

- IPR and Licensing Issues Video

<u>Briefings and Guides</u>

- Briefing paper on embedding licenses into digital resources
- Overview of licenses providing access to digital resources
- Seeking Permission and due diligence for digital resources
- Licensing Guide
- Practical legal tools for projects engaging with digital resources
- Model Consent Form
- Template Permissions Form

- IPR and Licensing: Top Tips for digital resources

Open Educational Resources provide two very useful tools for copyright and licensing. Tools like these should also be provided in the Go-Lab portal.

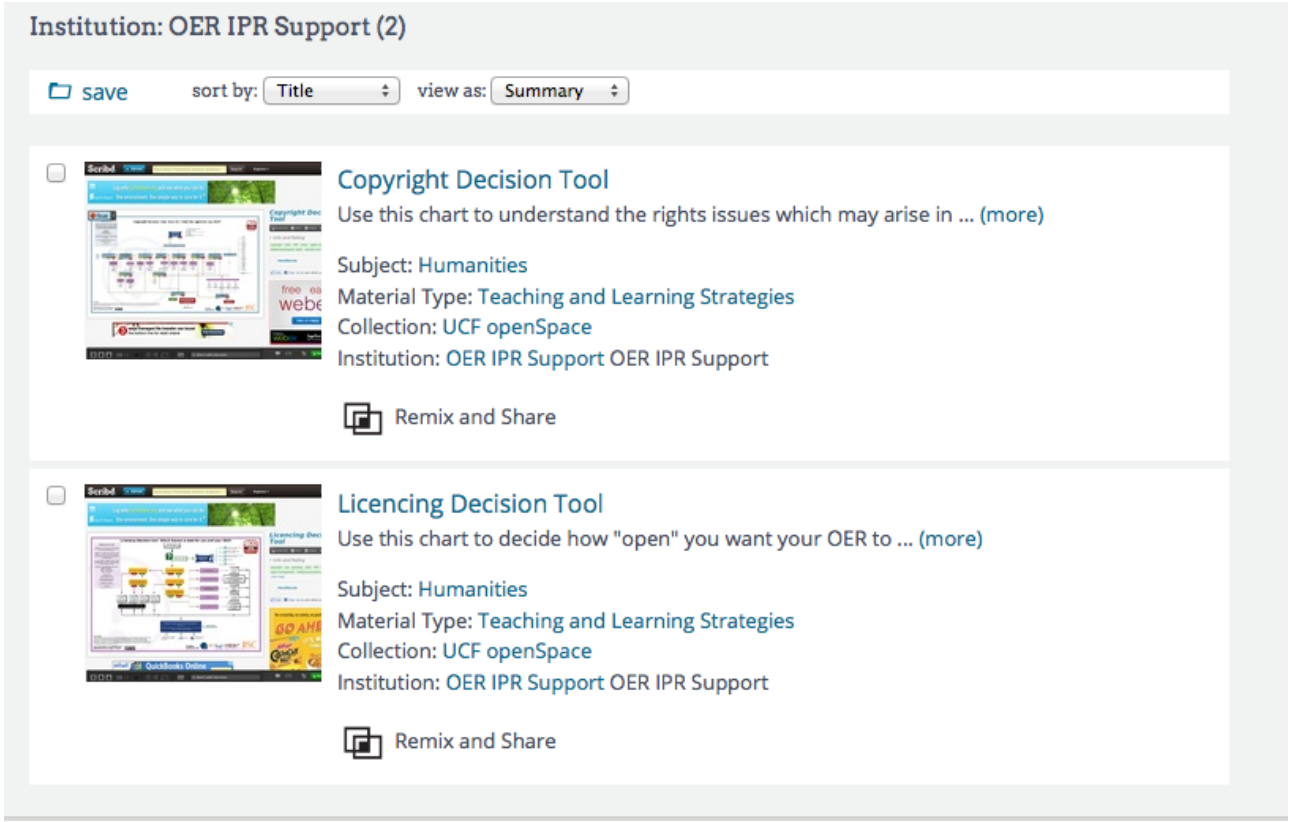

Figure 10. Example of IPR Support page in the OER Platform

Conclusions

In order to build a strong community of teachers and other types of users around the Go-Lab Portal, effective guidance and support mechanisms must be in place. These will have different forms according to the profile, needs and requirements of the users, as it has been described in detail in the preceding sections.

The support services for the Go-Lab Portal will progressively be developed for all different users. Of course their implementation will grow and improve flexibly changing the approach used to explain concepts or describe procedures according to the feedback collected from the users. More and more of such mechanisms will become available as time passes, to accompany the growing scale of piloting activities in the next three years.

The Go-Lab project is mainly targeted to teachers; therefore this user group has absolute priority over the other users, together with the other professionals connected to schools, such as school leaders and other school staff involved. From a qualitative perspective, formative evaluation instruments for Partners/project teams are in place and feedback from users will be collected both informally, by asking questions during any kind of interaction or workshop, and through formal feedback seeking mechanisms and tools though the Practice Reflection Workshops. This close connection with the final user will ensure tat the Go-Lab partners keep a constant tension on improvement of the support services. Every six months an internal quality review process will be conducted, either as an informal check-up of the status of the implementation or as a fully fledged formal practice, according to the form that best fits the needs of the project at the time. Risks connected to the use of the Go-Lab Portal and its use will also be assessed in this instance and appropriate contingency plans will be prepared and when necessary speedily implemented.

The results of this enquiry will feed into the ongoing service improvement plan. Optimisation and scalability will be two key criteria to define realistic objectives for quality improvement in order to make an efficient use of the resources of the project, which are of course limited.